YEARBOOK

OF THE

UNITED STATES

DEPARTMENT OF AGRICULTURE.

1905.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1906.

[CHAPTER 23, Stat. at L., 1895.]

[AN ACT providing for the public printing and binding and the distribution of public documents.]

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Section 73, paragraph 2:

The Annual Report of the Secretary of Agriculture shall hereafter be submitted and printed in two parts, as follows: Part One, which shall contain purely business and executive matter which it is necessary for the Secretary to submit to the President and Congress; Part Two, which shall contain such reports from the different Bureaus and Divisions, and such papers prepared by their special agents, accompanied by suitable illustrations, as shall, in the opinion of the Secretary, be specially suited to interest and instruct the farmers of the country, and to include a general report of the operations of the Department for their information. There shall be printed of Part One, one thousand copies for the Senate, two thousand copies for the House, and three thousand copies for the Department of Agriculture; and of Part Two, one hundred and ten thousand copies for the use of the Senate, three hundred and sixty thousand copies for the use of the House of Representatives, and thirty thousand copies for the use of the Department of Agriculture, the illustrations for the same to be executed under the supervision of the Public Printer, in accordance with directions of the Joint Committee on Printing, said illustrations to be subject to the approval of the Secretary of Agriculture; and the title of each of the said parts shall be such as to show that such part is complete in itself.

PREFACE.

In view of the recent somewhat active discussion with regard to Government publications, more especially annual reports, and in view of the fact that, under the law providing for its issue, the Yearbook is designated as Part II of the Annual Report of the Secretary of Agriculture, it may be of interest to indicate the circumstances which have given to the Yearbook its present special character.

The publication of the Yearbook is called for by "an act providing for the public printing and binding, and the distribution of public documents," approved January 12, 1895, which is quoted on the opposite page. This act was the result of a careful and protracted investigation by the Joint Committee on Printing of the Senate and the House of Representatives concerning the character of public documents and the manner of distributing them. Of the publications issued under the law then existing, the Annual Report of the Department of Agriculture was necessarily the object of special consideration, owing to the very large edition, 500,000 copies. It was recognized that in its old form the Annual Report of the Department contained a large amount of administrative detail of interest to comparatively few readers outside of Congress, and consequently quite superfluous in a volume intended for widespread popular distribution. Besides these administrative details, the Annual Report was made the vehicle for a considerable amount of scientific matter. This matter was of interest chiefly to specialists in some one but rarely in all of the lines of scientific work pursued in the Department. Moreover, the growth of the Department and the creation of new offices threatened to increase greatly the bulk of the volume. It was, therefore, wisely determined to divide the Annual Report of the Department into two parts, separately bound.

The first part, known as the Annual Reports of the Department of Agriculture, and issued in an edition of 6,000 copies, contains, first, the personal report of the Secretary of Agriculture, addressed to the President, and, second, a detailed report from each division chief addressed to the Secretary.

The Yearbook, forming the second part, is issued in an edition of 500,000 copies. It is made up of three sections. The first is the personal report of the Secretary, reprinted from Part I in order to fur-

nish a "general report of the operations of the Department." The second consists of papers prepared in the various offices or by special agents, with the object of presenting the latest and best practical and scientific information at the command of the Department in such form as to be readily understood by each reader of the Yearbook. The third section, under the title Appendix, contains a large amount of statistical matter of interest to the farming public.

In the present volume the first section covers 122 pages, while 440 pages are devoted to the papers composing the second section. Although information of immediate use and value to actual farmers holds the first place in the Yearbook, an important place is given to agricultural progress. As an educator, the Yearbook also gives space to the discussion of the problems underlying successful agriculture, avoiding as much as possible scientific and technical language, which would deprive it of its popular character. It is hoped that the Yearbook for 1905 will be found to meet these requirements. In the second section every article but one was prepared in some one or other of the offices of the Department, only one office being unrepresented. The third section, the Appendix, may itself be subdivided into three parts, the first consisting of a sort of agricultural directory, brought up to date; the second, a brief review from each office, setting forth the progress and conditions throughout the year of the special line of work assigned to it; the third, the statistics of agriculture covering the year 1905, but including, for purposes of comparison, various periods from three to ten years preceding.

The thirty special papers in the second section of the Yearbook average less than 15 pages, and every effort has been made to confine the illustrations to such as will clearly assist the reader in his apprehension of the text.

GEO. WM. HILL,
Department Editor.

WASHINGTON, D. C., *June 1, 1906.*

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YEARBOOK

OF THE

U. S. DEPARTMENT OF AGRICULTURE.

REPORT OF THE SECRETARY.

To the President:

I have the honor to submit herewith my Ninth Annual Report as Secretary of Agriculture.

INTRODUCTORY.

The well-being of the American farmer is a matter of profound interest to the entire country. It is, therefore, in the highest degree gratifying to present for your consideration the following evidences of the unprecedented prosperity which has in this and recent years rewarded the diligence of the farmer and the efforts of this Department on his behalf.

FARMER'S WEALTH AND WELL-BEING.

UNSURPASSED PROSPERITY.

Another year of unsurpassed prosperity to the farmers of this country has been added to the most remarkable series of similar years that has come to the farmers of any country in the annals of the world's agriculture. Production has been unequaled; its value has reached the highest figure yet attained; the value of the farmers' National surplus still maintains the magnitude that has built up the balance of trade by successive additions for many years sufficient to change the Nation from a borrower into a lender; there is a continuation of the unprecedented savings that have embarrassed local banks with their riches and have troubled farmers to find investments; and, as if all of these manifestations of a high degree of well-being were not enough, the farms themselves have increased in value to a fabulous extent.

Farm crops have never before been harvested at such a high general level of production and value. The partial failure of two or three second-class crops makes no apparent impression upon the great aggregate of all crops.

After much laborious collection of information an estimate of the value of the crops of 1905 and of all other farm products has been made, as was done last year. The census's detailed statement of the value of all farm products was taken as the basis, and the various items have been brought down from year to year in their quantities and values. For such crops as will later receive a final estimate by the Bureau of Statistics of this Department, the figures herein used are subject to small correction. All values adopted for the various products are farm values, and are in no wise to be mistaken for exchange, middleman's, or consumer's values.

HIGH CROP VALUES.

Corn has reached its highest production with 2,708,000,000 bushels, a gain of 42,000,000 over the next lower year, 1899. In value, also, the corn crop of this year is higher than that of the next lower year, 1904, by $128,000,000, and the total value may be $1,216,000,000. No other crop is worth more than half as much.

Hay.—Second in order of value among all kinds of crops is the hay crop, which takes the second place back from the cotton crop, which held it for the two preceding years. Many hay crops have exceeded in tons the product of this year, but because of high prices the crop reaches a value of $605,000,000, which is higher by $34,000,000 than the value of the crop of 1893.

Cotton, including seed, stands third in value among the leading crops of the year, although some uncertainty still remains concerning its quantity and value. It can only be said that its value, including seed, is expected to rise well toward $575,000,000, and will be nearer to that figure, or above it, in proportion as the expectations of cotton planters are realized with regard to higher prices.

Wheat.—Fears last year that the United States had fallen to the level of its consumption in the production of wheat were ill-founded. The short crop of that year is followed this year by the second wheat crop in size that this country has ever produced, 684,000,000 bushels, and the value of this crop, $525,000,000, overtops the highest value before reached, in 1891, by $11,000,000.

Oats.—Fifth in order of value among the crops of the year is the oat crop, with 939,000,000 bushels, or 50,000,000 bushels under the highest production, in 1902. In value as well as yield the oat crop of this year has been exceeded in only two previous years, amounting to $282,000,000, only $22,000,000 under that of 1902.

Potatoes.—Next after oats comes the potato crop, which has been a partial failure and falls below the highest production of preceding years, that of 1904, by 72,000,000 bushels; but in value the crop has done better, since it occupies the fourth place from the highest, and

is valued at $138,000,000, or only $13,000,000 below the highest preceding value, that for 1903.

Barley.—The high price of barley during the last three years has much increased the size and value of this crop, so that it now occupies seventh place among the leading agricultural crops. In quantity the crop of this year, 133,000,000 bushels, is third among annual barley crops, though only 7,000,000 bushels under the highest crop, that of 1904, and has a value of $58,000,000, or only $4,000,000 under the most valuable crop of this cereal, that of 1902.

Tobacco, like potatoes, is an undersized crop this year, as it was last year, and, considering the difficulties in the way of placing a value upon it at this time, an estimate of $52,000,000 may be too low. At any rate, because of high prices, the entire crop almost exceeds the highest value yet reached, that of 1899.

Sugar cane and sugar beets.—Although unrelated in culture, the common purpose of growing sugar beets and sugar cane permits their combination in a statement that their united value this year is estimated to be in the neighborhood of $50,000,000. This is a farm value for the raw material from which sugar, sirup, molasses, and feeding stuffs are derived in processes of manufacture.

Rice.—The rice crop is not as valuable as some other crops which are not mentioned here, yet its remarkable position entitles it to notice. Its production increased from 250,000,000 pounds of rough rice in 1899 to 517,000,000 pounds in 1903 and to 928,000,000 pounds in 1904; but the extraordinary production of 1904 fell to 637,000,000 pounds this year, and, although second in quantity, this year's crop is probably worth more than the crop of 1904, which was valued at $13,892,000.

Exceptional general level.—While it may be observed that only one crop—corn—reached its highest production this year, four crops reached their highest value—namely, corn, hay, wheat, and rice. The general level of production was high and that of prices still higher, so that no crops for which separate estimates can be made fall below third place in total value compared with the crops of preceding years, except potatoes, barley, tobacco, rye, and buckwheat. The cereals, including rice, more than maintained their previous strong position in production, and their aggregate yield is 4,521,000,000 bushels, with a farm value of $2,123,000,000, or $145,000,000 over last year.

DAIRY AND POULTRY PRODUCTS.

Butter and milk.—Both butter and milk have higher prices in 1905 than in 1904, and these, combined with increased production, permit an estimate of the value of dairy products at $665,000,000, or $54,000,000 above the estimate for last year. No crop but corn produces the income that the dairy cow does.

The farmer's hen is becoming a worthy companion to his cow. The annual production of eggs is now a score of billions, and, after supplying the needs of factories, tanneries, bakeries, and other trades, they are becoming a substitute for high-priced meats, besides entering more generally into the everyday food of the people. Poultry products have now climbed to a place of more than half a billion dollars in value; and so the farmer's hen competes with wheat for precedence.

TOTAL WEALTH PRODUCTION ON FARMS.

Dreams of wealth production could hardly equal the preceding figures into which various items of the farmer's industry have been translated; and yet the story is not done. When other items, which can not find place here, are included, it appears that the wealth production on farms in 1905 reached the highest amount ever attained by the farmer of this or any other country, a stupendous aggregate of results of brain and muscle and machine, amounting in value to $6,415,000,000.

The deduction from wealth produced, made in the report of last year on account of products fed to live stock, is not continued this year because the duplication of produced wealth in the consumption of products by farm animals is much less than has been assumed and is undoubtedly more than offset by the amount of wealth produced on farms which can not be estimated or even ascertained practically by census enumerators.

It might reasonably have been supposed in 1904 that the wealth produced by farmers had reached a value which would not be equaled perhaps for some years to follow, and yet that value is exceeded by the value for this year by $256,000,000, just as the value for that year exceeded that for 1903 by $242,000,000.

The grand aggregate of wealth produced on farms in 1905 exceeds that of 1904 by 4 per cent; it is greater than that of 1903 by 8 per cent; and transcends the census figures for 1899 by 36 per cent, and this after a lapse of only six years.

If there is no relapse from this high position that the farmer now holds as a wealth producer, three years hence he may look back over the preceding decade, and, if he will add the annual figures of his wealth production, he will find that the farming element, or about 35 per cent of the population, has produced an amount of wealth within these ten years equal to one-half of the entire National wealth produced by the toil and composed of the surpluses and savings of three centuries.

DOMESTIC ANIMALS.

Horses.—In the last annual estimate made by this Department of the number and value of domestic animals on farms, nearly a year ago, it appears that the farmers' horses had never before been so numerous

nor in the aggregate so valuable. First threatened by the bicycle, and later by the electric trolley car and the automobile, neither one of these, nor all combined, have scared the farmers' horses into diminished numbers or lower prices. On the contrary, horses on farms last winter were worth $1,200,000,000, or nearly as much as the corn crop of this year, and their number was over 17,000,000. Mules also are steadily increasing, and are worth $252,000,000.

Cattle.—Milch cows also are advancing in numbers and have reached a total of 17,570,000, worth $482,000,000. Other cattle, however, have not participated in this advance, and in recent years have declined in number and total value so that last winter they numbered 43,669,000, worth $662,000,000.

Sheep and swine.—Sheep, too, are declining in number and in total value, but swine are holding their previous position of many years, the number being 47,321,000, valued at $283,255,000.

Aggregate increase.—In the aggregate, the value of farm animals of all sorts has increased a few million dollars within a year and has increased $249,000,000 since the census of 1900, or 9 per cent.

FEATURES OF FOREIGN TRADE.

Unparalleled agricultural surplus.—Out of the enormous productions of the farms of this country the wants of 83,000,000 people have been supplied, and there remains a surplus large enough to become a generous contribution to the other nations of the earth and unparalleled among them as a National agricultural surplus.

During the last fiscal year (ending June 30, 1905) the exported domestic farm products were valued at $827,000,000. This was $51,000,000 below the annual average of the five preceding years, although it was $132,000,000 above the average of the five years 1895–1899, and $157,000,000 above the average of 1890–1894.

There was a loss of $32,000,000 as compared with the exports of farm products for the fiscal year 1904. In accounting for this it is proper to notice that the decrease in the exports of grain and grain products, due to the short wheat crop, equaled $41,000,000. To this decrease is to be added a reduction of $5,000,000 in exports of packing-house products, and another of $5,000,000 in fruits, and various minor items.

On the other hand, however, there were increases of $9,350,000 in exports of cotton; $4,700,000 in oil cake and oil-cake meal; $4,000,000 in vegetable oils; $2,000,000 in rice, and various minor increases.

The relative position of farm products in domestic exports is a declining one on account of the gain in exports of manufactures, so that, while the exports of the former averaged 62.6 per cent of all domestic exports for the five years 1900–1904, the percentage for 1905 was only 55.4 per cent.

During the last sixteen years the domestic exports of farm products have amounted to $12,000,000,000, or $1,000,000,000 more than enough to buy all the railroads of the country at their commercial valuation, and this with a mere surplus for which there was no demand at home.

Imports mostly noncompetitive.—In the matter of imports of farm products the total of the last fiscal year was $554,000,000, or $125,000,000 more than the annual average of the preceding five years. Over 1904 the gain was $92,000,000, which is accounted for by large increases in the imports of silk, wool, hides and skins, coffee, sugar, and molasses, against which there were relatively small decreases in imports of feathers, rice, tea, and vegetables. The imports of farm products in 1905 were 49.6 per cent of all imports, as compared with 46.7 per cent during the preceding five years.

Apparent balance of trade.—While the farmer has been a producer and a trader, he has also been an international paymaster. In his foreign trade of 1905 he had a net balance in his favor amounting to $285,000,000; in the preceding five years this favorable balance averaged $461,000,000; during the five years 1895–1899 it averaged $338,000,000, and in the five years preceding that the average was $271,000,000.

During the sixteen years past the farmer has secured a balance of $5,635,000,000 to himself in his international bookkeeping, and out of this he has offset an adverse balance of $543,000,000 in the foreign trade in products other than agricultural, and turned over to the Nation from his account with other nations $5,092,000,000.

Foreign trade in forest products.—Notwithstanding the constant weakening of the National forest resources, the exports of forest products had been increasing for many years, but during the fiscal year 1905 their value was $63,000,000, which was a decline of $6,300,000 from the preceding year.

Imported forest products are either noncompetitive with those of the Nation or introduced from Canada because of insufficient domestic production. The imports of 1905 were valued at $92.000,000, an increase of $12,000,000 over the preceding year, mostly on account of increased imports of india rubber, but partly on account of increased imports of lumber and wood pulp from Canada.

FARMERS' SUPPORT OF MANUFACTURING.

Not content with his other achievements, the farmer lends his strong shoulder to the support of the manufactures of the country by furnishing raw materials. Computations based upon census information disclose the fact that farm products, to some extent obtained from other countries, constitute 56.4 per cent of the total products, and 86.8 per cent of the total materials, of the industries

utilizing agricultural products as materials, and these industries produce 36.3 per cent of all manufactured products and use 42 per cent of all materials employed in manufacturing.

At the same time these industries using agricultural materials employed 37.8 per cent of all persons engaged in manufacturing, and the capital of these industries is 42.1 per cent of the capital of all manufacturing establishments.

Restated in absolute terms, during the last census year the farm products employed in certain manufactures were valued at $2,679,000,000; the value of all materials, including the preceding amount, was $3,087,000,000; and the products of the industries using these materials were valued at $4,720,000,000. These industries employed 2,154,000 persons and had a capital of $4,132,000,000.

Such are the enormous interests, not engaged in agriculture, but in industries that could not maintain themselves without the farmer and his extraordinary productive ability.

FARMERS BECOMING BANKERS.

Naturally such a large class of the population as the farmers, producing wealth and surpluses to the extent that they are, have savings which they invest in various ways, since in this country the stocking and its hiding place are not the savings bank. One of the most notable outgrowths of savings by farmers is the very great multiplication of small national banks in recent years. Under the amendment to the national banking act, permitting the organization of banks with a capital of less than $50,000, as many as 1,754 of these banks were organized from March 14, 1900, to October 31, 1905, excluding those organized in the noncontiguous possessions. These banks are distributed mostly throughout the South and the North Central States in rural regions, where they depend for their business primarily and directly upon the farmers' prosperity and, secondarily, upon the village merchants and persons of other employment, who themselves are dependent upon the prosperity of the farmers.

In the Southern States 633 of these banks were organized, representing 36.1 per cent of the total number; in the North Central States the number was 792, or 45.2 per cent of the total. To one who is familiar with State and regional conditions it is significant to notice that in the North Central States west of the Mississippi River 513 of these banks were organized, representing 29.3 per cent of the total number, and that in the Southwestern region, embracing Texas, Indian Territory, and Oklahoma, 397 new small banks stand for 26.2 per cent of the total.

If the capital of these banks had been sent from Boston and New York it would have been such a proceeding as was common fifteen years ago; but, instead of coming from such an origin, the capital

of these banks has come from the farmers. The State bank commissioner of Kansas, in his report for 1904, states that "it has been an era of small banks in isolated communities, and so many have been started that to-day every hamlet in the State where any considerable business is done has a bank. This increase in the number of small banks arises, first, from the fact that farmers and business men in these communities had idle money that they desired to invest and banking appealed to them," etc. The same cause for the establishment of these banks is reported from the South and North Central and Western groups of States.

DEPOSITORS IN BANKS.

In the North Central States farmers have been depositing money in the banks until the rate of interest on deposits has fallen so low that they have diverted a large portion of their savings to permanent investments. In spite of the fact that the banks do not receive and keep all or most of the farmers' savings, the increase of bank deposits in agricultural States and larger regions is most extraordinary. The following are some examples of the increase of the deposits in all banks in the agricultural States during the year ending June 30, 1905: In Iowa and South Dakota the increase was 14.9 per cent; in Nebraska, 13.5; in Kansas, 9.7; in North Dakota, 25. During the same time bank deposits in the great capital State of Massachusetts increased 9.1 per cent.

Still more remarkable is the bank statement for the South Central States. During the past year the deposits increased 18.1 per cent in Texas, 21.4 in Oklahoma, 24.1 per cent in Arkansas, and 45.7 per cent in the Indian Territory, while throughout the whole area of that geographic division the increase was 22.8 per cent. The general average increase for the United States was 13.5 per cent.

If a comparison is made with 1896, within the latest prolonged financial depression, the comparisons are still more striking. During the ten years from that year to June 30, 1905, the bank deposits of the United States, all banks included, increased 129.2 per cent. In comparison with this is the increase of the South Atlantic States, 167.4 per cent; of the Western or Rocky Mountain and Pacific States, 169.8 per cent; of the North Central States, 185.5 per cent; and still more striking is the percentage of the South Central States, 255.7 per cent; while during the same time the deposits in the North Atlantic States increased only 102.3 per cent.

For individual States there are such increases during the ten years as 190.9 per cent for Iowa, 239.3 per cent for Kansas, 294 per cent for North Dakota, and 355.7 per cent for South Dakota. The progress of the South Central States was still more rapid, as

evidenced in particular by Mississippi, with an increase of 347.1 per cent in bank deposits; by Texas, 248 per cent; by Oklahoma, 172.6 per cent; and by Arkansas, with 503.8 per cent.

For the first time in the financial history of the South, deposits in the banks of that region now exceed $1,000,000,000.

The foregoing remarkable increases in bank deposits in agricultural States, as well as the increase in the number of small country banks, are directly and indirectly because of the profits that have come to the farmers from the operation of their farms. The man with the hoe has become the man with the harvester and the depositor and shareholder of the bank.

DECADENCE OF THE CROP LIEN.

Nothing has been of greater financial moment to the cotton planters than the profitable price of cotton during the past three years. It has been the means of lifting them out of a rut that at times filled them with despair. The crop lien, which was a necessity immediately after the civil war, is disappearing where it has not already gone and released the planters from its bondage.

For the first time in nearly half a century the cotton planter's unsecured note is now good at the bank, and his land is a safe security and is salable.

INCREASE IN FARM VALUES.

Such an account of the farms of the United States as is given in the foregoing matter may seem too optimistic in tone and too extravagant in expression. With the expectation that the story of the year would present this appearance, and to verify or discredit it, the Department undertook and has just completed an investigation of the changes in the values per acre of medium farms since the census of 1900. The net result of these changes is an enormous increase in the values, which increase is entirely consonant with the period of high prosperity that the farmers have enjoyed since 1900, the only considerable blot upon an otherwise clean record of these years being the very deficient corn crop of 1901.

Inquiries were addressed to 45,000 correspondents, representing almost every agricultural neighborhood in the United States, and the returns of these correspondents warrant the statements that follow. The values asked for and reported include the buildings and all improvements, but no personal property.

Percentage of gain.—During the five years last past the value of the real estate of medium farms of this country has increased 33.5 per cent, as compared with the census increase of 25 per cent for the real estate of all farms from 1890 to 1900. The highest percentage of increase—40.3 per cent—is found in the South Central group of

States. Next to this is 40.2 for the Western group, which includes the Rocky Mountain and Pacific States. Third in order is the South Atlantic group, with 36 per cent of increase. The North Central States, containing most of the great cereal and live-stock surplus region, increased 35.3 per cent, and lowest of all was the increase of the North Atlantic States—13.5 per cent. Thus it appears that the medium farms of the South have increased in value in a greater degree than the medium farms of the entire North as far west as the Rocky Mountains.

Farms are classified according to their principal sources of income, conforming substantially to the census classification for 1900. With this understanding, correspondents report an increase of 48.2 per cent in value per acre for the medium cotton farms during the five years, 35 per cent for the hay and grain farms, 34.3 per cent for the live-stock farms, and 33.2 per cent for the farms devoted principally to sugar cane and sugar beets. Rice farming follows with an increase of 32.2 per cent in value per acre, while close to this is 32.1 per cent for tobacco farms. Next in order are the farms devoted to general farming, with an increase of value per acre amounting to 30.1 per cent, after which are the fruit farms, with an increase of 27.9 per cent; vegetable farms, 26.7 per cent; and, lowest of all, the dairy farms, with an increase of 25.8 per cent.

Dollars of gain per acre.—When a comparison is made among the various regions of the country and among the various classes of farms with regard to the number of dollars of increase, rather than the percentage of increase, the results are very different from the preceding. The medium farms of the North Central division increased on the average $11.25 per acre during the five years. In the Western division of States the increase was $5.33; in the North Atlantic States, $5.26; while the increases were lowest in the South, where in the South Atlantic division the gain was $4.93, and in the South Central, $4.66. The average increase per acre of medium farms in the United States, all classes combined, was $7.31.

Although the rate of increase for cotton farms was highest of all specialized farms, the amount of increase per acre was lowest, or $5.21 Next above this is rice, with $5.97; live stock, with $6.40; and general farming, $6.78. Rising considerably above this was the increase for dairy farms, $8.53; tobacco farms, $9.13; and hay and grain farms, $9.43. The highest increases are for vegetable farms, $11.10; sugar farms, $12.34; and fruit farms, $15.29.

Causes of increase.—While some decreased values were found in a few places, due to local causes, the general fact of large increases in farm values was explained by correspondents with much particularity. The increase is chiefly due to better prices and more profitable results of farm operations, leading to a higher capitalization of land

on account of increased net profit. But this by no means fully accounts for the marked increase discovered in farm values, when secondary causes are considered. Everywhere is revealed a more intelligent agriculture; the farmers are improving their cultural methods and are changing from less profitable to more profitable crops. They are discovering that high cost of production attends extensive agriculture, and that, on the contrary, intensive culture and intensive crops increase the net profits per acre. As disclosed in the preceding increases of average acre values, the farms of the less intensive culture and crop have increased in value less than the farms having the more valuable crops receiving high culture.

Other causes for higher values are the erection of new buildings, the keeping of buildings in better repair, better fences, tile draining of land that has been too wet, and a general improvement in farm thrift. New facilities for transportation, where existing, are everywhere reported as at once raising the value of farm lands, whether new railroads or wagon roads that will permit the hauling of larger loads and for longer distances.

Another cause of increase which has had a distinct effect by itself is the growing desire and ability of farmers, and townspeople also, to invest in farm lands as affording a safe investment, even though the rate of interest, as values now are, is not high.

Many minor causes have cooperated with the foregoing to bring about the wonderful increase in farm values during the past five years that the Department has discovered.

Grand aggregate increase of value.—The correspondents reporting with regard to this matter were requested to state increases and decreases for medium farms. There are reasons for believing that the increases for this class of farms may be extended to farms below and above the medium without a material distortion of the fact as representing all farms. While the increases reported for medium farms are higher than for the more poorly kept and less productive farms, on the other hand they are lower than for the better kept and more productive farms of the highest class, which are not covered in the reports of correspondents.

Accepting, then, the increased average acre values of the various classes of medium specialized and general farms as applicable to all farms, including those above and below medium, with such pertinent qualifications as may be made, these increases are applied to the total number of farms of the various classes with results which, it is believed, are approximately correct.

With this understanding it is found that the cotton farms have increased in value $460,000,000, the most prominent increase among the States being Texas, with $115,000,000, while Georgia stands second with $77,000,000, and Mississippi third with $62,000,000. Therefore,

it may be said that during the last five years the cotton plantations have had six crops of cotton, one of these crops being a permanent investment and promising to pay a good return year by year.

Sugar farms have increased in value $20,000,000, more than half of which is found in Louisiana and one-sixth in California.

Hay and grain farms have such an immense acreage that the increase for them amounts to $2,000,000,000, three-fourths of which is in the North Central States; and an even greater gain, or $2,263,-000,000, was made by the live-stock farms, nearly three-fourths of this also being in the North Central States. In the case of farms having dairying as a specialty the increased value was $369,000,000; tobacco farms increased $57,000,000; rice farms, $3,300,000; fruit, $94,000,000; vegetable farms, $113,000,000; and farms devoted to general and miscellaneous purposes, $768,000,000.

In the grand aggregate of all farms of all classes the increased value equaled the enormous total of $6,131,000,000.

Every sunset during the past five years has registered an increase of $3,400,000 in the value of the farms of this country; every month has piled this value upon value until it has reached $101,000,000; that portion of the National debt bearing interest is equaled by the increased value of farms in nine months, and this increase for a little over a year balances the entire interest and noninterest bearing debt of the United States.

This increased value that has come to farms is invested better than in bank deposits or even in the gilt-edged bonds of private corporations.

ECONOMIC POSITION OF FARMERS.

If the farmers' economic position in the United States is to be condensed to a short paragraph, it may be said that their farms produced this year wealth valued at $6,415,000,000; that farm products are yearly exported with a port value of $875,000,000; that farmers have reversed an adverse international balance of trade, and have been building up one favorable to this country by sending to foreign nations a surplus which in sixteen years has aggregated $12,000,000,000, leaving an apparent net balance of trade during that time amounting to $5,092,000,000 after an adverse balance against manufactures and other products not agricultural, amounting to $543,000,000, has been offset. The manufacturing industries that depend upon farm products for raw materials employed 2,154,000 persons in 1900 and used a capital of $4,132,000,000. Within a decade farmers have become prominent as bankers and as money lenders throughout large areas; and during the past five years prosperous conditions and the better-directed efforts of the farmers themselves have increased the value of their farms 33.5 per cent, or an amount approximately equal to $6,131,000,000.

In presenting this the first Annual Report of the third term of the present incumbent of the office of Secretary of Agriculture it has seemed desirable to deviate somewhat from the usual character of this document. As a rule, these reports cover the operations of the Department for a single year, and give considerable space to recording instances of new work undertaken and of partial progress made in the work being carried on. The principal purpose of the present report is to review the work of the Department during the past eight years, and to present for consideration work not only begun but actually accomplished during that period on behalf of the farmer.

WEATHER BUREAU.

SUMMARY OF ACHIEVEMENTS.

The results accomplished by the Weather Bureau for the benefit of the farmer, the mariner, the shipper, the manufacturer, and the seeker after health or pleasure prove that there is no weather service anywhere in the world comparable with it. In recent years it has been equipped with standard instruments, apparatus, and furnishings of the latest design; daily maps are printed at nearly 100 of its local stations; large glass maps, containing the current weather reports, are exhibited each morning before important commercial associations; maps, printed or milleographed, are distributed within three hours from the time that the observations are made. Climatic statistics for the various States are collected from nearly 4,000 voluntary observers using standard instruments, and printed in the form of monthly State bulletins, so that the climate of one region can be readily compared with that of another. It has extended its network of stations around the Caribbean Sea and the Gulf of Mexico, so that no destructive tropical storm may come without warning. It has established stations in Bermuda and in the Bahamas, and arranged for cable cooperation in the Azores and along the western coast of Europe, which enables it to make forecasts for two or three days in advance for steamers leaving this country, and to warn steamers leaving Europe for America of severe storms which they may encounter on their western voyage. With kites and mountain stations it has explored the upper air and gained useful knowledge. It has conducted experiments in wireless, or space, telegraphy, and developed one of the best wireless systems now in use. It has extended its system of telegraphic and climatic observations, so that now, except in some portions of the Rocky Mountain States, the temperature and rainfall conditions of nearly every county can be ascertained. These observations are of great value in the development of the arid and subarid regions, especially in the organization of the extensive irrigation works recently authorized by Congress.

The average per annum increase in the cost of the weather service during the past ten years is 4.41 per cent. During the same period the daily distribution of forecasts and warnings, or of printed charts containing the daily meteorological data of the United States, has increased from 22,582 to 622,880 copies, of which 158,000 represent printed reports.

INCREASE OF SCIENTIFIC RESEARCH.

The present appropriation for the support of the Bureau is $1,392,990. This is the amount to be expended during the current fiscal year in applying the inexact science of meteorology to the commerce and the industries of the United States, and to the saving of human life. A knowledge of the coming weather enters so intimately into every contemplated human action that the question is often asked: What are the prospects for further improvement in the accuracy of weather forecasts, and can the seasons ever be foretold? The answer is that the Government has a corps of forecasters, the members of which are the survivals of the fittest in a thorough system of elimination by competition. Since they are now applying all of the knowledge of the atmosphere that has been revealed, little hope for material improvement in their work can be held out until a substantial addition is made to the pure science of the problem. This can only come through experimentation, study, and research. With 200 stations engaged in applying the science, it is a wise economy to devote at least one of them to the work of adding to the knowledge that we are annually spending nearly a million and a half of dollars to apply. Accordingly, we have endeavored to lay out a plan of study and research leading to an increase in our knowledge of the laws governing the atmosphere such as should eventually make it possible to add to the accuracy of weather forecasts and to make them for a longer period in advance.

The last thirty years has witnessed such remarkable progress in new branches of science that fields of research formerly closed to the meteorologist are now open to him and must not be neglected. Recent observations have led to the discovery of a possibly large variation in the amount of heat that is received from the sun or an equivalent possible variation in the transparency of the highest portions of the earth's atmosphere.

In such studies the Weather Bureau has hitherto taken a subordinate part, whereas in so-called practical meteorology it has always occupied the leading position.

The highest efficiency in any art requires a perfect knowledge of the higher science behind it. To establish law is necessarily antecedent to correct forecasts of rains, frosts, or storms.

MOUNT WEATHER RESEARCH OBSERVATORY.

Under the authority of Congress, three years ago, the Department undertook the establishment of a station at Mount Weather, Virginia, devoted to meteorological research, and has established there a plant especially adapted to atmospheric research. The temperature, moisture, and movements of the air at great heights will be ascertained by means of balloons and kites; the absorption of solar heat by the atmosphere will be measured; the dissipation of solar light and heat will be determined; the special analysis of the sunbeam will be carried out, and the electric condition will be determined. In addition to this we have added apparatus for studying the relations to the atmosphere of the magnetism of the earth, the temperature of the soil, and even the motions of the earth. All these phenomena have been shown to have a more or less intimate connection with meteorology.

In so far as aerial research may require it, sounding balloons will be liberated from many of the weather stations in distant parts of the country in cooperation with those at Mount Weather, since it is considered very important to know the condition of the atmosphere above the land every day of the year up to the greatest attainable height, especially during the passage of storms and cold waves. Therefore, Mount Weather may be expected to do as much for the science of meteorology and the future improvement of the service as the service has already done during the past thirty-five years for the material interests of the United States. The employees at this station must necessarily live close by their apparatus, and provision must be made for all the ordinary needs of domestic life precisely as is done in all large astronomical observatories and in military establishments. This has been done economically and in accordance with established usage.

RIVER AND FLOOD SERVICE.

Neither the year 1904–5 nor its immediate predecessor was productive of serious floods in the larger rivers, although several damaging floods occurred in the smaller rivers, notably in the upper Sacramento in January, 1905; in the Purgatory and upper Arkansas rivers of Colorado; the Rio Grande, Pecos, and upper Canadian rivers during the latter part of September and the early part of October, 1904; and in the Grand River of Michigan in June, 1905. The floods in the rivers of the southwest in September and October, 1904, were peculiar in that they occurred in the semiarid region and at a time of the year when heavy rainfall is not anticipated. Their coming was not announced, since no flood service had yet been organized in that part of the country. The damage done by the floods in

Colorado, New Mexico, Oklahoma and Indian Territories, and Texas amounted to at least $1,000,000, of which the greatest share fell upon the railroads. The loss to the inhabitants was not less than $1,000,000. These very destructive floods brought to the attention of the Weather Bureau the need of a flood service in the States mentioned. Such a service has therefore been organized, with 15 river and 10 rainfall stations, the headquarters of the district being at Denver. Although the service is not complete, it has done much good in giving warning of the floods in the Rio Grande during May and June, 1905.

The flood of June, 1905, in the Grand River of Michigan, while not as great as that of 1904, was nevertheless a disastrous one, and that it was not even more so was without question due to the forecast and warning service given by the Weather Bureau.

METEOROLOGY IN SCHOOLS.

The Weather Bureau has encouraged the study of meteorology in educational institutions by allowing its scientists, outside of their official duties, to deliver courses of lectures to students, so that there are now 20 institutions of learning where meteorology forms a part of the curriculum, thereby giving preliminary training to young men who, in after years, may succeed to the duties now performed by the meteorologists of the Government.

At every station of importance occupied by the Weather Bureau it is the custom for the official in charge to deliver such lectures as are desired by the public schools in his immediate neighborhood, and to instruct such classes as visit the offices of the Weather Bureau. In this way a general knowledge of the work of the Bureau is being disseminated in the community. During the past year several hundred such lectures have been given.

BUREAU OF ANIMAL INDUSTRY.

The work of the Bureau of Animal Industry is of great value to the country, and no part of it is of greater importance than the study and investigation of contagious animal diseases with a view to their prevention or control. In the war waged in the interest of stock raisers against contagious diseases the work of the Bureau of Animal Industry has been unremittingly carried on.

BLACKLEG.

In 1897 was begun an investigation for the immediate control of blackleg, or symptomatic anthrax. Losses from this disease were found to be very heavy in Texas, Indian Territory, Oklahoma, Kansas, Nebraska, Colorado, the Dakotas, and it was more or less prevalent in many other States. A series of experiments was made to

determine the effect of vaccines, which were finally successful in developing a vaccine efficacious in producing immunity by a single vaccination. The preparation and distribution of this vaccine, with circulars giving methods for using it and containing a full account of the cause and nature of the disease, were undertaken on a large scale. Beginning with 355,000 doses distributed in 1898, the annual distribution was increased until it amounted to nearly 1,750,000 in 1903, with a little reduction since then, the distribution in 1905 amounting to 1,400,000. The effect has been to reduce losses from this disease from 10 to 12 per cent to about one-half of 1 per cent, and recent reports show that the dread disease is rapidly disappearing.

SWINE DISEASES.

In 1897 experiments were made looking to the control of infectious diseases of swine by administering a serum from animals inoculated, respectively, with the hog-cholera and the swine-plague germs. As a result of these experiments and the stamping-out work undertaken in July of that year, 49 entire herds, aggregating 2,904 animals, had been destroyed and the pens disinfected by the end of the year. This work demonstrated that the losses might be promptly checked by the stamping-out method, but many farmers objected to these measures being carried out, and it was difficult so to enforce the regulations as to prevent the spread of the disease from farm to farm. Continued experiments with the serum treatment showed that there were cases known as hog cholera which did not yield to the treatment, and the very careful work of the Biochemic Division of the Bureau extending over several years has proved that acute hog cholera is caused by a virus which has not yet been cultivated and identified, but which passes through filters which will entirely remove both the hog-cholera and the swine-plague bacilli. The discovery of this hitherto unsuspected contagion has opened up an entirely new field of investigation, which is being energetically developed, and experiments are under progress which, it is hoped, will throw some light upon methods of prevention adapted to this disease.

TEXAS FEVER.

Investigations have been conducted to throw further light upon the microbe organism which causes the Texas fever. It was found that this organism was fostered in the blood of southern animals for as long, in certain cases, as twelve years or more after the removal of the animals from infected districts. It was found, however, that the animal retains its immunity three years after the disappearance of the microbe organism from its blood.

Another point of interest was to determine whether Texas fever ticks were capable of transmitting the disease to susceptible cattle

at any time or only when they had recently absorbed blood of cattle from infected districts. It has been found possible to develop ticks in which the power of producing disease is absent. These ticks do not necessarily carry the Texas fever contagion, but obtain the germs of the disease from infected cattle. Other interesting experiments are now being conducted in connection with the subject with a view to acquiring a knowledge which will enable the Department to render more and more efficacious its control of this disease.

SHEEP SCAB.

Sheep scab has been one of the greatest obstacles to successful sheep raising, and the Department has experienced a great deal of difficulty in fighting it. Even after the order of June 18, 1897, was issued diseased sheep continued to arrive in large numbers at the principal markets. In 1898 a bulletin, entitled "Sheep Scab: Its Nature and Treatment," was issued, giving full information upon this subject and specifying the treatment by which the disease might be eradicated. This bulletin had remarkable influence in educating sheep raisers in checking the disease and in informing the public as to a possibility of curing infected animals. In July, 1899, an important order was issued describing the manner in which affected sheep should be dipped, instead of leaving this to the discretion of the owners and commission merchants. This order approved of the tobacco-and-sulphur and the lime-and-sulphur dips; formulas were given for their preparation, and the animals had to be dipped in one or the other before they were allowed shipment in interstate commerce.

While this action of the Department specifying dips to be used has been much criticised, it has proved a most important step toward the eradication of sheep scab. The number of sheep dipped under official supervision in 1899 was 672,944. The number increased after the year 1900 by leaps and bounds, nearly 17,000,000 having been dipped in 1905. At the same time it has been found that the dips become more and more efficacious. Reliable returns received in regard to 6,000,000 sheep in 1904 showed an effective percentage of 99.35. It is doubtful if such a measure of success has been achieved in any other country in treating animals for this disease. As the result of this work, sheep scab has almost or quite disappeared from several States that were badly infected and is much less prevalent in most others. By continuing the work and slightly increasing the number of inspectors for a few years it can undoubtedly be eradicated.

MALADIE DU COÏT.

An outbreak of *maladie du coït*, a venereal disease of horses, was discovered in Nebraska in 1898. The disease is a dangerous and

insidious one, many of the affected animals showing but very slight symptoms, and yet being capable of transmitting it. While, therefore, in the earlier stages apparently mild, it may be very serious and even fatal, and its existence threatens the horse industry in any section where it gains a foothold. It was important to undertake the suppression of the disease promptly to prevent at any cost its spread to other sections of the country. In 1901 twelve diseased animals were destroyed.

The semiwild condition of the country through which the disease had spread and the prejudices of the horse owners and their lack of cooperation made it a difficult matter to discover diseased animals. Yet in 1902 there were 95 diseased animals slaughtered and 29 diseased stallions castrated. In 1903 there were 16,287 horses inspected, 511 diseased animals slaughtered, 277 suspected animals quarantined, and 1,889 stallions castrated. An order was issued June 20, 1903, prohibiting the transportation of horses from the infected districts unless first inspected by an inspector of the Bureau, and the measures adopted in 1903 continued throughout 1904 and 1905, over 9,000 being inspected in the latter year without finding any actually diseased; also 23 suspected animals were slaughtered, and 9 stallions castrated. It appears from the investigations of the last year that the disease has been practically eradicated.

CATTLE MANGE.

The animals affected by mange were frequently found in important central markets, and accordingly a regulation was issued in June, 1903, prohibiting the shipment from one State to another of affected cattle, and making regulations for the inspection and certification of cattle from the infected districts, and the cleaning and disinfecting of cars. The number of cattle inspected under this order in 1904 was 1,124,321, and the number of dippings exceeded 157,000, and 535 infected cars were disinfected. The number of horses inspected for mange was 752; 453 were found diseased, and 138 were dipped. In 1905 the number of inspections of cattle was over 14,000,000, the number of dippings 563,394, and 29,897 cars were cleaned and disinfected. There were also inspected for mange 15,971 horses.

FOOT-AND-MOUTH DISEASE.

In the fall of 1902 there occurred an outbreak in New England of the foot-and-mouth disease, and arrangements were at once made with the authorities of the affected States—Massachusetts, Rhode Island, and Vermont—for the eradication of the disease. About 3,000 animals were known to be affected in December; the infected animals were placed under quarantine, a carefully selected force of inspectors organized, and arrangements were made for slaughtering the diseased

herds and disinfecting the premises. Owing to the extreme cold and hard freeze, the work of disposing of the carcasses and disinfecting the premises was very difficult. In spite of this, the work was pushed energetically and the spread of the disease was promptly checked. In all, 244 herds, containing 4,712 cattle, were affected; 3,872 cattle were slaughtered, besides a number of hogs, sheep, and goats which had been exposed.

Over $128,000 was paid in compensation for these animals. In the meantime the disease had spread somewhat extensively into New Hampshire, and thorough investigation was made of a considerable part of that State. It was found possible to remove the quarantine May 9, 1903, from Rhode Island, while the port of Boston, which had been closed to the exportation of animals during the outbreak, was reopened July 20, 1903, the quarantine of animals in Massachusetts being removed the following October. It would be impossible to commend too highly the fidelity and energy with which the force of the Bureau carried on the work of eradication in spite of many difficulties. This campaign against a contagious animal disease stands unrivaled, if we consider the celerity, the economy, and the satisfactory results of the work.

TUBERCULOSIS.

Tuberculosis has been studied both as to its effects upon the animal industry of the country and as to the danger of its being communicated from animals to man. It is not uncommon to find herds of dairy cattle where 50 to 90 per cent of the animals are affected with this disease, and in our meat-inspection service there have been found in some large abattoirs nearly 3 per cent of hogs with tuberculosis. The disease, therefore, deserves the most careful study. The studies of the Bureau have been much helped by certain discoveries made by our own employees by which methods of investigation have been greatly improved. Experiments with monkeys showed that these animals are susceptible to both forms of the disease—bovine and human—and that there is little difference to be seen in the results of the infection with either. Careful observations soon indicated that with cattle the disease is more frequently contracted by taking in the bacilli with the inspired air than with the ingested food. A study was made of a herd of 102 cows, 76 of which showed reaction to the tuberculin test, to determine the infectiveness of milk from cows that had reacted to the test. As a result of this study the following conclusions were reached:

(1) The tubercle bacillus may be demonstrated in milk from tuberculous cows when the udders show no perceptible evidence of disease, either macroscopically or microscopically.

(2) The bacillus of tuberculosis may be excreted from such an udder in sufficient numbers to produce infection in experimental animals both by ingestion and inoculation.

(3) In cows suffering from tuberculosis the udder may, therefore, become affected at any moment.

(4) The presence of the tubercle bacillus in the milk of tuberculous cows is not constant, but varies from day to day.

(5) Cows secreting virulent milk may be affected with tuberculosis to a degree that can be detected only by the tuberculin test.

(6) The physical examination or general appearance of the animal can not foretell the infectiveness of the milk.

(7) The milk of all cows which have reacted to the tuberculin test should be considered as suspicious, and should be subjected to sterilization before using.

(8) Still better, tuberculous cows should not be used for general dairy purposes.

SURRA.

In 1901 a serious disease known as surra was found to exist among horses in the Philippines. Upon the request of the War Department for information on the subject an emergency report on this disease was at once prepared in the Bureau. There is reason to believe that the information thus made available has greatly assisted in the work of repression undertaken in those islands, besides aiding the inspectors of the Bureau in their efforts to keep out animals so infected. On account of this disease the Department has prohibited the landing of any animals from those islands at ports of the United States. Surra is very destructive in its effects on horses, and its introduction into the United States would be a great disaster.

TRICHINOSIS IN GERMANY.

In order to study this subject and to counteract statements continually made by the German press concerning American pork, an employee of the Bureau was sent to Berlin as an attaché of the American embassy to get a correct statement of available records bearing upon the subject. His report, published in 1901, is a clear exposition of the whole matter, and shows conclusively the harmlessness of the American pork shipped to Germany.

MEAT INSPECTION.

The subject of meat inspection grows in importance every year. It is not too much to assert that upon the success of this branch of our work depends a foreign trade worth many millions of dollars yearly to our stock raisers. The meat-inspection law provides for an ante-mortem and a post-mortem inspection. It has increased

steadily from year to year. In 1898 the total number of animals inspected before slaughter aggregated over 51,000,000; over 9,000,000 of them being cattle, 10,000,000 sheep, and 31,000,000 hogs. In 1905 the total number inspected aggregated nearly 66,000,000. At the same time it is important and interesting to know that the increase in the number of animals rejected was much less proportionately than the increase in the number inspected.

In 1898 the number of animals inspected after slaughter was 31,000,000, of which over 4,000,000 were cattle, 5,500,000 sheep, and 21,000,000 hogs. The total number inspected after slaughter in 1905 was something over 40,000,000. There were tagged with the label of inspection in the year 1905 nearly 22,000,000 quarters of beef, nearly 8,000,000 carcasses of mutton, 845,000 carcasses of veal, 1,000,000 carcasses and 800,000 sacks of pork. Meat-inspection stamps indicating the regular post-morten inspection were affixed to 7,000,000 packages of beef in 1905, and to more than 15,000,000 packages of pork. The inspection of cars amounted in 1898 to 18,631, and in 1905 to 66,846. The number of live cattle inspected for export in 1905 was 824,914, of sheep 423,780, and of horses 2,358. In the same year 731 vessels which carried animals for export were inspected. The inspection of live animals at British ports by inspectors of the Bureau included in 1905, 401,623 cattle, 232,925 sheep, and 1,710 horses. Besides these inspections for our export trade, many thousands of inspections were made of imported animals.

NECESSITY OF ADEQUATE APPROPRIATION.

The importance of the cattle and meat inspection work of the Bureau of Animal Industry can not be exaggerated. It is only the certification, under the Government seal of the United States, as to the healthfulness of these products that enables us to place them in foreign markets. The withdrawal or even the restriction of our ability to supply such certification would mean the utter annihilation of our foreign trade in cattle and animal products. At the same time the Department is very much hampered by its inability to meet the demands for inspection for want of adequate appropriations. Requests for inspection—perfectly legitimate and having equal claims upon us with others already conceded—are constantly being received and continually increasing in number, so much so that even if the appropriations asked for for this Bureau last year had been allowed they would still have been inadequate to carry on the work. In the estimates submitted for next year these conditions are provided for, but it is only possible for the Department to carry on this important work adequately by the full compliance of Congress with the estimates submitted for this purpose. If an emergency appropriation be not allowed and made immediately available, the

Department will be compelled to abandon a large part of this important work. I deem it impossible to emphasize this situation too strongly.

ANIMAL NUTRITION.

The construction of a respiration calorimeter at Middletown, Conn., by Professors Atwater and Rosa for the study of human nutrition in cooperation with the Department suggested similar work with animals. Work along this line was authorized in June, 1898, to be conducted by Dr. H. B. Armsby, of the Pennsylvania Experiment Station, and his assistants. The calorimeter was constructed on the plans of the Atwater-Rosa apparatus, specially adapted for use with animals. Experiments were made on the available energy of timothy hay; later, of clover hay and maize meal. The work is now in progress, concluding with a study of the influence of age and individuality on the nutrition of animals.

ANIMAL HUSBANDRY.

An expert in animal husbandry was appointed July 1, 1901, and his attention was chiefly devoted to the investigation of questions of animal husbandry and to the practical or economic side of stock raising. July 1, 1904, an appropriation of $25,000 became available for experiments in animal breeding and feeding in cooperation with the State stations, and this work was placed under the supervision of the expert in animal husbandry. Experiments have been begun in cooperation with the Colorado Experiment Station in breeding American carriage horses; with the Alabama Experiment Station in beef production; with the Maine Experiment Station in poultry breeding, and with the Maryland Experiment Station and the National Zoological Park in breeding zebra hybrids. A study has been begun on the fecundity of Poland China sows, with a view to determining whether sows of this breed have decreased in fecundity, and, if so, whether such decrease is chargeable to particular families. The effect of cotton seed and cotton-seed meal when fed to hogs is also under investigation. Several valuable publications on animal husbandry have already appeared.

ANGORA GOAT INDUSTRY.

The Bureau has aided the establishment of this industry in every way. The goats have been taken into every State and Territory, and reports of their success as mohair producers are numerous.

MILCH GOAT INDUSTRY.

Careful investigation of milch goats of European countries have been made and the results printed in a bulletin. The demand for this publication has been large, very many physicians applying for it.

During the past year an expert was sent to Europe to investigate the industry in the leading goat countries, and an importation was made of 59 does, 4 bucks, and 5 kids of the Maltese breed. These animals are being employed in cooperation with the experiment stations at Storrs, Conn., and College Park, Md. At the former place cheese making has been undertaken and milk will be supplied to tuberculous patients and to children's hospitals; at the latter, milk will be furnished in Washington, D. C., to be used in the treatment of various diseases.

THE DAIRY INDUSTRY.

Dairying constitutes one of the main branches of animal industry. This line of agricultural effort in the United States yields good returns to a great number of producers. A large amount of capital is invested in dairying, and the development of the industry has been marked by the intelligence and enterprise of those engaged therein.

The interests of this industry have been looked after by the Dairy Division of the Bureau of Animal Industry. This Division was organized June 30, 1895, and during the past eight years its work has steadily expanded in scope, amount, and importance. At first its efforts were limited to the collection and dissemination of information regarding the dairy industry. Statistics and general information were collected and published; and bulletins were prepared describing the principal breeds of dairy cattle and outlining the most approved methods employed in the several branches of the dairy industry in this country and in Europe.

As time passed and larger funds became available new studies and original investigations were taken up. These included studies and investigations relating to the conditions and demands of domestic and foreign markets; the production of milk and its distribution to the people of cities; imitations of and substitutes for dairy products; and the number and distribution of pure-bred dairy cattle and grades, with their effect upon production and results.

WORK RELATING TO MILK.

Milk, an important product in its new state, and the basis for the manufacture of all other dairy products, has naturally received the first and largest share of attention. Popular bulletins have been prepared and issued in large and repeated editions, the object of which has been to raise the standard of production by educating both the consumers and producers of milk. The most approved methods of feeding, handling, and milking dairy cows, and of cooling, handling, storing, and transporting milk have been presented, and the common errors and dangers involved in careless dairying forcibly pointed out.

Butter exports.—Experimental exports of butter have received considerable attention. Special agents of the Department have

visited Great Britain, France, Germany, China, Japan, and the Philippine Islands and arranged for experimental exports of butter to places in all. Trial shipments have been made to Germany, France, and England. The shipments to Manchester, England, have been most numerous and the most satisfactory, and a good reputation has been established for our butter in that quarter.

Cold storage of butter.—To determine the best temperature at which to hold butter in storage, experiments were conducted in Chicago in 1903–4. The cream was collected and the butter made by the usual methods of a first-class creamery; the butter was put up in 60-pound tubs and stored at temperatures ranging from 5° F. below zero to 30° above zero. The results proved that a temperature a few degrees below zero is most desirable. The lot stored at 5° below kept almost perfectly for eight months, while the lots stored at 10° and 20° above zero deteriorated greatly.

Renovated butter.—To the Dairy Division was assigned the duty of assisting in the administration of the act of Congress approved May 9, 1902, which authorized the Secretary of Agriculture to provide for inspecting the materials, factories, and processes employed in the manufacture of renovated butter, the object being to insure a sound and wholesome product and to see that renovated butter was labeled and marketed as such. This inspection work was assigned to nine inspectors located in commercial centers. The results have been very satisfactory. The character of the product of renovated-butter factories has been improved, and its price has become steadier; the total product of such factories has increased from 54,500,000 pounds in 1902–3 to 60,000,000 in 1904–5; and the law has not proven in any way detrimental to the makers of country butter, whose product forms the bulk of the stock worked up in such factories. In 1903–4 the inspectors of the Dairy Division reported inspections of 76 factories, and visited the markets in 274 cities located in 44 States and Territories, to investigate and correct the conditions under which the renovated product was marketed. All renovated butter exported is inspected and certified by the dairy inspectors.

WORK RELATING TO CHEESE.

Cold curing of cheese.—In 1902–3 experiments were carried on in cooperation with the State experiment stations of New York and Wisconsin in the cold curing of cheese. In these experiments about 5½ tons of cheese were used, including all types of American cheese. Cheeses were cured at three temperatures, 40°, 50°, and 60° F. The commercial quality of the cured cheese was tested by a jury of experts. The advantage of curing at low temperature was established. More

recently an important experiment has been made in the cold storing of cheese, and the results were quite similar to those secured in the cold-curing experiment.

EXPERIMENT WITH SOFT CHEESE.—An interesting experiment now in progress in cooperation with the agricultural experiment station at Storrs, Conn., relates to the manufacture in this country of soft cheese of the Brie and Camembert types, so largely made in western Europe. About 1,000,000 pounds of this kind of cheese are imported into this country annually.

WORK RELATING TO DAIRY CATTLE.

Realizing that the dairyman's success is so largely dependent on the character of his herd, the Dairy Division has given much attention to dairy cattle and has issued several publications on the subject. The object has been to improve the dairy stock of the country, and two lines of effort promising the largest measure of improvement have been kept continually before those engaged in the industry—(1) the increase of pure-bred stock of recognized dairy breeds, and (2) selection and breeding to secure cows of dairy type.

BUREAU OF PLANT INDUSTRY.

Plant investigations have been a feature of the Department's work since its establishment, although the organization of the Bureau of Plant Industry was not effected till July 1, 1901. It consists now of eleven offices, each of which is charged with the handling of a group of important plant problems. The work is carried on by 508 employees, about 60 per cent of whom are engaged in scientific work. The work of the Bureau is designed to bear directly on the practical questions which daily confront the tiller of the soil.

PROGRESS IN TREATING PLANT DISEASES.

Extensive investigations have been made in the treatment of plant diseases, with excellent results.

Peach-curl, a disease which occurs wherever the peach is grown, but is especially severe on the Pacific coast, has been brought under control. Experiments on the Pacific coast have resulted during one year alone in a saving of nearly a quarter of a million dollars' worth of fruit.

The little-peach disease, which at one time threatened the orchards of Michigan, New York, and other States, has been studied and its nature and method of control determined. The systematic destruction of the trees, under careful scientific inspection and regulations, is making possible rehabilitation of the peach fruit industry in a number of sections.

Pear blight has received special attention during the past six or eight years. Its nature has been thoroughly determined, and the methods of treatment recommended by the Department are now being followed by large pear growers in a number of parts of the country. Wherever the work of handling the disease is conducted systematically and scientifically, success has followed.

The Department has devoted special attention to the study of diseases of citrus fruits, recognizing the great value of this crop. A method of controlling wither-tip, orange blight, and sooty mold of citrus fruits has been developed and is now in actual use in a number of regions.

The cranberry crop of this country is valued at about $2,000,000. Some years ago the crop was seriously threatened by a disease known as "scald." The Department's investigations resulted in the discovery of the cause of the disease and a method of prevention, thoroughly practicable, which is now in use.

Conservative estimates have placed the annual loss from bitter rot of apples in certain seasons, in the United States, at over $10,000,000. This disease has been successfully treated by spraying. In the past season 90 per cent of the fruit in large orchards was saved, while in adjacent orchards, not treated, the loss was nearly complete.

A number of important crops, such as cabbage, turnips, etc., have from year to year been seriously troubled by certain forms of bacterial diseases. These diseases have been studied, their natures determined, and in most cases remedies developed and put into practical use.

Some destructive diseases of the most important agricultural crops of the South, notably cotton, the cowpea, and the watermelon, have been studied and remedies found for them. One of the most serious diseases of cotton, which for years caused great loss, was wilt. This trouble was especially destructive in the Sea Island districts. Careful scientific investigations showed the cause of the disease to be a minute fungus working in the roots, and it was further shown that certain plants were able to resist this fungus. Selection of seed from year to year from these plants has resulted in the establishment of resistant types. At the same time that resistance was being developed it was necessary to maintain the value of the types in other directions, notably in lint production, length of fiber, etc. This has all been done.

Cowpeas, which are used extensively in rotation with cotton, are also subject to the same disease, and it therefore became necessary to secure resistant varieties of this crop. This has been accomplished.

The great importance of intensive horticultural work has been fully recognized by the Bureau of Plant Industry in the study of plant

diseases. Plants grown under glass are necessarily subject to a number of serious troubles. The Bermuda lily, a very important crop, has for years been subject to a disease which investigations have shown is primarily due to improper methods of cultivation. Methods of avoiding these troubles have been developed by the Department, and in most cases the disease may now be successfully controlled.

Diseases of the violet, the calla lily, the carnation, and other crops have been studied, and important discoveries in reference to their causes and control have been announced.

One of the most important lines of investigation conducted by this Bureau during the past eight years, in cooperation with the Forest Service, has had to do with a study of the decay of construction timber and methods of preventing such decay. This work has resulted in improved methods of handling construction timbers and impregnating them with protective substances. Only recently a cheap and effective method of treating fence posts has been discovered.

Within the past few years a serious disease appearing in the rice fields of South Carolina has threatened a most important industry of the State. Investigations of this disease, made in cooperation with the South Carolina Experiment Station, have resulted in the discovery of the cause of the disease and a comparatively simple remedy therefor.

AGRICULTURAL EXPLORATIONS.

Systematic work in securing new plants and seeds from foreign countries for introduction into the United States was inaugurated in 1897. Remote parts of the world have been searched by agricultural explorers for new crops, and valuable additions to our agricultural productions have been made. The aim of our agricultural explorers has been to seek living seeds and plants in quantity for extensive trial throughout the country. Their explorations have included the desert regions of Asia and Africa, the sub-Arctic regions of Russia, Norway, and Sweden, the climatically east-American regions of China and Japan, the tropical regions of the Dutch East Indies, the Pacific islands and Central America, and the Australian, South American, and South African regions of the southern hemisphere.

Our explorers have brought back large numbers of useful plants, which have been distributed to carefully selected experimenters.

ACHIEVEMENTS IN COTTON BREEDING.

In the breeding and improvement of cotton the first experiments of the Department were begun in 1899. At this time little had been published regarding cotton breeding. Careful methods of breeding were devised and methods of judging cottons by score cards worked out, which have become standards for work in this field of

investigation. The frequency of natural crossing in the field was studied, so that different varieties might be grown without risk of mixing and deterioration. The correlation of characters, the laws governing the splitting up of hybrids, the form of plant, and other important matters have been carefully studied. Reliable advice can now be given to cotton seed growers and breeders.

A most important problem in the cotton industry is the securing of varieties as productive as the ordinary staple sorts but producing longer and better lint. This can be done by two distinctly different methods.

The first method is to secure hybrids of the long-staple Sea Island cotton with the standard short staples, with a view to obtaining new sorts which combine (1) improved length of staple with the large bolls, opening well, and (2) the productive character of plant of the short staple. Many thousands of such hybrids have been made and carefully tested in the course of the Department's experiments, and three new sorts have been secured which possess distinctly valuable characters and are believed to be worthy of general propagation. These have been carefully bred until they are now nearly as uniform in type as the standard varieties, but require to be carefully selected for one or two more generations before they are generally distributed to planters. One of these hybrids, which is a distinctly Upland type of plant and produces large round 5-locked bolls, has fine silky lint from $1\frac{1}{2}$ to $1\frac{5}{8}$ inches in length and a smooth black seed, so that it may be easily ginned on roller gins if desired. The fiber of this variety will rival the Egyptian and lower grades of Sea Island. The other two varieties are similar, but have lint averaging only about $1\frac{3}{8}$ inches.

A second method of securing improved staple, which has given very striking results, is the straight selection of the standard short-staple varieties. It was found by careful examination of such varieties as Russell and Jones Improved, which are both excellent standard sorts, that there was considerable variation in the length of lint produced by different plants. Careful selection experiments have been conducted with both of these varieties, and the average length of lint in the breeding stock of these two varieties has been increased from the ordinary 1 to $1\frac{1}{8}$ inches until it is now from $1\frac{1}{4}$ to $1\frac{3}{8}$ inches; meanwhile the plants have maintained their full productiveness and all other good characters. These varieties, now clearly distinct from the original stock, should be propagated and placed with growers as rapidly as possible. King cotton, which has been so extensively recommended for cultivation in boll-weevil districts, but which has been condemned because of its poor lint qualities, has also shown itself capable of great improvement in the same manner.

All varieties of cotton have been found to vary greatly in their productivity in the case of different individuals and different strains of the same variety. One strain of Pride of Georgia, which for several years has been selected for increased yield by a careful system of pedigree breeding, has shown marked improvement. A considerable quantity of this seed will be distributed to planters in the spring of 1906, and in 1907 a still higher grade of select seed of the same variety will be available.

In the boll-weevil infested area there is great demand for earlier varieties of big-boll types. The extensive experiments inaugurated in 1904 on this subject have not yet reached a stage where safe conclusions can be drawn, but preliminary experiments started the year preceding have given one very early strain, selected from a native Texas big-boll sort, which has proven very productive and is considerably earlier than the big-boll sorts with which it has been compared. A limited trial distribution of the seed of this variety will be made in the spring of 1906.

A large quantity of Egyptian cotton is imported into this country annually and used in our mills. It seemed probable that with our extensive cotton area some soil and climate could be found where this cotton could be successfully grown. Experiments were conducted in various parts of the country and careful manufacturing tests were made with the fiber. These experiments have shown conclusively that we can in many places produce an excellent quality of fiber, possessing all the characteristics of the best Egyptian-grown fiber. The yield in most places, however, has been so low that these cottons can not compete with the ordinary Uplands. If they are to succeed, more productive and earlier sorts will have to be bred, or the cultivation will have to be conducted in the extreme southern part of the cotton belt, where there is a very long growing season.

MEETING THE RAVAGES OF THE COTTON BOLL WEEVIL.

As the spread of the cotton boll weevil extended north and east in Texas it became evident that there were problems connected with the invasion of this pest other than those purely entomological. The invasion of the weevil necessitated, in many cases, a complete revolution in agricultural practices. The Bureau of Plant Industry, in order to meet this exigency, has had for the past two years a corps of workers in the field carrying on important investigations in the matter of breeding new types of cotton better adapted to the conditions which have arisen since the invasion of the weevil. It has been conducting demonstration work to point out and emphasize the value of the discoveries which have been made by the Bureau of Entomology and other branches of the Department and to encourage diversification of crops. It has been searching the cotton regions of this and other

countries in the hope of discovering types of cotton better suited to the new conditions in the invaded territory. In connection with this work some important discoveries have been made in the matter of types of cotton which have, through a long series of years, been able to adapt themselves to the presence of the weevil.

The most important work, however, in this connection, has been the field demonstration work which has had for its object the bringing home to the people themselves practical methods of tillage, cultivation, and planting to enable them to grow cotton despite the presence of the weevil. This general demonstration work has been pushed energetically in Texas and also extended into Louisiana in advance of the insect.

NEW CITRUS FRUITS PRODUCED BY THE DEPARTMENT.

The two great freezes of the winter of 1894 and 1895, which killed to the ground practically every orange and lemon tree in Florida except in the extreme southern part of the State, served to emphasize the great importance of securing hardy varieties of these fruits. Experiments were started by the Department, and the results which have been obtained are very valuable and encouraging. It has been shown that valuable hardy races can be produced by crossing the very hardy cold-resisting trifoliate orange with the different varieties of the ordinary sweet orange. Two of these hybrids which were found to produce valuable fruits were propagated, and in the spring of 1905 distributed broadcast to interested growers in South Carolina, Georgia, Alabama, Louisiana, southern Tennessee and Arkansas, eastern and southern Texas, and regions of low altitude in Arizona, New Mexico, Washington, and Oregon. These fruits, being different from any known group of citrus fruits, were named citranges, and the two varieties distributed were named, respectively, the "Rusk" and the "Willits."

Four other varieties of hardy oranges, or citranges, have been obtained, each possessing special features of merit. One of these produces a fruit so similar in size and appearance to the ordinary orange that it can only be distinguished by an expert. This fruit has been named the Morton.

Another variety, similar to the Morton in appearance, but differing in flavor and tree characters, is also believed to be valuable and will be propagated for distribution as soon as possible.

A special feature of these hybrids is their fine foliage characters, which adapt them to propagation as lawn trees and as hedge plants. Some of the hybrid oranges are far superior in general adaptability to the trifoliate oranges often grown for this purpose, having much denser and handsomer foliage, and being largely evergreen, retaining the greater part of their foliage throughout the winter. The Rusk and Willits citranges and the two varieties last mentioned, however,

are hardly satisfactory to use for general hedge purposes, as they are nearly seedless and would require to be propagated by budding. Fortunately, two hybrids have been secured which have the desirable hedge characters and have thus far produced an abundance of seeds, indicating that they will be very desirable for use in this way. These two varieties will be tested as hedge plants and distributed if they continue to form numerous seeds, which will allow of their easy and cheap propagation.

In the course of the experiments two new tangerines have been produced, which have been named the "Weshart" and the "Trimble." These produce fruits considerably larger than the ordinary tangerine and are nearly two weeks earlier in season—two very desirable characters. These varieties have been propagated as rapidly as possible, and a limited distribution of budded trees will be made.

One of the most interesting of the Department's productions is the new tangelo. This fruit, a hybrid of the pomelo with the tangerine, may be described as a small, loose-skinned ("kid-glove") pomelo. It has a good sprightly acid flavor, which it is believed will render it a popular fruit. It has been named the "Sampson," and a limited distribution of stock will be made next spring.

One very excellent variety of sweet orange has been secured, which will probably be propagated and introduced. It is a large, round blood orange, nearly seedless.

NEW PINEAPPLES PRODUCED BY THE DEPARTMENT.

The so-called fancy varieties of pineapples grown and tested in the United States have as a whole proved unsatisfactory, so that their cultivation has been largely abandoned for the cultivation of the inferior but more robust and hardy varieties, such as the Red Spanish. It is thus desirable that varieties of better fruit qualities be secured, which at the same time will have a vigorous, hardy constitution, adapting them to general cultivation. To secure such improved sorts many hybrids have been made by the Department, the experiments having been started mainly in 1896 and 1897. These have as a whole produced fruits of exceptionally good quality.

WORK ON NITROGEN FIXATION.

The great value of leguminous crops for forage and as soil improvers, especially in their ability under certain conditions to fix atmospheric nitrogen, led this Department in 1899 to undertake a study of the Old World legumes with a view to introducing into the United States such as promised to be valuable in regions not now well supplied with these crops. Early in this work it became evident that we must also introduce the tubercle bacteria, especially for those species of legumes not having closely related species in cultivation in the United States. During the following three years a large number

of introductions of these crops was made, and in all cases where it seemed desirable root samples containing tubercles were also secured. The isolation and distribution of these nodule-forming bacteria, with their appropriate crops, was believed to be one of the prime factors in their successful introduction. The common practice of inoculating leguminous crops by the use of soil which was known to contain the proper bacteria was not only expensive, especially where the soil had to be transported for long distances, but was fraught with great danger of introducing noxious weeds, plant diseases, and insects. An investigation was therefore made of the method proposed by Nobbe and Hiltner, of Germany, for inoculation by the use of pure cultures under the name of "nitragin." It was found that these cultures had been tested very carefully in this country and in Europe and had proven unsatisfactory.

In the course of the investigations, moreover, it was soon found that the pure-culture method, as then practiced, was a failure, owing to the fact that the bacteria were cultivated artificially on a substratum rich in nitrogen, thus obtaining all of the nitrogen they desired for growth direct from their food supply without depending upon the atmosphere for it. It was found that as soon as the nitrogen was removed and the bacteria were required to depend upon the atmosphere for their supply of nitrogen it was possible to secure strains of bacteria with greatly increased nitrogen-fixing power. It was further found that these bacteria thus secured could be dried on an absorbent medium like cotton, retaining their vitality undiminished.

Extensive tests of this method of culture and distribution were made in the laboratory and field during 1902 and 1903. These tests under careful scientific control were so successful and the method was simplified so greatly that it seemed desirable to give it a careful test in the hands of practical farmers. It was believed that a method to be of any value should be simple enough to be used by an intelligent farmer. As a result of a general distribution of cultures in the latter part of 1903 and in the spring of 1904, it is evident that the method of distribution perfected by the Department has great advantages over any other method of soil inoculation yet devised. While there is much yet to be done in determining the conditions under which the use of these tubercle-forming bacteria will give the most favorable results, it is evident that we have a very successful method of growing and distributing them and increasing their nitrogen-fixing powers. No new development of this kind can be successful in the hands of everybody. Failure may come from many causes. Usually these causes are easily determined and corrected. Sometimes they are obscure and must be carefully investigated in order to be determined. On the whole, however, the intelligent farmer is able to use the cultures under favorable conditions with success and profit.

WORK ON WATER CONTAMINATION.

In 1902, under authority from Congress, this Department began an investigation of algal and bacterial contaminations of water supplies. Some preliminary tests made in 1901 in removing algæ from cress beds were so successful that it seemed desirable to test the method under a wider range of conditions. Although sand filtration in the case of water supplies for domestic use had proved successful in removing bacterial contamination, it failed completely in the matter of algal organisms that give disagreeable tastes and odors to water in which the algæ occur. Extensive tests were made in the laboratory during 1902 and 1903, and also in large reservoirs and other water supplies in various parts of the country. The results of these tests were first published in May, 1904. In this report it was shown that minute traces of copper, so small as to be entirely harmless to man and to the higher animals (and even to fish, if properly used), would successfully destroy not only contaminating algæ but also bacteria of the typhoid and cholera groups. The method has been further tested in cooperation with boards of health and water engineers in many parts of the country during the past two years, and in nearly every case where the work has been done according to directions of the Department it has resulted successfully. Many intelligent boards of health and water engineers are recognizing the value of the method when used under proper conditions.

ADVANCES IN GRASS AND FORAGE PLANT INVESTIGATIONS.

The Department has made considerable progress in grass and forage plant investigations. Largely through its efforts, alfalfa has been thoroughly established in almost every State, including the Eastern States. The new Turkestan variety, introduced by our explorers, has proved to be of special value for the Northwest and other cold, dry sections.

Methods of restoring denuded ranges and maintaining a productive condition have been worked out. Several spineless varieties of cactus have been introduced from Mexico, the value of this plant as a forage crop having been demonstrated.

It has been found possible to control drifting sand by vegetation, and valuable results have been secured in covering railroad embankments and cuts with plant growth.

Cowpeas, soy beans, and new varieties of sorghum have all been effectively studied, and their growth extended. Several new varieties have been studied, and their value for hay and pasture demonstrated. A number of wild grasses have been introduced into cultivation. As a winter pasture and forage for the South the hairy

vetch has assumed importance. A cheap and complete method of eradicating Johnson grass, which is probably the worst weed in the United States, has been worked out.

BETTER SEEDS FOR THE FARMER.

Methods and apparatus for testing seeds for mechanical purity and germination have been studied and perfected. By means of publications giving descriptions and drawings of weed seeds and the seed of our economic plants, farmers have been warned of the adulterants frequently found in field seeds and have been advised as to the general quality of those in the trade. They have been invited, in all cases of doubt, to submit samples to the Department for testing before buying.

Through samples of imported seed received from the customhouses, information has been obtained as to the quality and kinds of seed being imported both for legitimate use and for purposes of adulteration.

The proper conditions for the storage of seeds under unfavorable climatic conditions have been determined. The handling of Kentucky bluegrass has been studied and the proper treatment to economically produce seed of high vitality has been pointed out.

IMPORTANT RESULTS IN GRAIN INVESTIGATIONS.

DURUM WHEAT.—Durum wheat was first introduced from east and south Russia in the spring of 1899. During the next year a much larger quantity of seed was imported, including varieties from North Africa. In 1901 there were produced probably 50,000 bushels of durum wheat. The following year there appear to have been grown considerably over 1,000,000 bushels. The production has steadily increased until in the season of 1905 it is conservatively estimated by grain dealers to be between twelve and fifteen million bushels for the three States of North Dakota, South Dakota, and Minnesota. Add to this about 5,000,000 bushels for Kansas, Nebraska, Colorado, and the Rocky Mountain and Pacific Coast States, and the result is a production of probably 20,000,000 bushels for the entire country.

It is reported that during October about 6,000,000 bushels of durum wheat were shipped to Europe and that the prices recently offered by importers were an advance of 12 cents over the price paid for the first shipments. The question of marketing the wheat, therefore, can no longer be a doubtful one, as our reputation for furnishing a good quality of grain is well established. As stated recently by an official of the board of trade of Duluth, durum wheat has "passed the experimental stage and is now a regular commodity."

Swedish select oat.—Another valuable new crop is a variety of oat known as "Swedish Select," introduced in the spring of 1899. This oat is a pedigreed variety, developed many years ago in Sweden and afterward thoroughly acclimated in the cold region of northern Russia. It is admirably adapted to our Northern States, and long ago became the most popular oat throughout the region from Wisconsin to Montana.

Sixty-day oat.—This variety of oat was introduced from southwestern Russia four years ago, and is now giving results in the territory of the Middle West comparable to those obtained with the Swedish Select in the North. Being much earlier than ordinary oats, it is able to escape rust and other fungous and insect pests in seasons when other varieties are badly affected. For the same reason it also sometimes escapes the worst stage of a drought.

Extension of the winter-grain area.—One of the most important things in grain cultivation is to be able to grow fall-sown crops, as both the yield and quality of a winter grain are invariably better than those of spring grain in the same locality. A valuable achievement of the Department in this line is the successful introduction of winter barley, known as "Tennessee Winter," into northern latitudes. This barley is now thoroughly acclimated as far north as Kansas and gives yields so much greater than those of spring barleys and is so important on certain occasions for winter pasturage that it is causing little less than a revolution in grain cultivation in a number of localities.

Two Algerian barleys have been introduced with much success in the Southwest. They are thoroughly adapted to desert conditions and alkali soils and have so far given yields per acre that are from 50 to 80 per cent greater than those of other varieties in the region between Texas and southern California.

In the grain experiments carried on in cooperation with the Maryland Experiment Station it has been discovered that there are a number of important varieties of two-rowed hull-less and other kinds of barleys that are perfectly hardy when sown in the fall.

The winter-wheat area is being extended north and west, largely through the introduction of the Kharkof winter wheat, which has become almost as popular as the Swedish Select oat. It is closely allied to the well-known Kansas Turkey wheat, but is hardier both for the winter and in seasons of drought. The winter-wheat area has already been extended almost entirely over the State of Nebraska, to a considerable extent in Minnesota, and to a lesser extent in South Dakota.

ENCOURAGEMENT OF RICE PRODUCTION.

Rice has received special attention during the past six or seven years. The Japanese, or Kiushu, variety was brought into the country and disseminated. Since this introduction the development of the

rice industry in the South has been phenomenal. Between 1899 and 1904 the rice acreage of Louisiana and Texas increased from 210,396 acres, yielding 179,919,293 pounds of rough rice, in 1899 to 610,700 acres in 1904, yielding 869,426,800 pounds, an increase of upward of 190 per cent in acreage, by far the greater increase being in Texas. In 1889 Texas had 178 acres of rice, in 1899, 8,711 acres, while in 1904 the acreage had increased to 376,500, or more than forty-three times the area under this crop six years ago.

PROGRESS IN THE BEET-SUGAR INDUSTRY.

In 1897 there were but nine beet-sugar factories in the country, and the total amount of sugar manufactured was 30,000 short tons. A great change has since taken place, and the estimated output for 1905 is 280,000 short tons.

Extensive practical demonstrations carried on throughout the sugar-beet belt have clearly and positively proved that if the farmers will properly prepare and fertilize the soil, sow a high grade of seed, cultivate and care for the growing crop, and treat it for diseases and insects in accordance with the methods recommended by the Department, not only will their yield be increased but their beets will be of better quality and higher sugar content, while the cost of their production will be materially decreased.

The failure of more than one factory has been due to the use of poor seed, and the establishment of high grades of seed has been one of the most difficult problems with which we have had to contend. The Department has, however, within the last year or two, succeeded in establishing farms in sections of the United States where the climate and soil conditions are favorable for the supply of pedigreed seed of superior quality.

Last year one of the largest growers of this seed had to refuse more than 50 per cent of his orders on account of his inability to grow a sufficient quantity of seed. These results warrant the assertion that within the next few years the quantity of seed grown in the United States will not only greatly exceed that grown heretofore, but by its use beet-sugar factories will greatly increase their percentage of sugar extraction. The fact that an increase of 1 per cent in the sugar extraction for last year would have increased the output of refined sugar by more than 40,000,000 pounds is in itself sufficient reason to warrant the Department in exerting every energy to continue the encouragement and assistance it has given to sugar-beet seed growers.

The work the Department has undertaken in establishing single-germ beet seed has proved eminently satisfactory, and it is now assured that a high-grade strain of single-germ seed can be produced, which will greatly reduce the cost of thinning. This will mean the saving of thousands of dollars to farmers throughout the sugar-beet belt, and will give a new impetus to sugar-beet growing.

The yield of sugar beets has been greatly increased not only by scientific cultivation, but by the judicious use of fertilizers, which in some cases have increased the yield from 40 to 50 per cent, and at the same time improved the quality of the beets.

RECENTLY ESTABLISHED FACTS IN TROPICAL AGRICULTURE.

A special branch of the Bureau of Plant Industry has devoted a large part of its attention to various crops suitable for the Tropics.

Coffee has received special study in Porto Rico. Studies of coffee in other regions have been made with a view to profiting by the results obtained in those regions. Several of the supposed principles of coffee culture have been found, on being subjected to scientific study, to have only local application. It has been shown that the value of shade, which is recognized in a number of coffee-growing sections, is due primarily to the fact that the shade trees are of the leguminous family.

Important investigations have been made of the rubber industry in Central America. These studies have developed two important facts: First, that the rubber tree does not require to be grown in regions of great and continuous humidity, as heretofore believed, but thrives and produces better in districts subject to a distinct dry season. The second important fact is that, contrary to previous popular and scientific opinion, the same species of rubber does not extend throughout the Central American region. The reports which the Department has published have served as a warning to the public of the essentially uncertain character of a number of undertakings in rubber culture and have undoubtedly saved to the American public millions of dollars.

Cacao is another crop which has received special study. The cultivation of this crop is confined almost entirely to humid localities, in accordance with the belief that such a climate is necessary to the welfare of the tree. This belief is erroneous, and it is expected that with better cultural methods the growing of this important crop will become an established industry in all the tropical possessions of the United States.

Millions of dollars are paid annually by this country for tropical products grown outside of our territory. The efforts of the Department have been in the direction of encouraging the production of these crops, as already indicated, in our own tropical dependencies.

ADVANCES IN POMOLOGICAL INVESTIGATIONS.

Along the line of pomological work much of immediate practical value to fruit growers and handlers has been accomplished. Thousands of specimens of fruits forwarded by growers for identification have been passed upon by the pomologist and his expert assistants.

A fairly comprehensive test of a large number of Vinifera grapes on resistant stocks in North Carolina and Florida has demonstrated that certain choice sorts of this type hitherto considered impossible of cultivation in the open air in the South Atlantic States can be successfully grown for home use, at least, when grafted upon such stocks and when thoroughly sprayed to protect against fungous diseases. A systematic and comprehensive experimental investigation of the relative adaptability of resistant stocks to the various soil types of the Pacific slope and of the relative congeniality of the important commercial Vinifera varieties to these stocks is in progress in California. The continued prosperity of the viticultural industry of the Pacific coast, in which over $85,000,000 is now invested, depends in large degree upon the accurate determination of these important questions.

In recognition of the fact that the avoidance of disastrous gluts in our markets is one of the most important factors in developing and maintaining a thrifty fruit industry, special attention has for several years been paid to the encouragement of export trade in American fruits and the improvement of methods and practice in fruit storage and transportation. Comprehensive experimental investigations to determine the best methods of harvesting, packing, handling, and transporting such fruits as are most promising for export have been conducted. Through cooperative experimental export shipments during the last four seasons it has been demonstrated that eastern-grown "Bartlett" pears can be successfully and profitably exported in seasons when the European crop situation justifies the effort.

A large and rapidly developing export trade in eastern-grown "Bartlett" and other autumn pears has developed along the lines pointed out by these experiments. It has been further demonstrated that early varieties of apples from the Middle Atlantic States can be delivered in British markets in excellent condition when proper precautions as to harvesting, packing, and forwarding are observed; also that "Elberta" peaches from Georgia, Oklahoma, and Connecticut, and later varieties of this fruit from the mountain orchards of Virginia and West Virginia, can be delivered in the United Kingdom in sound and attractive condition whenever the market conditions warrant. It is believed that the establishment of these facts has laid the foundation for a normal and thrifty development of a profitable future export trade in these fruits.

When the Bureau of Plant Industry began the fruit transportation and storage investigations there was little exact information concerning the factors that influence the shipping and keeping qualities of fruits. Very serious losses occur in transit in small fruits and in fruits such as the peach and the orange, as well as in fruit in cold

storage. It has not been known whether these losses are due to the cultural treatment, to the methods of handling the fruit, or to the conditions surrounding the fruit in transit and in warehouses. There have been much litigation and many misunderstandings over these difficulties. The Bureau of Plant Industry has succeeded in establishing some of the fundamental factors that govern these questions. It has applied the results to the commercial fruit business of the country in such a way that it has been a distinct benefit to the grower, the shipper, the warehouseman, and the transportation companies.

It has been determined that fruit is not likely to keep well if it is forced to growth. The apple handler has been told to watch the fruit more carefully and sell it relatively early in the season if it has been grown on rank-growing young trees. It has been demonstrated that the apple scald, one of the worst troubles with some varieties in cold storage, can be practically controlled by letting the fruit reach the stage of hard ripeness on the tree, by storing it quickly after picking in a temperature not above 32° F., and by selling relatively early in the season the varieties that are likely to scald. A large proportion of the losses from decay in the transportation and storage of fruit such as the apple and the orange is the result of breaking the skin, thereby making the fruit susceptible to the attacks of the common mold. Fruit is injured by rough handling to a far greater extent than the most experienced fruit growers and shippers have supposed. We have gone into the field and have shown how these injuries occur. Extensive shipping experiments have shown that the losses in injured fruit may be very heavy in transit and in storage, while perfect fruit of the same varieties may be transported or kept in storage in sound condition. It has been clearly proved that the delays that commonly occur in shipping and storing the fruit in warm weather cause the decays and the ripening processes to develop prematurely, and, in connection with improper handling, cause a large proportion of the storage and transportation losses.

The Bureau has demonstrated that the ripening processes and the development of rots must be checked by cooling the fruit as soon as it is picked. Quick-ripening fruits, like "Bartlett" pears, do not cool quickly enough in the center of a barrel when placed in cold storage, and such fruits should be stored in small packages; fruit that is to be stored several months should be packed in closed packages to prevent it from shriveling; a wrapper lengthens the storage period, and a temperature as low as 32° F. keeps apples of all varieties, pears, peaches, and small fruits longer and in better condition than a higher temperature. It has been shown also that the losses from the ripening of fruit in the top of a refrigerator car may be reduced to an important extent by cooling it quickly, after picking,

to a temperature of 35° to 40° F., and, further, that a refrigerator car, kept well iced, will maintain such a uniform temperature if the fruit is first reduced to that degree of cold. These investigations are having an important influence on improving the methods of conducting the fruit industry of the United States.

DRUG AND POISONOUS PLANT INVESTIGATIONS.

In the drug-plant investigations a field study of small areas of many kinds of drug-producing plants has been made in Vermont, in the District of Columbia, and in South Carolina, and it has been shown that many of the most important kinds will do well, e. g., poppy, belladonna, digitalis, wormwood, peppermint, etc. Curing processes have been studied and some of the most important features worked out. A method of utilizing the poppy plant or its parts as a crude source for morphine has been developed on a laboratory scale, and through the Office of Seed and Plant Introduction, a larger test of the commercial possibilities is planned. The production of camphor and licorice is being studied. Distillations from Florida camphor plantations have given a good yield of crude gum camphor. The production of camphor on a commercial scale will be tested in the near future. Certain important wild drug plants threatened with extermination have been successfully brought under cultivation. The utilization of weeds used in medicine has received some attention as a source of profit.

The object of poisonous-plant investigations is to study the relation of stock losses to the eating of poisonous plants. Extensive field studies, especially in Montana and other Western States, have shown that great and often sudden losses are not infrequently due to the eating of harmful plants growing on the range. The chronic trouble known as "loco disease" is now under study.

TEA-CULTURE INVESTIGATIONS.

In conducting experiments in the cultivation of tea in the South it has been demonstrated that the most important varieties of the tea plant, that from Ceylon excepted, make a growth and give a yield comparing very favorably with the results produced in their own lands. It has also been shown that negro children make expert tea pickers when properly trained. Several new and valuable machines have been invented: (1) A rotary sterilizing machine for withering the leaf to be made into green tea; (2) an attritionizer which at minimum cost polishes the tea, thus enhancing its appearance and market value. A new type of rolling machine is now being perfected to give a better "roll" to the tea than is given by the machines now in use.

Twenty-five acres of tea have been planted at Pierce, Tex., and a

preliminary plucking indicates that a very high grade of tea will probably be produced. During the past season 9,000 pounds of tea were made at Summerville, S. C.

IMPROVEMENTS IN SEED DISTRIBUTION.

One of the most important tasks which the Department has to perform is the securing and distribution of the large quantity of seeds made necessary by the Congressional seed distribution. In the earlier work of the Department it was the practice to secure this seed, put it up, and send it out entirely with a departmental force. As the demand for seed increased and the work grew, it was found difficult to handle the complicated questions involved in this way. For a time the handling of the seed for the Congressional distribution was placed in the hands of contractors, but this was found unsatisfactory.

The Bureau of Plant Industry was charged with all matters pertaining to the seed work, and for the past four years has been giving special attention to improvements in the methods of securing, handling, and distributing. The Department has made a special effort to secure home-grown seed from growers and dealers in the United States.

A special effort has been made in the matter of encouraging bulb culture. While the actual number of miscellaneous vegetable seeds distributed has increased, the cost of the work has been diminished and the saving effected thereby has been devoted to the purchase, distribution, and encouragement of the use of improved seeds of various kinds. A special feature has been made of encouraging school garden work through the seed distribution. Formerly it was the practice to send the same kind of seeds to the cities as was sent to the country districts. Now special arrangements have been made for placing in the hands of Senators and Members of Congress who have city constituents seeds especially designed for encouraging garden work in the public schools. Circulars of instruction have been prepared and issued with these seeds. Special attention has also been given to the securing and distribution of improved forage-crop seed, cotton seed, and other seeds.

FARM-MANAGEMENT WORK.

The Office of Farm Management has been developed in the Department during the past four years. Until recently its most important work has consisted in the study of farm practice. This study has resulted in finding many farmers who are preeminently successful in their chosen occupation. A careful study of their methods has been made. It has been completely demonstrated that preeminent success in farming consists in combining scientific knowledge with business methods. The publication of the results of these studies has aroused among farmers great interest in agricultural science. Some farmers

who are following closely the teachings of agricultural science have been found who regularly secure a net income greater than the price of good farm land in this country.

As a result of the study of farm practice and of scientific investigation, it has been possible to establish object-lesson farms in various parts of the country, and 35 such farms are now in operation. The results obtained on these farms have surpassed expectations. On one dairy farm in the South the net income was doubled in one year. In another instance, a cotton farm with a net profit of $5 per acre was converted into a hay and stock farm with net profits three times the value of the land when work upon it was begun by the Department.

FOREST SERVICE.

During the past year the Government work in forestry entered upon a new phase. Practical work in the actual introduction of forestry began in 1898, but it was not until February 1, 1905, when the care of the National forest reserves was transferred to the Department of Agriculture, that the Forest Service became an administrative organization.

This transfer was a logical outcome of the recent work of the Service. During the last six or seven years it has passed through a remarkable development, which has followed but not kept pace with its demonstration of capacity for public usefulness. On July 1, 1898, the Division of Forestry employed eleven persons, of whom six filled clerical or other subordinate positions, and five belonged to the scientific staff. Of the latter, two were professional foresters. The Division possessed no field equipment; practically all of its work was office work.

At the opening of the present fiscal year the employees of the Forest Service numbered 821, of whom 153 were professional trained foresters. Field work was going on in 27 States and Territories, from the Atlantic to the Pacific and from Canada to Mexico. Over 900,000 acres of private forest were under management recommended by the Service, and applications on file for advice from owners contemplating management covered 2,000,000 acres more. During the year nearly 62,000 letters were sent out from the offices at Washington, the majority of them in reply to requests for information and advice from the public, of a kind which could not be met by printed information.

This contrast imperfectly indicates the full extent of the change which has taken place, and the progress which has been made. Seven years ago there were in the whole United States less than ten professional foresters. Neither a science nor a literature of American forestry was in existence, nor could an education in the subject be obtained in this country.

The real need of forestry was urgent. A time had come which presented at once a great opportunity and a dangerous crisis. Forest destruction had reached a point where sagacious men—most of all, sagacious lumbermen—could plainly discern the not distant end. The lumber industry, vital to the Nation at large, was rushing to its own extinction, yet with no avenue of escape apparent until forest management for future crops should be forced by famine prices. Meanwhile, however, the ruin would have been wrought already.

Timber-land owners were selling their holdings or their stumpage with little evidence of an understanding of their future value, and lumbermen were compelled by business competition to keep down the cost of operation to the lowest terms or market their product at a loss.

Forestry was both an evident economic need and an apparent economic impossibility. Few well-informed persons believed that the obstacles to its introduction could be overcome sufficiently to bring it into common practice among private owners during the lives of the present generation.

That the whole situation is profoundly altered is directly and chiefly due to the work of the Forest Service. With its offer of practical assistance to forest owners made in the fall of 1898, its field of action shifted from the desk to the woods. The lumberman was met on his own ground. Uncertain speculations were converted into business propositions and untried theories into practical rules. Actual management for purely commercial ends has been taken up and applied on their own holdings by some of the best known lumbermen in the country. What lumbermen as a body now think of forestry is illustrated by the recent effective movement in their National association to endow a chair of lumbering at one of the forest schools.

Forestry is a matter of immediate interest to every household in the land. Forest destruction is no imaginary danger of a distant future. If it is not speedily checked its effects will sooner or later be felt in every industry and every home. To make these facts known is a National duty. The work of education must continue until public opinion will not tolerate heedless waste or injudicious laws.

PRESENT STANDING OF FORESTRY.

The period which has passed since 1898 has been, in forest work, a period of large definite accomplishments and of effective preparation for the future. Of the exact knowledge concerning our American forests, upon which the practice of scientific forestry depends, vastly more has been gathered during the last seven years than previously from the time Columbus landed. In 1898 the Division of Forestry had hardly approached the specific problems of forest management in the United States, and had developed no efficient

methods of attacking them. The records now on file are based on the measurements of millions of individual trees. Commercial tree studies looking toward management have been prosecuted for 32 important species. Working plans have been prepared in 28 States, and field work has been conducted in every State and Territory in the United States, and in Porto Rico, Alaska, and the Philippines.

The scientific knowledge gathered in the field has taken form in a rapidly growing literature of the subject, and has furnished the basis for a system of professional education. To-day there is scarcely more occasion for the American to go abroad to study forestry than to study medicine or law.

Besides creating a science of American forestry, the Forest Service has worked out the methods of operation by which forestry may be put in practice. It found in existence a fully developed system of lumbering, which had brought efficiency and economy of labor to the highest point, but was often wasteful of material and regarded forests as simply so much standing timber to be cut. Men taught to regard cheap logs at the mill as the supreme test and sole end of good lumbering, justly proud of their proficiency in a highly specialized industry, and impatient of restraint, could not be expected to welcome with cordiality changes for a purpose whose utility they were necessarily slow to recognize. To work a reform it was necessary to begin with existing conditions and improve them instead of criticising them. Had not the Forest Service taken the lead in finding out just how practical rules for conservative lumbering might be laid down and carried out, forestry could not have reached the point at which it now stands in the United States.

In the field of economic tree planting the same story is repeated and shows definite, important, and permanent results. It is true that in 1898 farmers throughout the Middle West, where tree planting finds its largest field of economic usefulness, were already alive to their need of planted timber. But the knowledge of what kinds of trees to plant and how to make them grow was imperfect. These were the fundamental problems: (1) The comparative adaptability of various species to regional and local conditions of climate, soil, and moisture; (2) the comparative usefulness of the species which can be made to thrive; (3) the protective benefits of planted timber; and, (4) the rate of growth and the future yield which can be expected.

Substantial progress toward the solution of all of these problems has been accomplished. The Forest Service has made in all 300 separate planting plans for private owners, covering an aggregate area of over 50,000 acres, in 36 States and Territories. It has completed regional studies of the broad conditions in the New England States, California, Kansas, Nebraska, Iowa, eastern South Dakota, western Minnesota, Illinois, Oklahoma, and the Ohio Basin in Ohio,

Pennsylvania, and West Virginia. These studies largely supersede the necessity of future individual studies on the ground. It is now in a position to exercise great helpfulness in the whole planting movement throughout the United States. It has established in the minds of western farmers generally the fact that tree planting can be made successful and that it adds to the money value of their farms. It has also called attention to the great hygienic importance of tree planting on the watersheds; of public water supplies of cities, east and west; has developed practical methods for reforesting denuded mountain slopes and for establishing new forest growth in regions of little rainfall, and has powerfully contributed to the great work of reclaiming desert lands through water conservation and to the whole irrigation movement.

THE GAIN IN ECONOMY OF USE.

The Forest Service has in the last seven years added greatly to our visible forest resources. In the saving of waste it has enriched the country by many millions of dollars, and in this way alone has added vastly more to the National wealth than its total expenditures for all purposes during its entire history.

Its most important achievements in decreasing the drain upon our forests by providing for their more effective utilization have been along four lines—determination of the strength of different kinds of timber, studies of methods by which timber may be made more durable, efforts to decrease waste in lumbering, and the discovery and introduction of better methods of gathering forest products other than lumber.

By its timber tests the Forest Service has established the suitability of various little-used but abundant woods, especially for structural uses, and has made possible the more economical use of other woods by an exact determination of their strength. By its studies of the effects of seasoning and the value of different methods of preservative treatment, it has opened the way to an enormous reduction in the drain upon our forests for railroad ties. What this demand at present is may be realized when it is considered that if a tree were growing at each end of every railroad tie laid in the track in the whole United States all the timber produced would be needed for renewal alone. In other words, two trees must always be growing in the forest to keep one tie permanently in the track.

By its studies of lumbering methods the Forest Service has shown lumbermen how timber formerly wasted in high stumps, tops, and logs left in the woods could be utilized without added expense. And a not less serious waste of a great resource was cut off when the invention of a new method of turpentining made it possible to eliminate

the destruction of our southern forests through boxing the trees, and at the same time to gather a far larger value in turpentine than before.

FOREST EXPLORATION.

Finally, the Forest Service has rendered a great service by its explorations of forested regions. Useful contributions to the knowledge of our forest resources have been made through specific studies of important regions. The guiding principle of this policy is, of course, that all land should be put to its best use. This principle the Forest Service has assisted to put into effect by its recommendations as to what lands should not as well as what should be reserved.

RESERVE ADMINISTRATION BY THE FOREST SERVICE.

The Forest Service had become fully qualified, by its past work, for the responsibility laid upon it by the transfer of the reserves to its administrative charge. The immediate effect of the change was the opening of the reserves to much wider use than ever before. This is the natural consequence of intrusting the care of these great forests to the only branch of the Government which has the necessary technical knowledge. The inevitable consequence of a lack of such knowledge must be the restriction of right use or the practical certainty of misuse. Only under expert control can any property yield its best return to the owner, who in this case is the people of the United States.

Under the system of administration now in force everything affecting the reserves is determined or executed by men of expert knowledge, familiar with local conditions. This entire force has become a part of the classified civil service. Timber is cut only under the supervision of trained men in accordance with a plan carefully prepared to safeguard the permanent welfare of the forest; yet the sales of timber have many times increased since the Forest Service took charge. A far more complete control is exercised than formerly, yet the net cost to the Government of all the work of the Service will be less for the present year than that of the Bureau of Forestry alone before the transfer. A property worth in cash not less than $250,000,000 is administered at a cost of less than one-third of 1 per cent of its value, while increase in that value of not less than 10 per cent per annum is taking place. As the use of the reserves increases the cost of administration must, of course, increase also, but receipts will certainly increase much more rapidly. The forest reserves are certain to become not only self-supporting but a source of large public revenue.

WORK OF THE YEAR.

The transfer of the National forest reserves to the care of the Department of Agriculture was effected on February 1, 1905. The

administration of these vast forests fell quietly into its place in the Service, and has since been conducted with steadily advancing efficiency. Every office in the Forest Service is actively concerned in their management, working and planting plans are in preparation and have been prepared for various parts of them, and they are absorbing and will continue to absorb a greater and greater part of the work of the Forest Service.

FOREST MANAGEMENT.

PUBLIC LANDS.

On the public lands greater strides were made in the introduction of forest management than ever before. Wherever on the reserves timber is in present demand working plans are being prepared which will insure the best use of the forests. On the Chippewa Indian Reservation, in Minnesota, the complete success of the plan to secure the perpetuation of the forests is assured. In California, Colorado, Montana, South Dakota, and Wyoming studies of leading commercial trees have provided a basis for the intelligent management of the forests in which these trees hold an important place, including many of the reserve forests.

PRIVATE LANDS.

The movement to introduce forest management on private lands is spreading rapidly, especially in the Pacific Coast States and the Middle West. Nearly four-fifths of the applicants for cooperative assistance were small owners. The total area for which assistance was asked was nearly 1,500,000 acres. Examinations to determine the practicability of management were made of 22 large timber tracts in 15 States, and detailed working plans were made for 8 large and 81 small tracts, with a total area of almost 2,000,000 acres.

FOREST EXTENSION.

Up to the present year the work in extension found altogether its largest field of usefulness in the preparation of planting plans for farm protection and local timber supply in the scantily timbered regions of the Middle West. It is certain that tree planting will always hold an important place in farm economy, but it is more and more becoming possible to supply the needed information for this work from the central office as a result of regional studies. The large projects involved in the establishing or replacing of forests on reserve lands now unforested, and in demonstrating to the consumers of timber that they must provide for their future needs, will probably for the next few years increasingly claim the attention of the Forest Service.

During the year a revision of the terms of cooperative assistance was made to induce wider acceptance by small owners. Up to the present time 380 planting plans have been made, of which 49 were made during the past year.

Reserve planting during the year included the establishment of nurseries in the Santa Barbara and Gila River reserves, broadcast sowing and field planting on the Black Hills Reserve, and field planting in the San Gabriel and Dismal River reserves, besides the extension of previously established nurseries. The experiment in broadcast sowing in the Black Hills is especially notable, because the results obtained now appear to be entirely favorable and because success has never before been gained under this method in this country. The significance of this fact lies in the enormous difference in the cost of reforesting by sowing seed on ground not previously prepared and of rearing and transplanting nursery stock for large areas.

By the completion of the cooperative study conducted in the State of California valuable information was secured concerning the relation of chaparral to water conservation and forest renewal and concerning fire protection.

FOREST PRODUCTS.

Lines of cooperative work now completed have brought definite and important results in introducing preservative treatment as a means of increasing the durability of ties, and thereby decreasing the drain upon the forests. The results give good reason for the belief that tie preservation will shortly become practically universal.

The study of the preservation of telegraph and telephone poles promises further economies of the same kind.

In timber tests, studies of red gum, red fir, western hemlock, and loblolly and longleaf pine have furnished facts which will lead to the wiser use of these species and of structural timber generally. Strength tests of woods for other purposes have been begun, and methods have been prepared for the more extensive prosecution of this very practical work; but the full utilization of the opportunity presented for public usefulness must wait until the necessary facilities are provided.

DENDROLOGY AND FOREST EXHIBITS.

Progress was made during the year in the general study of forest distribution, classification, and composition throughout the United States, especially through regional studies. Previous studies of basket willows and turpentining methods have been continued with further helpful results.

BUREAU OF CHEMISTRY.

During the period begun July 1, 1897, and ended June 30, 1905, the present Bureau of Chemistry has increased its activities, and by reason of its enlarged work was raised from a division to the rank of a bureau July 1, 1901. The work of the Bureau has been seriously retarded, both during the past eight years and prior thereto, by reason of the large number of employees who, having attained a reputation for efficiency and ability, have been induced by superior opportunities of advancement to resign from the Bureau and enter work for other institutions or corporations. Nineteen of the promising members of the Bureau, during these periods, have resigned to enter more lucrative employment in other positions.

CEREAL INVESTIGATIONS.

The chemical investigation of the cereal products of the United States has been one of the principal items of work, and several bulletins have been published embodying the results of the investigations. Starting from the mean composition of the principal cereals, the chemical studies of the products made therefrom have included flours, meals, breads of every description, breakfast foods, cakes, and biscuits.

The changes which take place in cereal products during the process of milling are fully discussed in the above publications.

PREPARED MEATS.

Important investigations, also, were made in the study of prepared meats. As a result of these investigations it was shown that the process of parboiling, or "shrinking," as it is technically called, is practiced to produce a marketable article, since meat must be cooked before it is canned. The process was shown to detract little from the muscle-forming elements of the meat. The only substances removed in any considerable quantity are fat, soluble ash, and meat bases. In addition to this work, a systematic examination of the canned goods sold in the American markets was undertaken, and a total of 513 samples of such products were examined. It is interesting to note in connection with this work that in addition to the above 39 samples of horse meat were obtained, designed, according to statements made, for export to foreign countries.

The investigation of canned meats has proved of particular advantage, both to the manufacturers and consumers. That meat can be preserved unharmed for a long time when thoroughly sterilized in cans has been fully established as the result of the investigations. It has further been shown that it is not necessary in preserving the meat in this condition to add any chemical preservative whatever. The

meats thus prepared preserve their wholesome properties and nutritive value and do not lose appreciably in palatability when not kept for too long a time.

FOOD PRESERVATIVES.

Elaborate studies have been made of the character of preservatives used in food products and the best methods of detecting them. These investigations have proved most useful to all workers in this line in the United States and foreign countries.

An important investigation has also been made to determine the effect of preservatives and coloring matters, when added to foods, upon the health of the consumer. To this end a class of young men was secured to whom were fed foods containing these articles. In so far as the investigations have been completed, it has been found without exception that the addition of the ordinary preservatives to foods is prejudicial to health. The same is true, also, of at least one of the coloring matters commonly employed, namely, sulphate of copper.

The results of these investigations show the need of protecting the public by legislation against the addition of such articles to foods, either by prohibiting their use altogether or by regulating the amount thereof and securing a statement of composition upon the label of each package.

FOOD STANDARDS.

Important investigations have been conducted by the Bureau of Chemistry looking to the establishment of standards of purity for foods. The results of these investigations have been laid before the food standards committee of the Association of Official Agricultural Chemists, a body authorized by law to advise the Secretary of Agriculture, which has been instrumental in forming the standards already published as well as those which are still under consideration.

The lack of uniformity in the food legislation in the various States is a source of great annoyance to manufacturers and dealers. The Bureau of Chemistry has cordially cooperated with the officials of the various States in their efforts to regulate the manufacture and sale of adulterated foods, drinks, and drugs. It is becoming more and more evident, however, that for the complete control of evils of this kind interstate regulation of commerce in such articles is necessary.

THE INSPECTION OF FOODS INTENDED FOR EXPORT.

The Congress of the United States has authorized the Department of Agriculture, through the Bureau of Chemistry, to inspect all food products intended for export to countries whose laws require a physical or chemical inspection of foods. This privilege, however, is optional with the exporter. He is not compelled to secure such an inspection, but is authorized to do so if he so desires. Under this law

a great many of the exporters of food products in this country have applied to the Department for inspection of their goods. They have thus been enabled to send with the foods to foreign countries a certificate of inspection, which as a rule is accepted as prima facie evidence of purity. It is evident that our foreign commerce in food products would be greatly promoted if this practice should become general, and our foods would thus acquire a standing in foreign countries which would remove from them all suspicion of impurity.

INSPECTION OF IMPORTED FOODS.

Congress has also authorized this Department to inspect all food products offered for entry into the United States from foreign countries and to refuse delivery to the consignee of all products which are found to contain any added substance injurious to health, or to be misbranded in any particular, either as to their contents or origin, and of such products as are forbidden or restricted in sale in the country from which they come or from which they are exported. In order to carry this law into effect, branch laboratories of the Bureau of Chemistry have been established in the ports of New York, Boston, Philadelphia, New Orleans, San Francisco, and Chicago.

As far as the facilities at hand will permit, all food products entering this country are inspected and analyzed before delivery to the consignee. As a result of this inspection a great improvement in the character of our imported foods has already been secured. There has been developed also among the exporters from foreign countries a desire to send only such articles as may conform to the requirements of the laws of the United States.

During the period between July 1, 1903, when the enforcement of the law began, and June 30, 1905, 3,576 invoices of food products were inspected, among which 712 were found to be of a character forbidden by law.

TABLE SIRUPS.

Important investigations have been made in the last few years looking to the improvement of the character of the table sirups so largely used in the United States. These sirups are made chiefly from the maple tree, from sorghum, and from sugar cane. These investigations have shown the best methods of procedure in all these cases to secure a product of the highest quality, free from added chemicals. Several bulletins have been published embodying the results of these investigations.

INSECTICIDES.

An elaborate study has been made of the insecticides in use in the United States, in collaboration with the Bureau of Entomology.

These investigations have shown that many of the insecticides offered to our farmers are of little value, and that the price demanded and the value of the goods are not always proportionate. These studies have tended to protect the farmers of the country and secure for them a much better quality of insecticide for the money expended.

CONTRACTS.

In the Contracts Laboratory studies are made of the materials submitted for the Department of Agriculture, and other Departments of the Government which may ask for such studies. The results of these studies are of the greatest practical benefit in securing for the use of the United States Government materials which fully conform to the requirements of the contract and the character of the samples submitted. The extension of this inspection to all materials supplied the United States Government would undoubtedly prove advantageous.

DRUGS AND CHEMICALS.

The importance of pure drugs from the hygienic and remedial standpoint is evident to everyone. Congress has authorized the study by the Bureau of Chemistry of the purity of drugs, their nature, and the sophistications to which they are subject. The Drug Laboratory of the Bureau of Chemistry pursues investigations of this kind, as well as of the purity of chemicals and reagents offered for the use of the Bureau.

COOPERATIVE WORK WITH THE ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS.

The work of the Bureau of Chemistry in connection with the Association of Official Agricultural Chemists of the United States has been of a most useful character. This association is composed of all chemists connected with agricultural colleges, experiment stations, State and municipal boards of health, boards of agriculture, etc.; hence it represents some of the most important activities in connection with agriculture. By act of Congress this association is made the adviser in certain respects of the Department of Agriculture, and this Department has extended its patronage to the association from the beginning, with great mutual benefit, and still greater benefit to the agricultural interests of the country.

CIDER AND WINE INVESTIGATIONS.

It is well understood that the character of ciders, wines, etc., is due to the chemical reactions which take place during the process of fermentation. Special studies have been made by the Bureau of Chemistry of these chemical reactions, especially with relation to cider, and

numerous cultures of yeast, producing specific properties, have been made and distributed.

Careful studies of the wines of this and other countries have also been made which have proved of great practical benefit.

COLLABORATION WITH OTHER DEPARTMENTS.

Under the authority of Congress the Bureau of Chemistry is authorized to collaborate with other Departments which may require its aid. Under this authority work is constantly done for nearly all the Departments of the Government. A large number of investigations has been made for the Treasury Department; also for the War Department, especially for the Commissary-General; for the Interior Department; for the Navy Department; for the Department of Commerce and Labor, and for the Department of Justice.

During the last two or three years the most important of the collaborative work with the Departments is that which has been done in connection with the Post-Office Department. The Postmaster-General submits constantly to the Department of Agriculture for investigation samples of various substances which are intended either to be sent through the mails or advertised in newspapers, magazines, and circulars sent through the mails. Under the law poisonous matters and those which are combustible in character or dangerous to other wares are not allowed to be sent through the mails. Samples of such suspicious bodies are constantly submitted for investigation.

There are continually appearing advertisements of remedies said to possess most remarkable characteristics and to effect marvelous cures. Where such advertisements appear to be fraudulent in character, they are submitted, together with samples of the remedies, to the Bureau of Chemistry. After careful examination of the samples and of the literature reports are made to the Postmaster-General, embodying the results of our investigations and the conclusions based upon them. On these investigations and conclusions the Post-Office Department bases its action in either continuing the use of the mails for the distribution of such advertisements or debarring them from the mails as fraudulent. Much benefit must necessarily come to the people of the country from work of this kind.

BUREAU OF SOILS.

The work of the Bureau of Soils is of such a fundamental character that its results are being more and more widely used, not only by the other Bureaus and Divisions of the Departmental work, but by State agricultural experiment stations and State geological and economic surveys, as a foundation for further work along highly specialized lines. At the same time that the demands upon the Bureau for

additional work are increasing, the facilities for accomplishing this work have remained stationary or, in one case, been decreased.

During the past eighteen months the Soil Survey has lost by transfer to the United States Geological Survey, by assignment to alkali reclamation work within the Bureau of Soils, by the cooperation with other Departments of the United States Government and of the Philippine government, by special detail to educational institutions, and by resignations twenty of its most highly trained and efficient assistants. The Survey force, even with these depletions, mapped over 28,000 square miles during the calendar year 1904. With twenty parties of two men each continuously engaged in field mapping, about 35,000 square miles per annum could be surveyed and mapped.

The Bureau of Soils has on file at the present time requests for the mapping of two hundred and fifteen counties, located in forty States and Territories, and aggregating upward of 150,000 square miles. These requests are supported by 265 organizations and individuals.

Requests are on file either from the directors of experiment stations or from the State geological survey organizations for surveys of all of the areas of several States.

The Soil Survey at the present time is equipped with a force of 29 field men and some of the necessary executive and special assistants. In order that the work of this survey may be kept at its former efficiency, in view of the recent depletions, it becomes necessary to increase the number of field men engaged upon actual survey work to 40 persons, thus allowing the maintenance of 20 parties upon continuous field work. On account of the necessity of providing for resignations, for annual leave of absence, and for necessary sick leave, additional men are needed to keep these field parties constantly at their full efficiency. For this maintenance of the field force at least 12 more men are required for the Soil Survey service. To keep in close touch with all of the work as it is being conducted in the field and in order that the necessary correlations of the soils of one area with those of other areas which are in progress of mapping or have already been mapped may be made, it is necessary to have two inspectors, both highly trained men, appointed from the present Survey force, who will visit each area during the progress of the work and advise the men in regard to all difficulties which can not be solved through correspondence. Through their personal contact with the men the inspectors will keep the field work up to the highest state of efficiency and economy. The places on the Survey thus made vacant would need to be filled by the appointment of two new men at smaller salaries.

The character of the work already accomplished and the broad scope of the problems encountered in the areas already surveyed are

shown by a recapitulation of the work of the Soil Survey from its inception to June 30, 1905. All of the problems encountered in the field require additional research work in the laboratory for their complete solution. This is particularly true of the two great problems of American agriculture which concern, respectively, the arid lands and the humid lands of the United States. The first study concerns the accumulation of soluble salts, known as alkali; the second problem is that of soil fertility, or, as it is sometimes stated, that of "worn-out soils." Both of these problems are being studied by the laboratory force, and the results obtained are published in the form of special bulletins, which summarize the scientific facts discovered, and also in the form of circulars or additions to the Soil Survey reports, in order that the results may be placed in such a form as to constitute a practical working basis for the persons whose farms are concerned. In the same way the Tobacco Investigation work follows and supplements the Soil Survey. Recently arrangements have been made whereby cooperation has been secured with certain agricultural experiment stations and with the Office of Farm Management of the Department of Agriculture. Through this arrangement it is hoped to come into very close touch with all branches of American agricultural activity.

EARLY WORK OF THE SOIL SURVEY.

The first work of the Soil Survey consisted of preliminary studies of the tobacco soils of the United States and of the alkali soils of the Yellowstone Valley. These investigations showed that a field map could be constructed which would represent graphically the classification, occurrence, and distribution of distinctive types of soils. It was also found that in the arid regions of the West a second map should be constructed which would show the amount and character of the alkali, which frequently interferes with crop production or totally prohibits it. It was also found in the case of the arid regions that a map showing the depth to permanently saturated soil was necessary. For this reason, in the conduct of soil surveys in the arid regions, a soil map, an alkali map, and a ground-water map are prepared, whereas in the humid regions the soil map alone is sufficient. Each of these survey maps is accompanied by a report upon the climatic surroundings of the region, its transportation and market facilities, and the special adaptation of different crops to the different soil types, together with an outline of the transportation problems and of such other commercial, economic, and other essential facts as directly influence agricultural welfare and agricultural life.

THE VALUE OF THE SOIL.

The soils of the United States are considered as the greatest natural economic endowment of the American people, far exceeding in the value of their annual products all of the returns secured from mines and fisheries. It is the purpose of the Soil Survey work to outline the most economical method of securing the utmost efficiency in the handling of these soils and in the production of food products from them. The questions involved concern not only the farmers themselves, but also every person interested in labor, commerce, manufacturing, or professional life. The problems are fundamental.

The studies thus far made of the soils of the United States include the survey of 197 separate areas, located in 44 States and Territories. These surveys aggregate 63,621,120 acres, or 99,408 square miles. They have been so distributed as to constitute a study of soil conditions in all the different physical divisions of the United States and for all of the chief staple crops. In addition, the special conditions favoring the production of special crops under intensive methods of agriculture have also been studied.

Surveys of the tobacco soils of the United States have been made in 16 different States. Their results show that the variety of leaf produced is controlled largely by the texture of the soil upon which the crop is raised. Thus, the heavy clay soils produce a thick, gummy leaf, while the lighter sands produce wrapper leaf and bright tobacco.

The soils of the truck-producing regions along the Atlantic and Gulf coasts have been studied from Rhode Island to Texas. It has been found that the Norfolk sand is the best soil for the production of early truck crops in all of the tide-water districts of the eastern coast line. Where market facilities and transportation are favorable the land values upon the Norfolk sand have risen from $5 or $10 per acre under general farming conditions to $100 or $200 per acre for the production of sweet potatoes, early Irish potatoes, melons, small fruits, and small vegetables. The interior truck regions of the Central States have been similarly studied, and in this region the Miami sand has been found to be the type of soil best adapted to truck farming.

The grape soils of the United States have been studied in the Lake Erie region and in California. It has been found that the sandy and gravelly soils adapted to the production of the eastern wine and grape-juice grapes do not furnish a product well suited for shipping, and the production of table grapes for distant markets is best accomplished upon the heavy clay and shale-loam soils of what is known as the Dunkirk series. In the California grape belt of the San Joaquin Valley the alkali problem was found to be serious. The soil-survey

work around Fresno has been followed by alkali reclamation work. It has been shown that with an expenditure of less than $40 per acre soils which have decreased to the value of $20 or $30 per acre for grass and grain production can be restored to their former value of $350 to $700 per acre for grape production.

STUDY OF APPLE SOILS.

The apple industry has been served in two notable instances. The soil survey of the Lyons area in Wayne County, N. Y., was followed by an orchard survey made under the direction of the horticultural department of Cornell University. Thus, a map showing the adaptation of apples to the various soils has been supplemented by a comprehensive bulletin which discusses the question of the varieties to be raised for commercial marketing, the methods of culture and the fertilizer to be employed, questions of storage and shipment, and even the facilities offered by the different domestic and foreign markets. In the same way the great pippin belt of Maryland, Virginia, and North Carolina has been studied. It was found that the profitable production of pippins was confined to a single soil type—the Porters black loam—occurring in the coves and small valleys of the eastern ranges of the Allegheny Mountains. It was also found that not only were the most successful orchards located upon this soil type, but that a distinct climatic belt also existed within which the pippin production was especially favored. On account of differences in latitude this belt descends from higher elevations in the South to lower elevations northward. In Virginia it occurs between altitudes of 1,200 and 3,000 feet.

SOILS ADAPTED TO CITRUS FRUITS.

On the Pacific coast extensive studies have been made of the soils adapted to citrus fruits. Here it has been found that not only the soil played an important part in the location of groves of citrus fruits, but that the alkali problem and the conservation of irrigation water constituted dominating factors. The use of irrigation water containing considerable amounts of soluble salts for the safe irrigation of citrus and pomaceous fruits has been studied in this district. The melon-producing areas around Rockyford, Colo., and Indio, Cal., have been studied and the soils best adapted to the production of high-grade cantaloupes determined. It is found that the fine sandy loams of both regions, under proper irrigation conditions, constitute the best melon soils.

SUGAR-BEET SOILS.

In conjunction with the extension of the sugar-beet industry into eastern areas, it has been found necessary to take up the study not only of eastern sugar-beet soils, but the study of the soils upon which sugar

beets have long been produced to advantage in the irrigated districts. It has been found that the soils best adapted to raising sugar beets in the arid regions are not at all the soils adapted to sugar-beet production under humid conditions. In the former the sandy loams and adobe soils constitute the main sugar-beet producing types. In Wisconsin, Michigan, northern Ohio, and central New York the heavier loams or clay loams well supplied with moisture and still not too stiff to interfere with root development constitute the best soils for this crop. In Michigan and northern Ohio these soils are the Clyde loam, Clyde sandy loam, and Miami black clay loam. All of these are dark in color and contain considerable quantities of partially decayed organic matter. In New York the Miami stony loam and Miami silt loam are the soils upon which the best results are obtained.

ALFALFA SOILS.

The introduction of alfalfa into the Eastern States and its production under humid conditions have necessitated a study of alfalfa soils from New York to Alabama and Texas, and also throughout the central prairie region. While the soil factor is not the only one controlling the introduction of this crop, it has been shown that when other conditions are reasonably favorable the Miami stony loam of the Northeastern States almost invariably gives the best results for alfalfa growing. Similarly, in the Gulf Coast States, when proper drainage can be secured, the Houston black clay or the black "waxy land" of the Cretaceous prairies, as it is locally known, constitutes a soil type upon which alfalfa grows almost spontaneously.

RICE AND SUGAR CANE SOILS.

The rapid development of the rice industry in Louisiana and Texas within the last decade has necessitated a study of the soils of that general region. It has been shown that under the modern conditions of production, with the use of heavy power machinery and under copious irrigation, the heavier silt loams and clay loams of the low-lying Louisiana and Texas prairies are best adapted to this modern industry. The Crowley silt loam, Lake Charles fine sandy loam, and other similar types are the ones upon which this crop is meeting with the greatest success.

The sugar-cane interests have been served by a number of surveys along the Gulf coast. One area of special interest was mapped around the sugar station of the Louisiana Experiment Station. The results obtained upon the soils mapped in this area can readily be applied in connection with the same soil types mapped in the other Gulf coast areas.

While the Soil Survey is thus serving numerous special interests and in a great many instances obtaining new results which are

striking and gratifying, the total value of these is possibly small compared with that which comes from a study of the soils which produce our great staple crops like grass, wheat, corn, oats, and cotton.

IDEAL CORN SOILS.

The study of soil conditions in the great central cereal belt of the United States has demonstrated that three types—the Marshall silt loam, Marshall loam, and the Miami black clay loam—are beyond dispute the ideal corn soils of the central prairie States. The study of the extent and distribution of these three types, whose products dominate one great branch of American agriculture, has led to a better understanding of the conditions which lead to successful corn production. As the studies of corn breeders have led to new inspiration in the plant side of corn production, so the delimitation of these types of soil so admirably adapted to the production of maize will furnish direction for increased specialization in the selection of the best possible soil conditions for corn production.

At the same time it has been shown by the soil surveys that the typical corn soils of the central prairie States are not at all the most desirable corn soils for the northeastern and eastern tide-water States. Owing to greater elevation and a consequent shorter season the corn crop can be matured only upon those soils which are at once well drained, well warmed, and sufficiently retentive of moisture to satisfy the demands of a heavy, rank-growing crop. So in New York and the northeastern States in general the gravelly and stony loams lying below an altitude of 1,500 feet constitute the corn soils.

Again, in the Piedmont and Coastal Plain regions of the southern seaboard States it has been found that another entirely different set of conditions must be met. Corn does not thrive below an altitude of 100 feet, just as it is not successfully cultivated above 1,500 feet. Again, certain climatic peculiarities intervene to alter conditions of production. As a result the heavy loams and clays of the Cecil and Penn series and the heavier loams of the Orangeburg and Norfolk series constitute the soils best adapted to corn culture in these regions.

In addition to these uplands suited to corn production in the Southern States the narrow alluvial bottom lands, frequently subject to overflow, are found to constitute by all means the best corn soils of the region, and only their limited extent and the difficulty of protecting them from destructive inundation prevent these soils from being recognized as among the most desirable of any in the United States for corn production. The problem of the proper protection of these bottom lands, either by watershed forestation or by local levees, constitutes one of the most important problems of local production of provision crops throughout the South.

SOILS ADAPTED TO SPECIAL CROPS.

Several soils of the Northeastern States upon which an unsuccessful attempt is being made at the present time to produce cereal crops actually constitute the best grass lands of the region. This is particularly the case of the Volusia silt loam of northeastern Ohio, northern Pennsylvania, and southern New York. This soil lies at an altitude of 1,300 to 2,000 feet above sea level, and the production of corn is an uncertainty on account of the occurrence of unseasonable frosts. As a result, the farming population of this general district, particularly in the hill lands, is becoming discouraged and disheartened, while the soil with which they are dealing is admirably adapted to the production of grasses, oats, and buckwheat. The abandonment of grain farming and the turning to dairy industry and stock raising, based upon hay and oat production, would seem to be highly desirable throughout this general region.

STUDY OF COTTON SOILS.

A constant study is being made of the cotton soils of the Southern States. These communities have shown wonderful progress both in agriculture and manufacturing during the past decade. The study of soils in the Yazoo and Red River basins of Mississippi and Louisiana has shown ideal soil and climatic conditions for the continued production of maximum cotton crops. The annual overflows naturally enrich the plantations and render the soils subject to this influence of almost inexhaustible fertility. It was pointed out in the Yazoo report that the chief problem of these regions was to secure adequate protection from destructive inundation, while still securing the fertilizing benefits of the overflow waters.

Similarly the Upland cotton regions have been found to present two dominant soil problems. The first is that of preventing the bodily removal of the fertile surface soil through erosion; the second is that of securing such a rotation of crops and use of green manures as will restore the organic matter to soils depleted by long-continued clean cultivation in one crop. Both of these problems can be met and are being met by enterprising farmers in nearly every community where soil surveys have been made. The mere statement of these problems and the accounts given of cases where their solution has been worked out are of inestimable value to the planters whose attention has not formerly been called to the work already done by their own neighbors and by their local authorities.

ARID AND SEMIARID REGIONS.

The introduction of durum wheat into the regions sometimes deficient in rainfall, but not naturally arid, requires a careful investigation of the soils to which this new crop is best adapted. So soon

as the proper soil conditions can be ascertained there is a good prospect that a vast region marked formerly by uncertain harvests can become dependent on a totally new industry adapted to its peculiarities of soils and climate.

The interests of agricultural areas as yet undeveloped have also been served. The new irrigation areas of the arid States are being investigated and maps made which show not only the kinds of soils which exist and their proper crop adaptation, but also the locations of land too alkaline to be of any present value for crop production.

PRACTICAL UTILIZATION OF THE SOIL SURVEYS.

Surveys of single areas of this description have furnished prospective settlers with information which has prevented the unwise investment or total loss of thousands of dollars, in many instances constituting every dollar possessed by the individual. At the same time these settlers have been directed to lands within the same areas where their investments could be made with safety and their new homes established without risk of disappointment. The actual settler has thus been benefited, and new communities have secured advance information which only years of bitter experience would have furnished them under their own undirected efforts.

It will thus be seen that the Soil Survey reports and maps concern not only those engaged in the broad study of economic agriculture and its resources in the United States, but that they are of high value for daily use by a great variety of agricultural and commercial interests. The increase of the use thus made of the maps and reports is evidenced both by the requests received for reports already published and by the requests which are continually being made for additional surveys. It is possible only to enumerate the interests which make these requests. These include canning companies, granges, farmers' clubs, and other agricultural organizations; the leading educational institutions, not only those practically interested in agriculture, but also those which study agriculture as a portion of the economic system of the United States; the geological departments of the leading universities, and botanical, geological, agricultural, forestry, and irrigation surveys. The use of these maps by individual farmers, and particularly home seekers and those desiring to engage in special intensive forms of agriculture, is rapidly increasing. This is shown by the fact that maps of areas which are being developed along new lines of fruit growing, trucking, or market gardening are in great demand by individuals. Thus, Long Island, N. Y., Wayne County, N. Y., Norfolk, Va., and other areas mapped in the older settled States have met with the largest demand for single copies of the report and map of any of the areas published during the last two years.

MAINTENANCE AND RESTORATION OF SOIL FERTILITY.

The study of the main agricultural question of the humid sections—that of maintaining soil fertility, or of restoring lands to their former crop-producing power — has been taken up. It has been found through centuries of experience that there are three chief methods for maintaining the fertility of soils. The first of these—manuring or fertilization—is most generally practiced in the United States; the second method—crop rotation—is also widely practiced, and its importance is becoming thoroughly understood; the third method—that of proper culture or tillage, which would include drainage and irrigation—is of more modern origin, so far as the American people are concerned, and is less thoroughly understood and less widely practiced. A study of the relative values of each of these methods and of the relationship of each to the other must be made in order to meet the requirements of recent growths of agriculture in the United States. The broad areas of virgin soil which formerly existed in the United States invited the most superficial cultivation. Crop rotation was neglected or carried on in a haphazard fashion. Under mismanagement and unwise methods, engendered by long periods of abundant cheap land, the time must sooner or later arrive when the soils do not respond to cultivation with profitable crops. Recourse is then had to some form of fertilizer. This point has already been reached in certain portions of the United States.

NEW METHODS FOR TESTING FERTILIZER REQUIREMENTS.

In order that the restoration of these lands through the application of different manurial and fertilizer compounds may be accomplished most economically, the problems of soil fertility and of soil management have been taken up by the Bureau of Soils. New methods have been devised for testing the fertilizer requirements on each of the principal soil types encountered by the Soil Survey. This method gives results in about six weeks' time which have been found to be practically comparable with the results of plot experiments carried on over longer periods. The new method has been tested against the fertilizer and manurial plots of two leading experiment stations, one in Rhode Island and one in Ohio. The results of these tests have been highly satisfactory, not only to the Bureau of Soils, but also to the directors of the two stations. Letters from them are on file which show their appreciation of this new line of work. In order that the method may be completely tested, work has been arranged for the ensuing year in cooperation with four additional stations.

The parties assigned to this work will study not only the manurial requirements of soils occurring at the stations, but they will also

study the fundamental questions of the principles involved in the maintenance of soil fertility. In addition to this use of the new methods devised in the Bureau laboratories, work is being carried on for the determination of the manurial requirements of each of the principal soil types of the United States as they are encountered in the different areas which are being surveyed. The soils from thirty-nine different localities have already been investigated and a circular giving the results of these investigations has been published in three of these cases. It will thus be possible in connection with each survey to include directions for the fertilization of each of the different soil types encountered, with the reports upon the areas as they are published. It is only natural that investigations into such fundamental problems as those concerning soil fertility and manurial requirements should attract general attention and bring numerous comments from other investigators along the same lines. This has been more pronounced in the fertility studies, because not only the results obtained, but also the viewpoint and even the methods employed, were essentially new. It has been found necessary, in addition to the publication of the usual bulletins and circulars, to meet many of these inquiries by lectures upon the principles of the work and by exposition of its method of operation before the faculties and students of several scientific institutions. As these methods are becoming more thoroughly understood they are being gradually adapted for scientific work along the same lines by investigators who are working outside of the Department of Agriculture.

RECLAMATION OF ALKALI LANDS.

Another of the important problems of American agriculture—that of the control of alkali—chiefly concerns the arid regions of the United States. As a result of the very first survey work in such areas, it became manifest that certain methods should be employed to prevent the accumulation of alkali in irrigated lands and to reclaim those lands which had already been damaged by accumulations of soluble salts. This situation was met in earlier reports by recommendations concerning proper methods to be employed, but it was found that in order to bring this matter convincingly before the people most concerned and to get them to follow the recommendations made, it would be necessary to conduct actual demonstrations; consequently in 1902 the work of the Alkali Reclamation Service was begun upon the Swan tract, near Salt Lake City, Utah. This tract has been thoroughly underdrained, and frequent applications of irrigation water have been made by the method of flooding. After three years this land, which at the inception of the demonstration produced only greasewood and saltbushes, has produced fair crops of wheat and alfalfa. At the expiration of another year this tract should

be completely reclaimed, and in addition should produce good yields of farm crops adapted to the soil and climate.

Similar demonstrations have been undertaken in Montana, Washington, California, and at an additional station in Utah. These demonstrations will be completed in about the same time required for the original Swan tract. This reclamation of alkali land by thorough underdrainage, on account of the expense involved, is adapted only to the reclamation of lands of relatively high value.

TEXAS TOBACCO SOILS.

In Texas the possibilities of certain soils of the Orangeburg series for the production of high-grade filler tobacco have been investigated by field parties with headquarters at Palestine, Anderson County, and with substations in Nacogdoches County and Houston County. Experimental fields aggregating 103 acres have been planted in cooperation with thirty-four different farmers. The entire production of the Texas fields has already been bought by a Chicago firm at a very satisfactory price, and it was bought before the crop was even fermented. It is thus evident that a ready market for the Texas product can be secured.

The people of this general region are totally unskilled in the technical details of the production, curing, and marketing of tobacco. At the same time, the invasion of the boll weevil has rendered the introduction of some crop in addition to cotton highly essential to the welfare of this agricultural community. It is therefore necessary for the Department to maintain these tobacco stations in this region long enough to encourage and advise the individual farmers in firmly establishing this new line of crop production. A great interest is taken in this tobacco work by individuals and business organizations in eastern Texas. The same line of work has been taken up in Alabama, around Marion, with the same general results.

TOBACCO WORK IN OHIO.

In Ohio the Bureau has practically finished its experimental work. The crop grown upon 32 acres in cooperation with eight different farmers in Montgomery County was purchased at very remunerative prices even before it was cut. The work of tobacco fermentation in cooperation with the Ohio tobacco men has been continued. This is the fourth season for this line of work, and practically all of the Ohio packers have now abandoned the old practice of case fermentation, substituting the Bureau method of bulk fermentation. This change has resulted not only in the saving of thousands of dollars formerly lost through imperfect curing and through black rot, but it has also added materially to the profits of all tobacco by a general improvement in the quality of the different crops.

TOBACCO WORK IN VIRGINIA.

Work has been extended in the dark-tobacco districts of Virginia, where tobacco growers were securing very unsatisfactory returns for their labor. A station was established in Appomattox County and a number of experimental plots established upon the Cecil clay. Different methods of fertilization and of handling were tested. The result of a single season's work indicates that the methods introduced by the Bureau of Soils will result in profits on the investment of fertilizer and labor of from 13 to 35½ per cent. These conclusions are drawn from the results of actual field experience. Although only one year's work is concerned it has been clearly shown that by a judicious use of fertilizers and with thorough and proper cultivation it will be possible for the Virginia tobacco raiser to increase his yield and his profits materially.

SHADE-GROWN TOBACCO IN CONNECTICUT.

The work in the Connecticut Valley upon shade-grown wrapper leaf has been continued. The object of this work is to develop a type of tobacco which at the same time is adapted to the soil and climatic conditions of Connecticut and to the market demands. During the year nearly 100 bales of this tobacco have been sold for domestic use. The prices obtained range from 20 cents per pound to $1.75 per pound, with an average of 75½ cents. Eighty-six bales unsuited to the domestic demands were sold for export at prices ranging from 10 to 70 cents per pound, with an average price of 27.8 cents per pound.

MISCELLANEOUS TOBACCO WORK.

The tobacco work of the Bureau of Soils includes the improvement of domestic filler tobacco through the introduction of the Cuban seed-leaf industry into the Southern States and into Ohio; the introduction and supervision of the bulk fermentation process in Ohio; the completion of the experiment for producing a shade-grown wrapper tobacco in Connecticut which will meet trade requirements; improving the fire-cured types of shipping tobacco in Virginia; and it is very desirable that investigations of the same kind should be made in the tobacco districts of New York, Pennsylvania, Maryland, Wisconsin, Kentucky, and Tennessee.

Requests for this work have been received from many farmers, from various tobacco growers' associations, and from a variety of trade interests. The importance of this work is obvious, and the Bureau is prepared to carry on and enlarge this line of work in the future as rapidly as appropriations can be made available.

BUREAU OF ENTOMOLOGY.

The work of the Bureau of Entomology during recent years has greatly increased, and beneficial results have been obtained in many lines of work, while several new and important branches of investigation have been entered upon.

THE MEXICAN COTTON BOLL WEEVIL.

The large-scale experimental work made possible by the emergency appropriation of Congress was carried on to the close of the season of 1904, and was taken up again in the spring of 1905. The territory infested by the boll weevil had unfortunately considerably increased both northward and eastward by the close of the season of 1904, at which time it covered approximately 98,000 square miles in Texas and Louisiana.

EXPERIMENTAL FARMS.

The territory in question probably exhibits as great variation in rainfall, temperature, and other particulars as any area of like size in the United States. Therefore it was necessary to establish fourteen experimental farms, where all sorts of experimental work were carried on. The adaptability of the weevil to new conditions, as has been shown by its having acquired an ability to become perfectly acclimated in the United States, is also witnessed in local variations due to climatic and other conditions. The general cultural method was tested in these various localities, as well as the benefit of planting selected varieties, of fertilization, and of thorough cultivation to accomplish the same result and at the same time to cover the infested squares with earth. Important and suggestive conclusions were reached which will have an important bearing on modifications of the general system.

COOPERATION WITH THE LOUISIANA CROP PEST COMMISSION.

This cooperation was continued and an energetic attempt was made by the State to check the further advance of the weevil. Five experts were placed at the disposal of the State authorities, and were stationed at various points where the progress of the weevil could best be investigated. While the Louisiana authorities did not succeed in checking the advance of the weevil, many important features of the dissemination of the pest have become well known, and the knowledge gained will be of direct benefit to other States which may at any time attempt to prevent invasion by the pest.

It has been known for some time, as pointed out in publications of the Bureau of Entomology, that the late summer and autumnal work of the cotton-leaf caterpillar is detrimental to the progress of the boll

weevil. The early fall destruction of the leaves, when this is at all complete, exposes the boll weevil to the action of the sun, which is inimical to it and deprives it of its food supply. The extensive defoliation of the cotton crop in September and October, 1904, in Texas is in a measure responsible for the late start of the boll weevils in the summer of 1905. In Louisiana this phase of the cotton question is much more marked than in Texas. The cotton caterpillar is present every season, and planters generally poison against it. If the late poisonings are omitted and the caterpillar is allowed to increase, the dense foliage of the cotton plant, which is so abundant in the moist bottom lands of Louisiana, will be done away with and the autumnal ravages of the weevil decidedly checked. In this fact lies possibly a practical measure of considerable importance.

POSSIBILITY OF CONTROLLING THE WEEVIL AT GINS.

It has been evident for some time that gins have been very important factors in disseminating the boll weevil, and during the year this subject has been investigated very carefully. An especially trained expert was employed in this work, and a large number of experiments were carried on with gins in actual operation. Important results were obtained, and a series of recommendations have been sent to all ginners in the infested territory, by the observance of which, and at no very great expense, the danger existing from these establishments may be totally overcome.

INSPECTION OF FARM PRODUCTS QUARANTINED AGAINST BY STATE LAWS.

Nearly all of the cotton-growing States quarantined against certain products of Texas, on account of the danger of introducing the weevil. Some of the rules operating under State laws were too stringent, and at the suggestion of the Bureau they were modified by several States in order to permit the shipment of such products as should be certified by the Bureau as not dangerous.

THE COTTON BOLLWORM.

An investigation of this dangerous insect carried on and concluded within the past few years has resulted in the ascertaining of a complete knowledge of its habits and life history and in the elaboration of a system of treatment which will reduce its ravages in the southern cotton fields to a minimum. The investigation has been concluded and the final report published. The work that is still being carried on with regard to this species is demonstration work undertaken to show cotton planters on a large scale that the recommendations of the Bureau are sound.

THE INTRODUCTION OF BENEFICIAL INSECTS.

Very important results have been gained in the introduction of beneficial insects. One of the most striking of these results is the importation and establishment of the fig-fertilizing insect of south Europe. This was established at Fresno, Cal., with almost immediate results of great interest. A properly planted orchard had existed at that point for some time, but efforts to import the fertilizing insect had failed. As a result of the Department's efforts, the insects were brought over alive and were thoroughly established, enabling, after one year, the production of 10 tons of Smyrna figs of a quality slightly superior to those imported from Europe. The crop has continuously increased, new orchards of Smyrna figs have been set out in parts of California, and a new industry has been established as a result of this importation.

The black scale has for many years been a serious enemy to the citrus and olive crops of California, and although a ladybird enemy of the scale had been imported from Australia, it was efficacious only in certain portions of California, not thriving in other portions where these crops have a great monetary value. After several unsuccessful attempts to establish a parasite, known as *Scutellista cyanea*, from Italy, it was found that this species also inhabits South Africa, and from that point specimens were introduced which at once took hold in California and have multiplied with such rapidity as to prove of enormous benefit to the growers of oranges, lemons, and olives.

The native home of the San Jose scale was found by one of the experts of the Bureau to be northern China, and from that point he secured specimens of a ladybird, known as *Chilocorus similis*, which were brought to Washington, propagated in numbers, and sent out to different portions of the United States infested by the San Jose scale. The insect does not seem to do well in the Northern States, but has become established in the Southern States. It is prolific and will probably maintain itself and become more and more useful every year. The lime, sulphur, and salt wash and other remedies for the San Jose scale, however, have proved so efficient and are so cheap as to be practically universally adopted, and this adoption takes away the possibility of a very rapid multiplication of the imported ladybird.

An interesting antlike insect, known as the "kelep," was discovered in 1904 in Guatemala by an officer of the Bureau of Plant Industry, and was found to be such an important enemy of the cotton boll weevil in that country as to hold it distinctly in check and to permit the cultivation of cotton where otherwise it would be impossible on account of the weevil. Colonies of this insect have been introduced into the United States, and while it is as yet impossible to state

whether it will establish itself and become an important feature in cotton cultivation, it promises good results, and the fact has at least been established that in tropical regions it may be used to very great advantage.

A systematic effort has been begun within the past summer to import the European and Japanese natural enemies of the gypsy moth and the brown-tail moth. The Chief of the Bureau visited Europe and secured very many parasites and sent them to Massachusetts, where they are being cared for. The trip has demonstrated effectually that the natural enemies of these two important insect pests may be easily brought from Europe to the infested territory in the United States, but it is as yet too early to state whether they will establish themselves in such a way as to afford relief. The outlook, however, is hopeful.

THE SENDING OF USEFUL INSECTS ABROAD.

During this period many sendings of important parasitic and predatory insects have been made to foreign countries where it was thought they would be of assistance in warfare against injurious insects. The most striking instance of the value of this work occurred in 1898, when the orange groves of Portugal were threatened with extinction by the ravages of the white scale. The officials of the Portuguese department of agriculture appealed for assistance, and through the cooperation of the State board of horticulture of California specimens of *Novius cardinalis*, the ladybird enemy of the white scale, imported from Australia into California by an employee of the Bureau some years previously, were secured. The Entomologist had these specimens carried in the refrigerating compartment of a steamer to Portugal. The success of the experiment was almost immediate and very great, and the scale was practically annihilated in a little more than a year.

Parasites of American scale insects have been, and are still being, sent to the official entomologists of Italy, France, and other countries, and good results are constantly being secured. No results, however, have as yet proved as striking as those in Portugal, just described.

WORK ON SCALE INSECTS.

Careful investigations have been made into the habits and life histories of very many species of injurious scale insects, and the Bureau has built up what is probably the largest collection of these insects in existence. Its publications on the life histories of these insects are standard, and its especial publications on the San Jose scale are the basis of all of our knowledge of this important pest. The work of the Bureau on remedies for scales has been very extensive, and for the past eight years has formed an important part of

the output of the Bureau. Nearly all of the standard remedies against this class of insects are the result of these labors.

When various foreign governments passed regulations forbidding the importation of American plants and fruits, on account of the danger of introducing the San Jose scale, some of the edicts went too far, and forbade the importation of unpeeled American dried fruits. An important investigation was therefore carried on to determine the effect on the San Jose scale of the different methods in use in this country in drying fruits for exportation. The results showed the unnecessary nature of the foreign regulations, not a single scale having been found which showed the slightest signs of life after drying by any of the processes in use. The result of this investigation was of distinct benefit to dried-fruit exporters, and necessitated the revision of the laws of several foreign countries.

INSECTS INJURIOUS TO FRUIT AND FRUIT TREES.

While scale insects form many of the important enemies of orchards, there are many others which have also been investigated. In 1901 the necessity developed for a careful investigation of the codling moth in the Northwestern States, where it seemed the remedies applied in the East were not effective. It was supposed that the difference in climatic conditions had brought about a change in the life history and habits of the insect which rendered eastern remedies less useful. Consequently a thorough investigation was carried on, which lasted for three years and cleared up all doubtful points in life-history conditions as applied to the Northwest, and resulted in the publication of results which have been of great value to the fruit growers of that region. In the course of this investigation demonstration work was carried on in one of the largest orchards in Idaho, and fruit growers from different parts of Washington, Oregon, and Idaho were invited to inspect the methods and the results. Many did so, and were convinced of the value of the work. Fruit growers in California and other States have written to the Department stating that their operations had been rendered much more profitable as the result of this investigation.

While more or less work against fruit insects has been constantly carried on, an effort has been organized to make a very especial and widespread investigation of this class of pests, and several experts have been assigned to the work, which is now being carried forward on a broad scale.

INSECTS DAMAGING FORESTS.

Beginning with 1899, an investigation of the damage to forests by the work of insects was begun by the Bureau of Entomology in cooperation with the Bureau of Forestry. The importance of these

investigations was immediately recognized, and they have been extended until they form a distinct section of the Bureau's work. Many important results have been reached. In 1902, for example, great loss of pine timber, to an amount of more than 226,000,000 feet (board measure), was found to have resulted in the Black Hills Forest Reserve from the work of a bark beetle mining under the bark of living trees.

An investigation resulted in the discovery of practical methods by which the ravages may be entirely checked. The cost of carrying out the recommendations is not great, and the investigation means not only the saving of threatened loss of forest property valued at many millions of dollars, but also the prevention of the crippling of great mining and commercial enterprises representing many more millions. In the course of this work especial cooperation has been entered into with lumbering companies, manufacturers of wooden articles of trade, importers of exotic woods, and forest rangers, which is rendering the work more efficient and bringing it close to the people directly interested in its results.

INSECTS INJURIOUS TO STORED FOODS.

An extended investigation has been made of insects injurious to stored foods. The full life history of practically every species known has been worked out, extensive experimental work has been carried on with remedies, and a thoroughly practical and efficient system of fighting these insects has been ascertained. The publications of the Bureau on this class of insects have been in great demand among grain and milling men, and the efficacy of the Bureau's recommendations is undoubted. The number of species of insects which infest stored food supplies is very great, and the labor of working out the full life histories has been prolonged and arduous.

INSECTS WHICH CARRY DISEASE.

Special and important studies have been made of certain of the insects known to carry disease, with results of great importance. The publications of the Bureau on the subject of mosquitoes have been in great demand by members of the medical profession, and to a large extent the knowledge we have in this country of the mosquitoes which carry malaria has been due to the work of this Bureau. Important studies have also been made of the yellow-fever mosquito, and the quarantine regulations of the Public Health and Marine-Hospital Service, in the recent yellow-fever emergency, are based on the results of this work. The Bureau was a pioneer in work against mosquitoes, and its constant reiteration of the possibility of controlling mosquitoes has been in a large measure the cause of the large-scale antimosquito work now being carried on.

The Bureau has also paid special attention to the study of the house fly, especially in relation to its agency in the carriage of disease. These studies revealed the very great danger that exists of the carriage of typhoid fever by the house fly and by certain other insects. This investigation is the only one of its kind that has ever been carried on, and its results are considered of great value by the medical profession.

INSECTS AFFECTING LIVE STOCK AND FIELD CROPS.

Studies of the insects affecting live stock have been continued, and new material of value has been published about several of the more important. An investigation into the natural history of the cattle tick is now being carried on, which will have an important bearing on the cattle industry of the South, since upon such an investigation may depend the important question of rotation in pasturage to do away with the so-called Texas, or splenetic, fever.

Careful studies have been made of a number of the principal field-crop enemies of the country, and as a result special bulletins were published on the Hessian fly, on the chinch bug, and on the general subject of insects injurious to grains and grasses.

SILK CULTURE.

In 1902 the Bureau began once more, after an interruption of a number of years, a systematic effort to introduce the culture of the domestic silkworm into the United States, and this effort has continued since that time. Guaranteed eggs were purchased in Italy, mulberry cuttings of best varieties were also purchased abroad, manuals of instruction in the raising of silkworms and in the care of silkworm food plants were issued, and two silk reels purchased in France. Two skilled French reelers were brought over from France, and remained in Washington for some months instructing several American girls in the process of reeling thread from cocoons. The eggs purchased abroad were sent, on application, to all persons in the United States who possessed mulberry trees, upon the leaves of which the worms are fed. Persons not possessing mulberry trees were supplied with cuttings, rooted seedlings, or seed of the mulberry.

Following the instructions given in the manuals, the correspondents of the Department raised their silkworms, harvested their cocoons, and sent them to the Department, for which they were paid the current European prices. The cocoons were then reeled by the Department's employees, and the silk resulting will eventually be sold. This process has been repeated each year. The establishment of commercial filatures in the United States without a guaranteed crop of cocoons is obviously an impossibility. Therefore it has been the aim of the Department to get mulberry trees planted in favorable situations, to educate as many people as possible in the care of the worms,

and, by purchasing the cocoons, to keep its correspondents interested and engaged in the culture until the time comes that the establishment of commercial filatures will be possible. The recent invention of silk reels which greatly reduce the cost of reeling and the establishment of colonies of Italians and others skilled in silk culture at different places in the United States seem to point to the establishment of the industry before long.

WORK IN APICULTURE.

There have been carried on during the period mentioned certain investigations in bee culture which have in the past year become extended and which promise to be of much assistance to the keepers of bees in the United States. The lines of work being carried out are principally in the studies of bee diseases, in the investigation of new forage crops, and in the introduction and establishment of valuable races of bees from other parts of the world.

SAVING FROM INSECT LOSSES RESULTING FROM THE WORK OF THE BUREAU.

Some indication of the cash value of the work outlined should be given.

The boll weevil, which in 1904 caused the destruction of $22,000,000 worth of cotton in Texas, did not prevent, in that year, the production of the largest cotton crop grown in this State, and the very regions where the crop in the earlier years of the invasion of the weevil had been utterly destroyed produced cotton this year in very profitable quantities. The enormous cotton crop of Texas for 1904 affords an evidence of the value of the methods of control elaborated by this Bureau. In the case of the bollworm, which has caused a loss annually of about $12,000,000 throughout the cotton-producing area of the South, the careful experimental field work of this Bureau has shown means of preventing a very large percentage of this loss, and these means of control are being gradually adopted, to the great profit of cotton growers.

The methods of controlling the San Jose scale, the most important pest of the deciduous fruit trees in this country, are so effective that commercial orchard growers no longer fear this scale insect. The proof of the efficiency of these methods and their general exploitation have largely come about within the last eight years, and chiefly as the result of the experimentation conducted by the Bureau of Entomology. The saving effected amounts not only to millions of dollars in value of the fruit product, but also to the very life itself of the trees and the continuance of large commercial orchard enterprises. The cost per tree of this treatment is not heavy, but it is expected that this charge will be still further reduced by the importation of natural enemies of the San Jose scale.

The saving which has already resulted from work against the insect enemies of forests is illustrated by the outcome of the investigation in the infested Black Hills district. Here a loss of more than $10,000,000 worth of timber occurred in a single year. Simple and effective means of preventing repetitions of such losses were discovered.

In the case of stored products, such as cereals, tobacco, and woolen and manufactured goods, the processes of fumigation with bisulphid of carbon and hydrocyanic-acid gas, which have come into general use during the last eight years, are preventing enormous losses every year. The annual loss in stored products is probably fully 5 per cent, which gives the enormous total of $100,000,000, and certainly one-half of this loss can be prevented by the proper use of the fumigants mentioned. These same fumigants are also coming into very common use for the eradication of insect pests in houses and stores, and the saving in this field is already very great.

The lessening of the diseases due to mosquitoes and house flies, such as malaria, typhoid fever, and yellow fever, has been very greatly assisted by the investigations of the breeding habits and means of controlling these pests conducted by the Chief of the Bureau of Entomology. The cash value of such work is almost beyond computation when the stagnation of business enterprises and general commerce which results from epidemics of yellow fever and, to a less extent, of typhoid fever and malaria, is considered. The same is true of insect parasites and disease conveyors affecting domestic animals.

Many other items of equal importance could be added relating to field-crop insects and insect enemies of fruits and other farm and orchard products. In the case of the latter more particularly the benefits resulting from the work of the last eight years have been in continuation and accentuation of work of earlier years, but a good share of the present benefits must be ascribed to the increased effectiveness and knowledge gained by the more recent investigations.

BUREAU OF BIOLOGICAL SURVEY.

The work of the Biological Survey began in 1885, and at first consisted chiefly of the study of the food habits of birds and mammals for the purpose of determining their exact relations to agriculture.

A second line of investigation was soon added, for it was perceived that the distribution areas of indigenous plants and animals were closely correlated with those of cultivated crops. The determination of the boundaries of the natural life zones of the United States and the corresponding crop zones, therefore, became an important division of the work of the Survey.

In 1900, as a result of the passage of certain Federal laws, a third division of the work, that of game protection and introduction, became necessary.

The work of the Survey is now pursued along these three distinct lines.

DETERMINATION OF LIFE ZONES AND CROP ZONES.

Early attempts at agriculture in the United States were necessarily almost wholly experimental, and the particular locality, climate, and conditions suited to special crops were ascertained only after many and costly individual trials. The chief purpose of a biological survey of the several States is to ascertain and make known, by means of maps and reports, the boundaries of the natural life zones, together with the physiographic and climatic conditions that determine them. The life zones of a State once ascertained with precision, the farmer is greatly aided in selecting the crop best adapted to his own district and, what is scarcely less important, in avoiding crops unsuited to it. Thus the uncertainty and cost of farming experiments may be greatly reduced.

In a publication entitled "Life Zones and Crop Zones of the United States" the life zones of the country were defined and mapped, and the adaptation of various crops to the several zones was indicated so far as the data collected to 1898 permitted. Future and more detailed work in the several States will enable the life zones to be defined with greater precision and the selection of crops to be made with great accuracy.

Biological field work in the State of Texas, which was begun in 1899, has been completed and final reports are being prepared. A report already published contains an account of all the mammals and reptiles of the State, with especial reference to their economic status. The life zones of the State are defined and, as a means of identifying them, the mammals, birds, reptiles, and plants characteristic of each zone are specified.

A biological survey of California was begun in 1891 and is far advanced toward completion. Its size, peculiarly diversified surface, its mountains and deserts, and its climatic conditions render California a difficult field for biological surveys, while the varied resources of the State and its immense agricultural interests make the work exceedingly important.

Work in outlining and mapping the life zones of Colorado and New Mexico along lines similar to those indicated above was begun in 1904, and is progressing satisfactorily.

Preliminary work has been carried on in most of the States whose agricultural interests are large, and detailed surveys of the several States will be undertaken as rapidly as means and the exigencies of work already begun permit.

Investigations in Alaska were begun in 1899, when the increase of population and growing commercial importance attracted attention to that Territory. Little accurate information was then available regarding the game and fur-bearing animals which add so largely to the resources of the region. Moreover, important problems connected with the study of the life zones and crop zones of the United States could not be solved satisfactorily without contributive data from more northern regions. An assistant, therefore, has been engaged in field work in Alaska each season since 1898, excepting 1901 and 1905, and the results are found to have an important bearing upon many phases of the work of the Biological Survey. Of particular value has been the direct knowledge of local conditions thus obtained, which is necessary for use in connection with the administration of the Federal game law of Alaska. A part of the results of these investigations has been published in three faunal reports. Other reports of similar nature are in preparation.

From 1900 to 1903 a small party of the Survey was engaged in studying the geographic distribution of birds, mammals, and plants in the Boreal and Arctic zones of Canada, particularly for the purpose of connecting the results of work in Alaska and the home territory by means of investigations in the intervening regions. Part of the results appeared in 1902 under the title "A Biological Investigation of the Hudson Bay Region," and a report upon the work in the Athabasca and Mackenzie valleys is nearly ready for publication.

In 1897 the work of the Survey was extended into Mexico for the purpose of tracing into that country the life zones of the United States, to determine the northern limits of the tropical zone of Mexico, to ascertain its extent within the United States, and to obtain a knowledge of the distribution, abundance, and habits in Mexico of American plants, birds, and mammals. A general zone map of Mexico has been completed, and a large amount of scientific and economic data is on file.

ECONOMIC ORNITHOLOGY.

This section of the Biological Survey is engaged in the study of birds in their various relations to man. Two principal lines of investigation are followed. In the first, the habits of birds are studied in the field, especially with reference to their food. Orchards, gardens, and grain fields are visited in order to determine whether birds damage crops, attack insects, both injurious and beneficial species, and to what extent they feed upon wild fruits and weed seeds. In this field study it is desired to enlist the cooperation of every cultivator of the soil. In the second, stomachs of birds are examined in the laboratory and their contents tabulated. In addition to the stomachs

collected by our own assistants, many are obtained from ornithologists throughout the country. From 1885 to 1897, 24,000 stomachs had been collected, and of these about 12,000 had been examined. Since then stomachs have been received at an average rate of more than 4,000 annually, and the number is constantly increasing from year to year. The total number now on hand is about 66,000.

In 1903 an article was published upon the "Economic Value of the Bobwhite," in which the salient points in the food habits of this valuable bird were brought out. Attention was paid also to birds in their relation to bee culture, as complaints had been made that birds destroy bees.

In 1904 a preliminary article upon the work in California, begun in 1901, was published, in which the conditions attending fruit growing in that State were briefly reviewed and the birds of economic interest were discussed.

The constantly increasing ravages of the cotton boll weevil have created an urgent demand for accurate knowledge of the food habits of insectivorous birds in the cotton districts, and during the past two seasons assistants of the Biological Survey have made a special study of birds in relation to the destruction of the boll weevil. As a result of these investigations a bulletin on the subject has been published, and considerable additional data have been gathered.

ECONOMIC MAMMALOGY.

In connection with the study of the geographic distribution of mammals, field naturalists are instructed to observe particularly the food habits of each species, to secure data concerning their relation to the farmer, whether beneficial or injurious. Many stomachs have been examined and others are now on hand awaiting examination.

During the past eight years experiments in the use of poisons and other means for destroying noxious mammals have been made, both in the laboratory and in the field. Rats, prairie dogs, ground squirrels, rabbits, field mice, and pocket gophers have been the subjects of these experiments.

Special reports on prairie dogs, ground squirrels, pocket gophers, jack rabbits, and coyotes have been published, and investigations concerning these and other mammal pests are being continued. A great mass of notes on the habits of mammals has been accumulated, and reports on the economic relations of field mice, beavers, wolves, and skunks are now in course of preparation.

Experiments with fences to protect sheep and other domestic animals from the depredations of coyotes, dogs, and other predatory animals are in progress in cooperation with farmers in Oklahoma and Kansas.

GAME PROTECTION AND INTRODUCTION.

The duties of the section of the Biological Survey devoted to supervision of game protection and introduction grow out of three acts of Congress: Act of May 25, 1900, commonly known as the Lacey Act, requiring supervision of importations of wild birds and animals from foreign countries and of the preservation of the birds and game of the United States; act of June 3, 1902, requiring supervision of the importation of eggs of game birds; and act of June 7, 1902, requiring supervision of the preservation of the game of Alaska.

ENTRY OF FOREIGN BIRDS AND ANIMALS.

Since the passage of the Lacey Act, May 25, 1900, constant vigilance has been exercised to prevent the entry of injurious species of birds and mammals. The annual importations of birds and animals are large, and include canaries and miscellaneous cage birds, shipped mainly from Germany, Australia, China, and Japan; a few pheasants and other game birds, for liberation or confinement in aviaries, and rare birds and animals for the various zoological parks of the country, brought in chiefly at New York and San Francisco; pheasants for aviaries imported from Canada at ports along the northern border, and parrots and monkeys from Mexico and Central America, entered at southern ports. Inspectors have been appointed at seven of the principal ports to examine all large shipments or such as may possibly contain injurious species.

During the five years ending June 30, 1905, 1,591 permits have been issued for the entry of 1,006,964 birds (principally canaries), 2,846 mammals, and 38 reptiles, and 13 for the entry of 6,500 eggs of game birds. Of the consignments entered 402 have been inspected. To prevent inconvenience in cases where no danger exists, the requirement of permits for reptiles and a number of species of well-known mammals was removed at the end of the first quarter of the operation of the law. So far as is known, no injurious species have been entered. Seven mongooses, 54 flying foxes or fruit-eating bats, 1 kohlmeise, 15 blaumeisen, and 2 starlings have been refused entry, and either killed or reshipped to the original port of shipment. Six keas were refused entry at Honolulu.

INTERSTATE COMMERCE IN GAME.

Through cooperation with the Department of Justice and game officials throughout the United States 166 violations of the Lacey Act, involving the shipment of 24,424 head of game and 2,608 plume birds, have been investigated, and 49 convictions have resulted. Of the convictions 30 were secured in Federal and 19 in State courts. In addition to securing convictions for violations of law, great effort

has been made to secure observance of both the Federal and State laws. Summaries of the principal provisions of the game laws of the United States and Canada have been issued annually and widely distributed, and several publications on special subjects have been prepared.

Aid in framing satisfactory laws has been extended to State officials and legislators; the conditions of illegal traffic in game have been carefully studied and in special cases have received personal investigation, and copious correspondence and many personal interviews have been had with State game officials with a view to securing better legislation and more rigid observance of the laws. To this phase of the Department's duties railroad and express companies have lent cordial and valuable cooperation.

PROTECTION OF GAME IN ALASKA.

Thorough supervision of game protection in Alaska has not been possible because of the limited means available for this purpose. With the cordial cooperation, however, of the Treasury Department, through its customs officials at Port Townsend, Seattle, San Francisco, and various points in Alaska, a rigid surveillance has been maintained of all exports of game trophies and specimens from the Territory. During the three years the law has been in operation 155 permits for such exports have been issued, under which 93 trophies were shipped, including heads of 29 moose, 38 sheep, and 3 caribou, as well as several consignments of specimens for scientific purposes. Owing to expressed local dissatisfaction with the law a bill materially modifying it was introduced into Congress in the session of 1904–5. For this reason it was deemed desirable to further restrict the issue of permits, and very few have been granted during the present year.

BIRD RESERVATIONS.

It is well known that certain favorable localities form breeding places for large colonies of birds. Such localities offer tempting marks to those who gather eggs or plumage for commercial purposes, and if these depredations are unchecked complete extermination of certain species is sure to result. Within the past three years three such breeding grounds have been converted by the President into bird reservations. Pelican Island, a breeding resort for pelicans, off the coast of Florida, was so set apart on March 14, 1903; Breton Island and two smaller islands off the coast of Louisiana, a breeding ground for gulls and terns and a wintering resort for hundreds of thousands of ducks, were reserved on October 4, 1904, and four small islands in Stump Lake, North Dakota, which form a breeding colony for many ducks and other water birds, on March 9, 1905. The Department cooperates in the establishment and regulation of these reservations.

ACCOUNTS AND DISBURSEMENTS.

In this Department the keeping of accounts and disbursement of funds are assigned to the Division of Accounts and Disbursements. The report of the Chief shows the work of the Division to be in good shape. Of the $6,094,540 appropriated by Congress about $800,000 remained unexpended at the close of the fiscal year, but most of this sum was covered by liabilities. The accounts for 1903 have been finally closed, and an unexpended balance for that year of $281,615.16 has been covered into the Treasury.

The estimates for the current fiscal year (1906) amounted to $5,697,810, of which $1,388,490 was for the Weather Bureau. It should be stated that the estimates and appropriations mentioned here do not in any case include the $720,000 annually appropriated for the support of the State Agricultural experiment stations. Congress made small reductions in many of the estimates, but large increases in several others, so that the total appropriations exceed the estimates by $292,880. This increase does not include $190,000 appropriated for continuing the cotton boll weevil investigations, nor $950,000 appropriated for the new Department buildings, which subjects were not included in the Department's estimates. The large apparent increase in appropriations for salaries resulted mainly from the fact that employees formerly paid from " lump-sum " funds have been placed on statutory rolls. The largest actual increase was one of $330,180 in the appropriation for the Forest Service, which resulted chiefly from the transfer of the National forest reserves from the Interior Department to this Department.

DIVISION OF PUBLICATIONS.

THE WORK OF PUBLICATION.

At this time, when the publication work of the Government is the subject of considerable discussion and not a little criticism, it is meet and proper that this branch of the work of this Department should be presented clearly to the public.

DIFFUSION OF INFORMATION AUTHORIZED BY LAW.

In the organic law which created this Department it was made the duty of the head of the Department to diffuse just as much as to acquire information of value to agriculture. While the Secretary is authorized to diffuse this information by all means at his command, the most obvious method, the most economical, the most available, is to put this information in print. Inasmuch as the acquisition of any information of value to agriculture imposes on the Secretary the

duty of making it public, it is obvious that the work of publication must grow with the growth of the Department. Every line of inquiry authorized and undertaken by the Department implies necessarily the publication of results.

GROWTH OF PUBLICATION WORK.

Under the circumstances it is not surprising to find that whereas in 1897 the total number of publications was 424, in 1905 the total number was 1,072, and whereas in 1897 the number of printed pages of original matter was 11,715, in 1905 the number of printed pages of original matter was 20,000. The unavoidable growth of the publication work of the Department has been from the first the subject of my earnest consideration, and every effort has been made toward economy consistent with the duty presented above of making speedily available to the public whatever valuable information has been acquired. The practice has been adopted of restricting the size of the editions as much as possible with a view to preventing the accumulation of undistributed publications, and reprints have been resorted to from time to time in the case of publications for which a continuous demand was found to exist. Especially has this been true of publications of a technical character.

WATCHFULNESS IN THE DISTRIBUTION OF PUBLICATIONS.

Objections have been urged against the publication and distribution by this Department of bulletins of a technical character. The answer to these objections is that many of our publications are unavoidably scientific or technical in their character, being the practical record of scientific investigations by scientific men, the value of whose conclusions must necessarily bear the scrutiny of scientific investigators the world over. The elimination of all scientific terms and language from such reports is impossible. In this connection it is well to call attention to the fact that the average edition of these more technical or scientific publications is about 2,000 copies, and distribution to others than specialists, libraries, and educational institutions is very insignificant. For popular use the great bulk of publications has appeared in the form of inexpensive pamphlets, such as, for instance, the Farmers' Bulletins, which constitute nearly one-half of the total number of publications issued. Every possible care is taken in the distribution of our documents to minimize the waste inseparable from any system of gratuitous distribution.

The permanent lists of the several Bureaus, Divisions, and Offices are kept within as narrow bounds as possible, the policy of the Department being to widely advertise its publications as they appear and confine the distribution almost entirely to persons applying for

them. A fair test of the demand for the Department publications is furnished in the records of the Superintendent of Documents, from whom the publications of the Department may be obtained by purchase. This official reports the sale during the year 1905 of 68,000 Government publications, of which more than 38,000 were publications of this Department.

FARMERS' BULLETINS.

Of the Farmers' Bulletins there were distributed upon the orders of Senators, Representatives, and Delegates in Congress 4,782,643 copies during the past year. Unlike the Yearbook and other publications of the Department especially ordered by Congress, the Farmers' Bulletins are not delivered to the folding rooms of the Senate and House, subject to the order of members, but are held in this Department and are distributed mainly under addressed franks furnished by them. Moreover, under the law providing for this class of publications, all those remaining on hand of the 80 per cent provided for the use of Congress revert to the Department and are thus made available for redistribution.

One feature of the Congressional distribution deserves to be specially noted, and that is that the proportion of Senators, Representatives, and Delegates failing to use their quotas is very much less than heretofore. The fact that the number of Farmers' Bulletins left over from the 1st of July last was less than the year previous by over a million copies has resulted in a reduction of the Congressional quota of the current year from 15,000 to 14,000 copies.

THE YEARBOOK.

The Yearbook of the Department is published annually in an edition of 500,000 copies, as provided by the act governing the public printing and binding approved January 12, 1895. Of this enormous edition, however, but 30,000 copies are placed at the disposal of the Secretary of Agriculture, and of this number 27,000 or 28,000 are reserved and sent to active correspondents who have in some way earned, by actual services rendered, a right to such recognition, leaving the number in the hands of the Secretary for miscellaneous distribution but about 2,000. It may be stated here that the total number reserved for the Department, namely, 30,000, is just the same as it was twenty years ago, when the total edition was 300,000. Of the 200,000 additional copies printed since then not a single copy finds its way to the Department itself, and every business day of the year scores of letters are written by the Department explaining to applicants, including even those who have certain claims upon the Department, our inability to supply them with the Yearbook;

this notwithstanding that, as has been recently shown, thousands of copies remain stored in the folding rooms of the Senate and House undistributed and unavailable—a condition of things, however, which it is obvious the head of this Department is powerless to affect. Investigation would probably show that a similar condition exists in regard to many other of the publications printed by order of Congress and reserving a considerable quota for Congressional use.

A FRUITFUL SOURCE OF EXTRAVAGANCE.

The provision of the law already cited, which limits to an edition of 1,000 copies all publications of this Department exceeding in size 100 octavo pages, has proved a fruitful source of extravagance. While designed, undoubtedly, merely to effect the limitation of our publications to small-sized pamphlets, a limitation which it has been the general policy of the Department to encourage, the actual effect has been to compel application to Congress for a larger edition, such action almost invariably involving provision for several thousand copies for the use of members, and this even in cases such as the Beet Sugar Reports, where only a minority of the members was interested in the subject. Some of these publications have been printed and reprinted by order of Congress, such as the Report on the Diseases of the Horse, and the Report on Diseases of Cattle, and others, the total editions in some cases aggregating hundreds of thousands of copies, where no application for such provision was ever made by this Department, and in many cases where no provision was made for a single copy for the use of the Department.

From the foregoing it is obvious that in the matter of printing this Department occupies a unique position, it being the Department's special duty to print, and to print abundantly; that in the aggregate nearly one-half of all the copies of its publications are issued subject to the order of Senators and Representatives; that economy is practiced both as to style of publication and in the manner of distribution; that a determined effort is made to restrict the number of copies of the publications of the Department to the actual demand existing for them.

The total number of documents distributed was 12,089,653 copies, the actual mailing, correspondence, and clerical work in connection therewith involving work of considerable magnitude and difficulty. It is gratifying to report, however, that the distribution has been unusually prompt, the average length of time required in filling miscellaneous requests for publications having been reduced to an average of two days. This result has been rendered possible largely owing to increased facilities and improved service.

DEMAND FOR PUBLICATIONS FROM EDUCATIONAL INSTITUTIONS.

Unfortunately, under the limitations imposed upon the Department either by the printing law or the available appropriations, the actual demand for publications is far beyond our ability to supply. A very large proportion of the correspondence of the Division of Publications consists of letters explaining our refusal to comply with what seem to be perfectly reasonable requests for Department publications. One feature of this demand deserves special notice. Of late years the demand made upon us for publications in bulk for class work in institutions of learning, for use at farmers' institutes, and from others of the very numerous and rapidly increasing agencies seeking to promote agricultural education has multiplied tenfold. While this is a most encouraging feature from an educational and sociological point of view, it is truly discouraging to be able to meet only a very small proportion of these demands, and rarely to be able to comply with any of them in their entirety. It is of no use to allege the existence in large numbers of undistributed publications of this Department in the folding rooms of the Senate and House, this supply being entirely beyond the reach of the Department, and serving only, as its existence is reported from time to time in the public press, to stimulate demands upon the Department and to make more difficult to the minds of many applicants our explanations of inability to satisfy their requests.

REPORT TO JOINT COMMITTEE ON PRINTING.

This Department furnished to the chairman of the Joint Committee on Printing of the Senate and House of Representatives a statement showing the publications issued by this Department during the fourteen years ended June 30, 1905, giving the number of copies of each edition printed, the cost of each publication, the manner of distribution, and the number of copies on hand July 1, accompanied by replies to the several interrogatories contained in the request for the information furnished, together with certain recommendations in regard to the public printing and binding.

BUREAU OF STATISTICS.

THE DEVELOPMENT OF THE BUREAU.

The statistical work of the Department of Agriculture, begun in 1862, has developed into wide use in serving as a basis in establishing prices of farm products. The relations and mutual interests of agriculture, commerce, and manufactures, and of consumers of farm products, are now so vast and so complex that the necessity of issuing impartial crop reports by this Bureau is generally recognized. The needs of all interests require that there be published at frequent

intervals during the crop season by a disinterested agency reliable information of the acreage, condition, production, and value of the principal crops, also reports of live stock, by States and by total crop areas, to serve as a legitimate basis for current prices. When this work was begun the value of farms and farm equipment was about $7,000,000,000; now it has reached nearly three times that amount. Of the $5,000,000,000 worth of annual farm products a much larger per cent than formerly is sold off the farm and enters commerce and manufactures.

The industries depending on agriculture have grown to vast proportions, and not only manufactures, but transportation and mercantile business are in more sensitive touch with the products the farmer can sell and with his power to purchase than ever before. Trade has become vastly more complex, partly owing to the rapid development of reselling on close margins to take advantage of fluctuations in prices, and of dealing in futures and in options. The development of organizations to fix prices and of other organizations to force temporary changes in prices, giving unnatural advantages to price manipulators, has led the public more and more to recognize the need for a strong and impartial agency to make comprehensive reports of actual facts relating to prospective crops and yields, that all concerned may know how to buy and sell.

THREE CLASSES OF CROP REPORTS.

There are three classes of statistical reports of agricultural products prepared by the Federal Government.

(1) The census of agriculture, issued every tenth year by the Census Bureau of the Department of Commerce and Labor, giving a census count of all acreages and yields of crops and reports concerning farm animals, the last census having given the figures collected in 1900 of the crops and live stock for 1899. The reports of the Census Bureau, coming out one year in ten, after the crop of that year is harvested and sold, serve only as a basis and a check, making it possible for the Bureau of Statistics of this Department during the succeeding ten years to more accurately estimate amounts of crops in prospect or amounts actually harvested. The reports of this Bureau could be made more accurate if an agricultural census were taken every five years instead of every ten, providing bases of comparison not so far removed.

(2) The monthly and annual reports by the Bureau of statistics of agriculture, giving acreage, condition, yields, and prices of crops, and reports of live stock, serve as bases for current prices.

(3) These monthly reports, expressed numerically for entire crop areas, serve also as bases for more frequent reports of changed conditions caused by marked weather changes as reported by the Weather Bureau of this Department.

CONDITIONS GOVERNING THE MAKING OF CROP REPORTS.

Various conditions govern the making of reports which influence the prices of farm products. Government crop reports deal mainly with products which are not quickly perishable. The prices of these are fixed at frequent intervals—often daily—by large market organizations, which gather information from the entire area as to the probable amount of products available, positions of any of the products on the routes of commercial movement, and the demand for the products. About these markets there are agencies which may combine to raise or lower prices artificially and temporarily, often so manipulating the prices as to destroy the needed confidence in merchandising the products, and resulting in unwarrantably large "handling charges" from the time the products leave the producer till they reach the consumer.

The producer should have as good a central crop-reporting agency as the buyer. Since his business is divided into many small noncooperative units, he can not have this without Government aid. The manufacturer, the dealer in actual products, and the consumer also need protection from the speculative manipulation of agencies organized to modify prices temporarily for their own advantage, and the main purpose of crop reports is that the whole people may be benefited by a knowledge of the actual facts which may influence current prices.

A knowledge which covers only parts of the area of a given crop may be misleading, because to judge for the entire area from conditions in some localities may give wrong results; hence the producer and others interested need a knowledge of the crop of the entire area expressed as a total. Reports covering part of an area, or covering the area definitely only in parts, may be used by self-interested crop reporting agencies to mislead. The reporting agency, in order to enable those interested as producers, consumers, or dealers to recognize the conditions in the entire crop area, must resolve all the facts into quantitative statements, preferably a single numerical statement, as of yield for the entire area, and the market must then resolve the balances between supply and demand into current prices. Only by "weighting" reports from each district, that is, by giving to each partial report only that arithmetical weight which the acreage in the area covered by the partial report demands and assembling the whole into one statement, can the crop estimator accurately report for the whole area. Such definite forms of statement have the advantage of placing the reporting agency under responsibility to attain accuracy, also of being easily interpreted by all parties; and they are capable of comparison from month to month or from year to year or with averages, as for the previous ten years.

The Bureau of Statistics, acting as a disinterested agency, has assumed the task of keeping the farmers, the dealers, and the users of farm products informed, and the general acceptance of its estimates in deciding prices is the only proof needed to establish the reasonable accuracy of these estimates. Its reports of conditions and its estimates used by markets in establishing current prices have become a necessary part of our domestic trade and our foreign business. These monthly reports serve as guides to all intermediate reports from whatever source, which without this monthly basis would be too local and partial to be of much value, and enable producers to know the facts as to the promise of prices for their crops, that false reports—which were common before the Government arranged to give the facts as nearly as they could be ascertained—may not mislead them into early sales at prices purposely made too low.

METHODS OF CROP REPORTING.

The Bureau of Statistics issues each month detailed reports relating to agricultural conditions throughout the United States, the data upon which these statements are based being obtained through a special field service, a corps of State statistical agents, and through a very large body of voluntary correspondents composed of the following classes: County correspondents, township correspondents, individual farmers, and special cotton correspondents.

A special field service is composed of ten traveling agents, each assigned to report for a given group of States. These are especially qualified by statistical training and practical knowledge of the crops. They systematically travel over the districts assigned them, carefully note the development of each crop, and keep in close touch with best-informed opinion; and they render written and telegraphic reports monthly and at such other times as required.

The State statistical agents are paid agents located in 43 of the States. Each of these reports for his State and maintains a corps of correspondents entirely independent of those reporting directly to the Department at Washington. These State statistical aids report each month directly to the State agent on schedules furnished them. Their reports are then tabulated and weighted according to the relative yield or area of the given crop in each county represented, and are summarized for the use of the State agent. Then he coordinates and analyzes them in the light of his own knowledge of conditions derived from personal observation and other sources, and prepares his monthly and other written and telegraphic reports to the Department.

There are in the United States approximately 2,700 counties of agricultural importance. In each of these counties the Department has a county correspondent, who maintains an organization of several assistants. These county correspondents are selected with especial

reference to their qualifications, and constitute an efficient branch of the crop-reporting service. They make the county the geographical unit of their reports, and after obtaining data each month from their assistants and supplementing this with information obtained from their own observation and knowledge they report directly to the Department at Washington.

In the townships and voting precincts in the United States in which farming operations are extensively carried on the Department has township correspondents, who make the township or precinct the basis of the reports which they send directly to the Bureau of Statistics each month

Finally, at the end of the growing season a large number of individual farmers and planters report on the results of their own individual farming operations during the year.

With regard to cotton, the information secured from all the foregoing sources is supplemented by that furnished by special cotton correspondents, embracing a large number of persons intimately concerned in the cotton industry.

SCOPE OF CROP REPORTS.

Eleven reports on the principal crops are received yearly from each of the special field agents, State statistical agents, county correspondents, and township correspondents, and one report relating to the acreage and production of general crops is received during the year from individual farmers.

Six special cotton reports are received during the growing season from the special field agents, from the State statistical agents, from the county correspondents, and from township correspondents; and the first and last of these reports are supplemented by returns from individual farmers, special correspondents, and a list of cotton ginners supplied through the courtesy of the Census Bureau, Department of Commerce and Labor.

HANDLING THE CROP REPORTS.

It has been found necessary during the past year to thoroughly recast our methods of handling the crop reports. A gross breach of trust on the part of one of the responsible employees of the Bureau of Statistics, involving the misuse for private gain of the confidential reports to which this person had access, revealed a weak link in the chain. An entirely new method of handling the reports was devised, which it is believed makes it practically impossible for such a breach of confidence to occur in the future.

In the case referred to the prompt dismissal of the culpable official was followed by the submission to the Department of Justice of the

whole matter, with a view to the prosecution of the guilty party or parties. It has thus passed beyond the jurisdiction of this Department. It is hoped that the law will be found adequate to reach this class of offenders.

This Department acted with vigor and dispatch when it got evidence of wrongdoing on the part of its own officials, but we have no evidence of disciplinary or preventive action at the traders' end of the line, where gamblers interested neither in production nor consumption disturb values to the injury of both, and make loud outcry when creatures of their own kind corrupt officials to betray confidence for the love of money. The responsibility for this "leak" is shared by everyone who, to get money without work, gambles in farm products. When this form of industry ceases these parasites who tempt Department officials will have to work for their bread.

METHOD OF PREPARING REPORTS.

For the purpose of checking up the results of the several sources of information and reducing the possibility of error to a minimum, the final results are made up by a crop-reporting board composed of the Chief Statistician or Chief of the Bureau of Statistics, as chairman, and four individual members, selected from statisticians and officials in the Bureau and members of the special field service called to Washington on report days for that purpose. Thus the plan is to select this board of four members each report day from an available corps of six or eight men well trained and thoroughly informed as to crop conditions and as to the relative value and correctness of the reports from the different corps of correspondents. This board, with several expert computers, meets on report days in the office of the Statistician under the personal supervision of the Secretary or the Assistant Secretary.

After the assembling of the board all reports by States from the several distinct corps of correspondents are brought together in convenient form in parallel columns on final tabulation slips, and the board is thus provided with several separate estimates covering the same territory and the same crops, made by the respective corps of correspondents, each reporting for a territory with which he is thoroughly familiar. There are also prepared for the board abstracts of the reports on each crop by States from the weekly weather-crop bulletins of the Weather Bureau, issued during the month. With all these data before them each individual member of the board computes separately his own estimate of each crop by States. These reports are then compared and discussed by the board under the supervision of the chairman, and the final figures by States are decided upon. It is interesting to remark how often the reports from the different corps of correspondents are very nearly identical and how often the final figures arrived at by the individual members of the board agree with

each other. These State estimates, which are in percentages, are then multiplied into the acreages for their respective States. The sum of these products is divided by the sum of the acreages giving the percentage for the entire crop for the United States.

METHOD OF ISSUING REPORTS.

Reports in relation to cotton thus prepared by the crop-reporting board are issued on the 3d of each month during the growing season, and reports relating to the principal farm crops and live stock are prepared and made public on the 10th day of each month. In order that the information contained in these reports may be made available simultaneously throughout the entire United States, and that one part of the country may not have the advantage over another, they are simultaneously handed, at a given hour—as at 12 o'clock noon or 4 o'clock p. m.—on report days, to all applicants and to the Western Union Telegraph Company and the Postal Telegraph Cable Company for transmission to the exchanges and to the press. A mimeograph statement also containing such estimates of condition or actual production, together with the corresponding estimates of former years, for comparative purposes, is prepared and sent to a mailing list of exchanges, newspaper publications, and individuals. The same afternoon printed cards containing the essential facts concerning the most important crops of the report are mailed to the 77,000 post-offices throughout the United States for public display, thus placing the most available information within the farmers' immediate reach.

Promptly after the issuing of the report it, together with other statistical information of value to the farmer and the country at large, is published in the "Crop Reporter," an eight-page publication of the Bureau of Statistics, under the authority of the Secretary of Agriculture. An edition of over 100,000 of this Reporter is distributed to the correspondents and other interested parties throughout the United States each month.

CHANGE IN METHODS.

A very great improvement has been made in the special field service by districting the United States and assigning each of the field agents to a definite group of States, which they thoroughly travel over and report on each month. The cotton-producing States have thus been redistricted and the service augmented and perfected there by the appointment of two new agents, men widely recognized as having a thorough knowledge of conditions and of the highest ability and integrity. A special agent has also been appointed for the collection of statistics of tobacco and has entered upon his duties of supplementing the reports from the Bureau correspondents by actual observation in the field. The work of the State statistical agents also is being improved.

Working in harmony and cooperation with the Census Bureau of the Department of Commerce and Labor, the compilation of statistics of the commercial cotton crop has been transferred to the Census Office.

The resignation of Mr. John Hyde as Statistician was accepted, and pending the permanent appointment of a successor to that important office Assistant Secretary Hays was directed to take charge of the Bureau.

FOREIGN MARKETS.

Required by law to collect and disseminate information concerning the exporting of the surplus of farm and forest above the requirements of domestic consumption, and concerning the preparation of such products to meet the special requirements of the various foreign markets, the Division of Foreign Markets of this Bureau has been of much service to the producers and the handlers of the agricultural surplus of this country.

DETAILS OF EXPORTS AND IMPORTS.

The base of the work done is necessarily the assembling and suitable treatment of the statistics of the foreign trade of this country in the products of farm and forest, and this work has been done in the most comprehensive way and with all available detail.

During the past eight years special examination has been given to certain classes of exports. The increasing restrictions of importing countries against the admittance of packing-house products and live meat animals have impelled cattle growing and slaughtering interests to request the aid of this Division; and in partial compliance with this request a complete statement has been prepared to show the extent and directions of this export trade during the last fifteen years.

So many inquiries have been received concerning various features of the exports of agricultural products during a long period of years that a report has been prepared and published covering the exports as far back as 1851.

Closely related to the disposal of the agricultural surplus is the subject of agricultural imports, and all necessary consideration has been given to this subject, besides utilizing current information. A compilation has been completed covering the last half century of these imports.

Within the last three years more particular attention has been given to the trade of the United States proper with its noncontiguous possessions, in the products of farm and forest.

BALANCE OF TRADE.

A new feature of the examination of statistics of exports and imports of agricultural products is the presentation of the foreign

balance of trade in these products for a long series of years. This had not been done by any public office or private individual, and the importance of the matter at once appeared when it was discovered that the great balances of trade in favor of this country have been mostly, if not entirely, because of the products of the farm, which have often been called upon to offset adverse balances in manufactures.

FOREST PRODUCTS.

Particular attention was devoted three years ago to the foreign trade of this country in forest products, and this subject has been one in which current information has since been especially utilized. Statistics in detail of the entire foreign trade in forest products, including both exports and imports, have been compiled for a period of half a century.

EXAMINATION OF COMPETING COUNTRIES.

One of the most useful lines of investigation in behalf of exporters has been an examination of the conditions found in countries which have a surplus in certain agricultural products which meet those of this country in common markets.

General agricultural and industrial conditions have been the subjects of inquiry with regard to Norway, Sweden, Denmark, Spain, Scandinavia, Porto Rico, and the Philippine Islands during the past eight years.

A somewhat allied and more useful and important work has been undertaken with the object of ascertaining in detail the quantities and values of all the agricultural imports of the countries which receive a large share of such imports from the United States, as, for instance, the United Kingdom, Germany, and the Netherlands.

WHEAT AS A WORLD PROBLEM.

Besides such investigations as the foregoing of general trade competition in certain markets, special investigations have been conducted concerning particular products. Wheat is one of these. A special agent of the Department spent over a year in Argentina collecting information concerning the production and marketing of wheat, among other subjects of inquiry.

Wheat again has afforded a special study of its production and prospects in Russia; and, as an important part of the cereal problem of the world, compendious facts concerning the production of cereals in principal European countries have undergone suitable assimilation for public uses.

Sugar is another product of international concern, and information covering the more important economic features of both beet and cane sugar production has received a clear and ample, although compact, presentation in a bulletin prepared in this Division.

PROBLEMS OF COTTON COMPETITION.

Within very recent years no agricultural product has given to the world as great a problem as cotton, and on this account cotton production, actual and potential, in all of the countries where such production is possible, has received a searching examination. The inquiries made with regard to prospective cotton-growing competition have not so far discovered that it has any reasonable immediate prospects, but rather indicates that if such competition is to arise it will be in consequence of years of effort and development. Besides this, it appears that nearly all regions where new production is attempted for commercial purposes produce a cotton like the Egyptian.

DAIRY PRODUCTS.

The low position occupied by the dairy products of this country in principal European markets has excited comment, and the weakness of their representation in foreign trade statistics has led to a special examination of this subject by an agent who has spent several years in England.

PACKING-HOUSE EXPORTS.

In connection with other work done in the interests of cattle growers and meat packers, particular attention has recently been given to all of the principal countries of the world which have a surplus of these products of the farm or ranch for export.

The principal countries of Europe that import packing-house products have afforded a field for a full investigation concerning the kinds, quantities, and values of such products as enter these countries, together with sources of such imports among the various exporting countries of the world.

TARIFF LIMITATIONS.

In every consideration of an export problem it may be and often is essential that the foreign tariff shall be ascertained and made understandable to the public. Work of this sort has been carried on during the past few years upon a large scale and has embraced the translation and elucidation of all the tariffs of the world governing the importation of packing-house products, of grain and grain products, and of fruits and nuts. A more particular study has been given to packing-house products than to any other.

TRANSPORTATION OF EXPORTS.

Transportation is a prominent subject with which the attention of this Division has been occupied within half a dozen years. The object is to provide the public with useful information concerning the routes over which the surplus products of the farm go to ports for transportation by water to foreign markets; to explain the methods by

which shipments are made; to make known the equipment of the various ports for handling export business; to ascertain and make known the rates charged by railroads for moving freight of this sort; and also to ascertain for the service of exporters what lines of steamships are in regular operation, to what ports they carry freight, and what the charges are for various descriptions of farm products.

RESIDENT LONDON AGENT.

This Department maintains a special agent in London for the purpose of being in closer touch with Old World markets and information, and has done so for the past four years. Besides reporting the crop news of other countries he is engaged from time to time upon special inquiries which are of practical concern to producers and exporters in this country.

GROWING SPECIAL SERVICES.

Along with numerous special lines of work carried on and developed within the Bureau has grown a correspondence with persons in all parts of this country who are in pursuit of special information, and in this way a public service has developed which has assumed proportions of considerable size and of increasing utility.

THE LIBRARY.

For the advancement of work in the Department all important publications relating to agriculture and to the sciences upon which it is based are necessary. General treatises, technical monographs, and new scientific periodicals must be available as laboratory tools for the up-to-date investigators in agricultural science. Over 4,000 such books and pamphlets, including publications of scientific societies, have been added to the Department library during the past year. This growth has been steadily maintained for the past ten years, resulting in a collection of works relative to agriculture, agricultural education and research, as well as the kindred sciences, not elsewhere to be found in the country. The collections of works relating to special sciences such as economic entomology, zoology, veterinary science, and botany are of exceptional excellence, both as to size and the number of valuable books of early and late dates.

To facilitate the use of this valuable material, card catalogues, reference lists, and bulletins are maintained and kept as nearly up-to-date as possible.

The present quarters are inadequate for housing this collection of 87,000 books and pamphlets and insufficient in the accommodations for readers and the staff in charge of these books. In addition to space for this valuable possession of the Department, the protection of a fireproof building is most urgent. Such protection, however, will soon be provided by the new Department building.

The resources of the Library are not only made available to scientists at a distance through the system of interlibrary loans, whenever it is possible to do so without interference with the work of the Department, but information is also constantly forwarded in response to letters from all parts of the country. The reference work of the Library has more than doubled in this direction during the past two years as the facilities for meeting the demands have increased.

The publication of a quarterly bulletin of accessions, which is a representative list of current agricultural literature, and of the index cards to the Department publications has been continued. The latter publication, numbering upward of five thousand cards, is of especial value to agricultural colleges, experiment stations, public libraries, and libraries of institutions receiving the Department publications. These cards furnish a permanent index which can be incorporated with the public card catalogue of any library.

The wide distribution of our publications, especially to institutions and scientific societies in this country and abroad and to foreign governments, has resulted in the receipt of a very large number of transactions, periodicals, and foreign documents, which have added much valuable material to the files of periodicals and other serials in the Library. India, Japan, Australia, and Africa, together with other less remote countries, have generously contributed reports of their work in agriculture in exchange for the printed results of work done by the Department. The foreign mailing lists of the Department being in charge of the Librarian, a system of exchanges is thus maintained which is of great benefit to the Library.

OFFICE OF PUBLIC ROADS.

Probably no field of work is of greater interest to the public at large than the improvement of our highways. The Office of Public Roads, as now constituted, represents a distinct stage in the development of the work undertaken by the Federal Government in 1893 by the establishment of the Office of Road Inquiry. At the time of the establishment of the Office, the lack of a knowleage of existing conditions was a serious hindrance to an intelligent application of any plan for road improvement. The name originally chosen for the Office was suggestive of the purpose of Congress, which was to inquire into systems of road management throughout the United States, and into methods of road making, and to disseminate information as to the results of such inquiries.

The most important result which has been attained up to this time, whether produced by influence in or outside of the Office of Public Road Inquiries, is that the people in all parts of the country are now interested in the subject of road improvement, and are seeking such information as will enable them to carry on the work along intelligent

lines. It was found, therefore, that the collection of information must of necessity become only one feature of the work of the Office, and that facilities must be provided for answering as well as awakening inquiries. At the same time the necessity for demonstrating scientific and economical methods of road construction instead of mere agitation has been clearly established.

EXPERT ADVICE AND OBJECT-LESSON ROAD WORK.

The work of the Office is primarily educational in character. Its province is to detail engineers and experts to give information and advice. Whenever there is any question as to what road material is best suited for the local conditions, samples of all the available materials may be sent to the laboratory of the Office, where tests will be made to determine the selection of the best material. In the majority of cases the detail of an engineer or expert to make a preliminary investigation and give advice is all that is required. There are, however, communities where it has been found advisable to supplement advice by a practical demonstration of effective road building.

OBJECT-LESSON ROADS.

To meet this need the object-lesson method was adopted on the following plan: A section of road is selected for improvement, and after the proper surveys and estimates have been made by an engineer of the Office, expert foremen and machinery operators are sent out in charge of modern road-building machinery, and the local officials are taught by actual demonstration every step in the proper construction of a road. Absolutely no expense is incurred by the Federal Government in this work except for the salaries and expenses of the Government employees, the local communities being required to furnish the right of way, all common labor, teams, materials, etc., used in the work.

The total number of experimental and object-lesson roads built under the direction of the Office since its organization is 96, with a total length of about 39 miles. The roads were built in 28 States, the materials used in construction being shells, gravel, brick, oil, tar, sand-clay, marl, stone, burned clay, slag, and steel track.

Four complete road-building outfits were placed in the field at the beginning of the past fiscal year, and their work has continued without interruption. Twenty-one sections of road have been built during the year in nine States, the total length being a little over 9 miles. In the construction of these roads a variety of materials was used, such as stone, shale, burnt clay, sand-clay, shells, gravel, and marl. The detailed reports submitted by the engineers in charge of work show a maximum cost of 98 cents and an average cost of 55 cents per square yard for macadam roads, while the average cost of sand-clay roads is

shown to be $9\frac{1}{2}$ cents. The only burnt clay road constructed was built at a cost of 20 cents per square yard.

In the work done under Government direction there was of necessity a great variation in cost on account of the difference in cost of labor and teaming, amount of grading required, length of haul, and general efficiency of labor.

Since the passage of the act of Congress approved March 3, 1905, creating the Office of Public Roads, steps have been taken to place the field work on a more systematic and businesslike basis than heretofore. This has been to some extent accomplished by increasing the force of engineers and experts and decreasing the number of men detailed as public speakers and lecturers.

A circular of instruction defining object-lesson road work and expert advice within the meaning of the act of Congress, and setting forth the terms under which this Office is prepared to grant assistance is sent out in answer to inquiries on the subject. A blank form of application for expert advice and assistance has been prepared, which is required in every instance to be filled out and signed by the local authorities.

The construction work is at present under the management of trained engineers, who are assisted by experts qualified to operate all road-building machinery. When an object-lesson or experimental road is to be built, complete surveys, plans, specifications, and estimates are prepared and the fullest preliminary information is obtained.

As far as practicable itineraries are made up for each party in the field, covering a considerable period of time, in order that the greatest amount of work may be accomplished with the least expenditure of time and money. The work is planned so that it may be carried on in the North in summer and in the South in winter, thus avoiding interruption as much as possible.

There appears to be a growing need for the construction and maintenance of roads in the forest reserves. In view of the fact that the Office is maintaining a gradually increasing corps of competent highway engineers and experts, it would seem to be a wise arrangement to utilize the services of these men, wherever practicable, in the construction and maintenance of roads in the forest reserves and other areas which are now or which may hereafter come under Government control.

Heretofore machinery has been borrowed from the manufacturers who have been willing to lend it for the construction of the object-lesson roads. Transportation for men and machinery has usually been secured free of charge from the railroad companies, who have generally shown themselves ready to cooperate on the ground that improved highways directly benefit them. The practice of borrowing machinery and of depending upon free transportation is not, however,

the best policy. Gratuitous assistance inevitably tends to hamper that freedom of action on the part of the beneficiary which is essential to the proper performance of the work intrusted to public officials. A plan for leasing machinery at a certain per cent per annum of the list price is being favorably considered, and, if the request for an additional appropriation to make this arrangement possible is granted, it is probable that ten outfits of machinery will be secured and placed in the field. It has been ascertained that this plan is perfectly feasible, and that the machinery can be secured at a fair and reasonable rental. Should the recommendation in regard to an appropriation to cover freight charges meet with approval the old practice of free transportation will be abolished.

EXPERIMENTAL FIELD WORK.

There are vast areas in the country in which stone is not available for road making, and in only a few localities has it been found practicable to overcome the difficulty, on account of the cost of transportation. In such cases the problem is how to obtain a suitable substitute. In some sections of the South roads have been built of mixtures of sand and clay. These roads have generally proved satisfactory, and the efforts of the Office have been directed toward originating special methods for putting such materials to use.

In the great Mississippi Delta the use of burned clay or gumbo has been introduced, under the direction of the Office, with what would seem to be marked success. This is shown by the results obtained on an experimental burned-clay road constructed at Clarksdale, Miss. Previous to the construction of this road experiments had been made in the laboratory of the Office to determine the best method of burning the clay. This experiment may possibly prove of value to other parts of the country, for instance, in many of the prairie States, in which no other form of road-building material is available. The report from the South on this special form of construction has been most encouraging, one county alone having appropriated $25,000 to be expended principally in this way in the immediate future. Roads of this nature are said to be more economical, efficient, and lasting than gravel roads which have been constructed in the same section.

In addition to the study of the various methods of construction and their application to those large sections of the country which at present enjoy few if any improved roads, considerable attention has been given to problems in the maintenance of roads. These have particularly to do with the suppression of dust, which has already become in some localities such a nuisance as to warrant considerable expenditure for its cessation. This is a question that has already received the attention of the French Government road engineers, as well as those

in England and elsewhere, for the past seven or eight years. It is now occupying the attention of highway engineers in this country.

A treatment which will retain the dust on the surface of a macadam or gravel road is of special value at present, owing to the great damage done to such roads by motor-car traffic, which has the effect of loosening the dust to such an extent as to seriously damage the road.

Extensive experiments for laying dust by the application of oil and coal tar on macadam and earth road surfaces have been conducted by this Office during the past year at Jackson, Tenn., and it is hoped that the data and information to be obtained from these experiments will be of great interest and value. In this connection it might be mentioned that perhaps more inquiries are received concerning the use of oil and tar than on any other phase of the work of this Office. At present there exist little or no exact data on this subject, but it is believed that the experiments referred to will in a great measure answer many of the questions that are now in doubt.

There are at present a number of patented solutions which are recommended to lay the dust on roads more effectively and economically than water sprinkling. It is expected that investigations will be carried on in the laboratory of this Office to ascertain the relative effect of various chemicals which may be used in sprinkling streets and roads.

INSTRUCTION IN HIGHWAY ENGINEERING.

In order to secure engineers having the necessary technical training as a basis, and to supplement such training by special work in highway engineering under the direction of the Office, the plan has been adopted of appointing graduates of reputable engineering colleges to the position of civil engineer student in the Office of Public Roads. These young men are required to pass rigid competitive examinations before entering the service and receive practical and scientific instruction and work for the period of one year, this being in the nature of a graduate course in highway engineering. At the end of that time they are given a certificate in the nature of a diploma, and may be retained in the service without further examination.

The work of these students includes personal inspection and reports in detail of the methods of construction carried on by different State highway commissions in the States where such work has been systematized and put upon a practical basis. They are also required to make surveys and estimates of the actual cost of building roads under various local conditions. Thorough training in methods of testing the various qualities of road materials is acquired by actual work in the laboratory, so that the value of the different physical properties of the materials may be made clear to them. The work of these engineer students is of great assistance to the Office, in addition to being of much practical value to the public at large.

It is of the utmost importance that the great sums of money appropriated for road improvement throughout the country should be expended wisely, under the direction of properly qualified men. At the present time the number of trained highway engineers is entirely inadequate to meet the demand. It will be of inestimable value to the public if the Office can provide even a few such men each year.

Instruction in highway engineering in schools and colleges throughout the country should receive greater attention at the present time, owing to the rapid development of road building. The Office, so far as its limited facilities permit, will cooperate with the various educational institutions in placing this branch of education on an adequate basis and in inaugurating highway work.

TESTING OF MATERIALS AND SPECIAL INVESTIGATIONS.

One very important feature of the development of the work of the Office has been the testing of materials available for roads in different parts of the country and the investigation of special qualities which are necessary if the most successful results are to be obtained. A large number of tests have been made on all the different kinds of materials which are in use in the construction of highways, and in addition to these routine tests a number of important and valuable investigations have been carried on. By far the greater number of tests have been made for the benefit of State and municipal authorities who have evinced a desire to obtain accurate data to enable them to make a careful and wise selection of the best material at hand. The best indication of the importance of this work is shown by the fact that many of the State governments are establishing laboratories and conducting work along the same general lines that have been followed in the laboratory here.

The equipment of machinery necessary for testing road materials is also available for testing other materials of construction relating to agriculture, and thus duplication of equipment is avoided by extending the scope of the work of the Division of Tests. It has been possible to undertake several investigations which bear directly upon problems that the farmers of the country have to face.

For some time past numerous complaints from a variety of sources have reached the Department concerning the inferior lasting quality of the steel-wire fencing offered in the market at the present time. Preliminary inquiry showed that these claims were well founded, and a thorough investigation was ordered. Enough has already been accomplished to show that the farmers will derive great benefit from this work.

The interest of manufacturers has been aroused to the extreme importance of this matter, and measures are already being taken in many of the leading manufactories to bring about an improvement in

the conditions complained of. When it is considered that much of the wire which was produced thirty years ago is still in good condition, whereas the life of wire put on the market in more recent years is often not longer than two to seven years, the money saving to the farmers of the country that will be brought about by the improvement in present conditions becomes apparent.

The fact that in many parts of the country it is difficult to procure wood for fence posts, added to the fact that wooden posts rapidly decay, has stimulated the desire to present the farmers with simple information and directions that will enable them to make use of reinforced concrete. Reinforced-concrete fence posts of various types have been made in the laboratories and tested.

One of the most important qualities possessed by rocks which render them useful for macadam-road building is that of binding power. A study of this important quality has been one of the principal subjects of investigation by the Division of Tests, and several valuable bulletins have been published setting forth the results obtained. In the course of this work it was observed that when some rocks are ground to very fine powders they undergo certain decompositions, owing to the action of water. In view of the fact that many of our large rock deposits are rich in potash, and in view of the extent to which these decompositions are found to take place, it becomes apparent that if the rocks are subjected to a process of fine grinding it is possible that they may be directly available as fertilizers.

The importance of this subject of investigation can not be overestimated, when it is considered that no original source of potash exists in this country to-day and that we are entirely dependent upon foreign sources of supply for all the potash used annually by our farmers and growers. The further investigation of the possible source of supply will be vigorously pushed in the various bureaus of the Department which are especially equipped for carrying on work of this nature. Under the stimulus of the cement industry, which has grown to enormous proportions in this country, the development of machinery for grinding rock to fine powders has made rapid strides within the past few years, and it is now possible to consider the feasibility, from an economic standpoint, of grinding material which a few years ago would have been out of the question.

In view of the growing importance of the cement industry to-day it is necessary to prosecute studies and inquiries into the actual constituents and character of Portland cement, and to this end an agent of the Office was assigned to work on this subject.

It is proposed during the next fiscal year to carry out investigations along the same general lines, adding from time to time other problems of a similar nature in so far as time and equipment will permit.

COLLECTION OF INFORMATION.

While it is known in a general way that some parts of the country have progressed much further than others in the matter of road improvement, there is little available information regarding what has been accomplished in the various States and counties. If comprehensive statistics were available it would be shown that large sums of money are annually wasted in some sections, while in others surprisingly satisfactory results are obtained at a moderate cost. The Office is now collecting information from every county in the United States in regard to the mileage of improved and unimproved roads, the amount of cash tax, bonds issued, and other information of a similar nature. No more telling argument for reform in wasteful methods can be adduced than to bring home to every county just what results they are obtaining as compared with the results obtained by other counties at a similar cost. This information, which is now being compiled, will be published for each State as soon as completed.

CONVENTIONS.

Government participation in road conventions and the organization of road associations has been considerably curtailed during the past year. Such participation does not seem to be justified when the sole object of the meeting is agitation for the purpose of influencing legislation. Aside from the propriety of the case the results achieved through speeches by Government employees at popular gatherings of this character can scarcely be considered as having a marked influence upon the progress of road improvement in the United States.

There is, however, a field of real usefulness to be reached by means of speakers and lecturers of the Office. Road organizations serve a useful purpose in arousing the people to a realization of the need for better roads. The problem that is most serious to rural communities, and one which it should be the province of specially equipped employees to explain at meetings of local officers and taxpayers, is what they need, how to go about getting it, and what their roads will cost. These speakers should be so well equipped that they can give definite and concise information, on which the local committees may act with safety.

Another branch of this work capable of beneficial results is a cooperative system of lectures in engineering schools throughout the country. As already stated, the demand for skilled highway engineers is already in excess of the supply and the educational institutions of the country should take prompt and adequate steps to meet the situation. Aside from the engineering features, there are many economic questions involved that should be brought out in lectures to students who intend to devote their lives to highway work.

Much of the work embraced in the scope of the Office is of a scientific and technical nature and involves original thought and investigation. Papers should be prepared and read at the meetings of scientific bodies, and properly qualified members of the Office should keep in touch with organizations having under consideration matters bearing in any way upon the purposes for which the Office was established.

OFFICE OF EXPERIMENT STATIONS.

RELATIONS WITH AGRICULTURAL EXPERIMENT STATIONS.

The work of the Office of Experiment Stations has greatly increased during the past eight years, partly by the extension of its business along lines previously established and partly by the addition of new functions. The Office was established to be a clearing house for the agricultural experiment stations organized under the act of Congress of 1887, and as such it has accomplished much valuable service. This Office is charged with the supervision of the Federal funds granted to the experiment stations and issues a considerable number of publications based on their work. The policy has been to make the supervision of these funds more strict and to insist on their application to agricultural research. The result is that the stations have been greatly strengthened as research departments of the agricultural colleges, and their experimental work has been so successful as to win the support of a very large constituency of intelligent farmers. The States have thus been led to supplement the funds granted to the stations by Congress, until now the annual resources of the stations from sources within the States are equal to those derived from the National Treasury. While many forces have contributed to this end, the influence of the Department is generally acknowledged as an important factor in determining the success and prosperity of the stations and in making our experiment-station system the strongest and most efficient in the world.

It is fitting in discussing the relations of the Department with the stations to call attention to the great influence the latter have had in bringing home to the people the results accomplished. Not only have the stations been a vital factor in making the Department's work more effective, but they have by their own investigations lifted American agriculture to a higher plane.

The Department is cooperating in many ways with practically all of the stations, and as time goes on this work is bound to increase. The stations have now reached a critical point in their development, and they need and will receive all the assistance the Department can give them. In the increasing demand for more light on agricultural practices and the growing interest in rural life generally, the stations must have the means for meeting these demands. It is hoped that Congress

will recognize this need, as it is already being recognized by some of the States themselves. There is no direction in which public moneys can be appropriated that will bring more certain and lasting returns than in helping the State experiment stations to do more research work.

The close relations which the Department has held with the stations in recent years has naturally led to a great increase in the number and extent of the enterprises in which the Department and stations have cooperated. By this means the range and effectiveness of many agricultural investigations have been enlarged, and it has been possible to bring the Department's work into vital touch with agricultural industries and agricultural people.

PROMOTION OF AGRICULTURAL EDUCATION.

The period covered in this review has witnessed very great activity in the development of agricultural education by the reduction to pedagogical form of the great mass of educational material accumulated by this Department, the experiment stations, and similar agencies in many countries; by the enlargement and better organization of agricultural faculties in our colleges; by the providing of more adequate buildings, apparatus, illustrative material, and other equipment for agricultural instruction, and by the extension of agricultural courses to the lower schools.

The Department has been active in promoting this educational development in various ways, and the Office of Experiment Stations, through its intimate relations with the agricultural colleges, has naturally taken a leading part in this work.

Since the permanent success of agriculture depends on the intelligence and technical knowledge of the farmers, the Department can engage in no more important work than to aid in arousing agricultural people to a keen sense of the importance of establishing in this country a system of public education which will make men and women not only intelligent citizens but also efficient and successful workers in agriculture and the other industries which must ever engage the attention of the great mass of the population. This Department and the experiment stations are largely engaged in gathering the materials which will constitute the future of education in agriculture, and the permanent impression which their work will make on agricultural practice will be largely determined by their success in incorporating the results which they obtain in courses of instruction to be given the youth in agricultural colleges and schools. The Office of Experiment Stations has been encouraged to ally itself as closely as possible with the movement for the extension of agricultural education among the colleges and in the public schools, and the Department will this year recommend to Congress that provision be made for a more active

propaganda by this Office in the interests of agricultural education, for it is certain that active work in this direction will produce far-reaching results in the near future.

AID TO FARMERS' INSTITUTES.

Recent years have also witnessed the development of a great system of popular agricultural education for the adult farmer through the farmers' institutes which are now held throughout the country and annually attended by about a million men and women engaged in agricultural pursuits. With the growth of the research work of this Department and the experiment stations it has become very evident that publications alone would not meet the demand for information regarding improved methods of agriculture and the ways in which the results of scientific investigation may be applied to agricultural practice. The absence of agricultural instruction in the schools and the coming on to the farms of millions of people from foreign lands, together with the widespread interest in the results of agricultural research, have made it necessary that means be devised for giving agricultural people instruction by word of mouth which will enable them to understand and utilize the information so largely given out in the publications of this Department and the stations.

For this purpose the farmers' institutes established under public authority in the States and Territories furnish an agency of great usefulness. It has therefore seemed highly desirable that this Department should ally itself closely with the farmers' institutes, and make them efficient instruments for the wide diffusion of the knowledge gained by the Department and other agencies for agricultural research. With this end in view a farmers' institute specialist was appointed two years ago in the Office of Experiment Stations, and efforts have been made to place at the disposal of the institute lecturers the information gained by the Department in many lines.

ESTABLISHMENT AND PROGRESS OF EXPERIMENT STATIONS IN ALASKA, HAWAII, AND PORTO RICO.

Under various acts of Congress provision was made for agricultural experiment stations in Alaska, Hawaii, and Porto Rico, and the stations were established in Alaska in 1898 and in Hawaii and Porto Rico in 1901. Their administrative control was placed in the Office of Experiment Stations, and a Division of Insular Stations was created.

The headquarters of the Alaska stations were established at Sitka, and branch stations were undertaken at Kenai, Copper Center, and Rampart. In Alaska the first problem was the introduction of agriculture. With a few exceptions about some of the larger villages,

little had been attempted in the way of gardening, and nothing done on an extensive scale. Much pioneer work in the way of clearing, fencing, building, etc., was necessary at all these places, but attention was given from the first to the introduction of varieties of economic plants that were thought promising for this country. When tried and found adapted to the prevailing conditions they were distributed as far as possible, and the settlers urged to take up their cultivation. For a time the principal investigations were with garden vegetables, and it has been demonstrated that the growing of hardy vegetables is possible over a great portion of Alaska as far north as the Arctic Circle. This has made possible a wide extension of gardening, and many villages owe their present supply of fresh vegetables to the demonstration of the experiment stations.

Cereal growing has also been taken up and found practicable away from the coast, rye, barley, and oats having matured every year at the Rampart Station, although situated at 65° 30′ north latitude. The climatic conditions at Sitka not warranting extensive experiments with cereals, horticultural crops of various kinds are being investigated, and nurseries of hardy fruits, berries, etc., have been established. In addition to introductions, experiments in plant breeding with native fruits are being carried on with promise of success. Soil studies made over large tracts have shown that the seemingly rich soils are peaty and often quite acid. Methods of treatment for correcting the faulty conditions have been found, and the station's results are being widely adopted. Experiments in animal husbandry and dairying have been begun and will be developed as the facilities of the stations will admit.

In Hawaii the station was located adjoining Honolulu, on a tract of land set aside for the purpose by the Territorial authorities. The work in Hawaii has been along the line of the development of agricultural industries, to supplement sugar-cane growing and to secure a greater diversification of crops. The station's experiments with tobacco, although only carried on for the past two years, seem to indicate that it is entirely feasible to grow a type of cigar tobacco but little, if any, inferior to the average product of Cuba. Previous experiments with tobacco had failed, but with attention to varieties, soils, curing, and fermentation a product was secured that was given high rank by experts. Successful efforts to introduce forage plants for the stock ranges have been noted in a number of instances, and a prominent stockman says the success along this one line is worth many times over what the station has cost. Through the station, bananas from Central America have been introduced to supplant the varieties in cultivation for markets of California, Oregon, Washington, etc. The local varieties do not bear shipping well and the Central American varieties are superior in this respect. An effort is being made to develop the growing of citrus fruits for local use, the supply now

coming almost wholly from California. Investigations are being made of fungous and insect pests, soils, etc., and many matters of great importance have been discovered and the results given to the public.

The Porto Rico Station was first located on a tract of leased land near Rio Piedras, but after a year it was permanently established at Mayaguez, where a plantation of about 240 acres was furnished by the insular authorities. One of the chief problems in Porto Rico has been the introduction of improved methods of agricultural practice. To supply information along this line experiments have been inaugurated with nearly all agricultural and horticultural crops grown on the island, and also with others believed to be adapted to the conditions. It has been possible to suggest methods whereby increased production with several crops can be secured with but little more labor and expense than that usually given. Insect pests have been studied and means found for combating a number of the more destructive ones. Experiments with coffee have been in progress ever since the station was established, and trees under investigation yielded double the crop obtained from others in the same plantation. The means by which this result was obtained were pruning, cultivation, and fertilizing, and they may be readily followed by any grower. A large collection of economic tropical plants has been brought together, permitting a comparison of varieties, testing their adaptability, and making possible plant-breeding work on an extensive scale. Experiments with horses, cattle, and pigs have been begun and will be extended as opportunity offers. Other experiments under way are with leguminous plants for forage and rotation crops, rice growing, citrus and other fruits, vegetables, etc. The value of tile drainage has been shown by a demonstration on part of the station farm. This was the first piece of tile drain in Porto Rico, and its efficiency is well recognized.

All the insular stations cooperate in various ways with our Bureaus, giving a wider field to the investigations of the Department, while the stations receive the benefit of our more extensive resources. These stations are all becoming centers of information and demonstration in their several localities, and their power for good is already recognized.

PROGRESS IN NUTRITION INVESTIGATIONS.

The nutrition investigations have been conducted on a coöperative plan by which work has been undertaken in nineteen States and three Territories, in which the Department has been associated with experiment stations, agricultural colleges, universities, and other educational institutions, philanthropic associations, hospitals, and institutions for charity and correction. The Department funds have been supplemented in various ways, including the use of laboratories, apparatus,

and the time of investigators, as well as by State appropriations and funds derived from other sources.

During the past eight years the work has developed very materially both in scope and in the importance of the results obtained. During this time some 200 dietary studies have been made and not far from 800 experiments in which the digestibility of different foods was determined with healthy men under normal conditions. Over 70 experiments with the respiration calorimeter have been completed with 9 different subjects covering a period of two hundred and nine days, during which time the total income and outgo of both matter and energy have been measured and studied. Many experiments have also been made regarding the changes which take place when meat, vegetables, and flour and other cereal products are cooked in different ways, and considerable attention has been devoted to the compilation of the results of Department work, as well as that of other investigators.

As the nutrition investigations have developed it has been found in the main desirable to concentrate resources upon several problems which have seemed of special importance and to cooperate with institutions where conditions were particularly favorable.

The experiments which have been carried on in California have demonstrated the fact that both fruits and nuts may furnish a considerable portion of the diet at a reasonable cost.

A large number of studies made at the Maine and Minnesota experiment stations have shown that, with all classes of wheat, white bread furnishes the body with more protein and energy, pound for pound, than whole wheat or Graham flour ground from the same lot of grain, since any deficiency in the composition of the white flour is more than offset by its more thorough digestion. Investigations with cereal breakfast foods have also shown that the different commercial brands differ little in real nutritive value, though they differ widely in cost and quite considerably in method of manufacture. The different kinds of bread have been shown to be wholesome and economical foods, and the same may be said of the standard breakfast foods, the use of different kinds of breads and breakfast foods being an easy way to secure that variety in the diet which is considered important as well as pleasing.

The Tennessee investigations have demonstrated that dried legumes (beans, peas, and cowpeas) are quite thoroughly digested and are economical sources of vegetable protein. The thoroughness with which they are assimilated depends in considerable degree upon the method of preparation, being greatest when the legumes are so thoroughly cooked that they are readily masticated and thoroughly mixed with the digestive juices of the stomach and intestinal tract.

As shown by the investigations at the University of Illinois, the losses which meat sustains when cooked in hot water are greater than

when dry heat is used, as in roasting or baking, though in all cases the losses of nutrients are small. Dry heat applied in different ways develops flavor to a greater extent than cooking in hot water. The different kinds and cuts of meat differ somewhat in the thoroughness with which they are digested, as do meats cooked in different ways. However, it may be said that meats as a class are very thoroughly assimilated by the average man under normal conditions.

The experiments carried on at Middletown, Conn., with the aid of the respiration calorimeter have furnished very accurate data regarding the actual energy requirements of the body, the relative energy production at work and at rest, sleeping and waking, and under other conditions; the normal variations in body temperature, effect of varying amounts of carbon dioxid and moisture in the air upon bodily comfort, the relation between food consumption and excretory products, and similar topics; they have also supplied valuable data for the discussion of problems of ventilation and hygiene. Recently, as a part of this work, very important and useful factors have been deduced with which it is possible to compute the carbon dioxid and energy output of man at rest and performing muscular work of different degrees of severity, and also the energy expended per day by men engaged in any one of the ordinary occupations or trades. When these quantities are known it is possible to form an estimate of the actual food requirements.

ESTABLISHMENT AND DEVELOPMENT OF IRRIGATION AND DRAINAGE INVESTIGATIONS.

In 1897 Congress appropriated $10,000 to enable this Department to investigate irrigation laws and irrigation practice. The present Irrigation and Drainage Investigations, for which $74,200 was appropriated in 1905, is the outgrowth of this initial appropriation. It was the beginning of systematic study by the General Government of the agricultural and legal features of irrigation—the two features which have a controlling influence on the peace and enduring prosperity of irrigated districts.

The need of more definite information on these subjects was shown in the wide discrepancy of view regarding the duty of water as exhibited in court decrees fixing water rights and in the water-right contracts of canal companies, the quantity allowed for the irrigation of an acre of land one year varying all the way from enough to cover it to a depth of 6 inches to enough to cover it to a depth of 500 feet. The value of these measurements of the duty of water has been shown in preventing decrees for excessive amounts of water and the chaos, injustice, and unending litigation which came from decisions and agreements which gave one man more than he could use profitably and another less than his crops required.

These measurements of the quantity of water used in ordinary practice have been followed by more careful experiments to determine the frequency of irrigation and the amount of water which should be applied at each irrigation in order to get the best results. The object of these investigations is to furnish the information needed to establish a proper system of rotation, prevent the injury of land by excessive use of water, and reduce to a minimum the losses from seepage and evaporation.

Accompanying the measurements of the duty of water have been measurements of the losses from seepage and evaporation in canals and ditches. These losses were far greater than had been commonly supposed, amounting in many instances to more than half the water turned in the head-gates.

The determination of seepage losses has been followed by experiments in the lining and puddling of ditches to lessen such losses, which have been an active agency in improving this feature of irrigation practice and increasing the service which streams will render. It has also retarded the extension of the area injured by seepage water and alkali.

An important feature of irrigation development in the United States is that each year thousands of acres of new land have to be cleared of brush, graded, and ditched for the distribution of water. Another fact is that much of this work is done by settlers to whom the whole subject of irrigation is strange and new. Nothing could have been more wasteful than to leave each of these beginners to find out for himself how to do this work, and the Department has rendered valuable aid by the publication of practical bulletins describing the tools and methods of clearing and grading land, giving the cost of this work, and explaining the methods of applying water suited to different soils, crops, and climates. The information given in these bulletins has been collected in widely separated sections of the country and includes practically every method of applying water to be found in this or any other irrigated country.

The studies of irrigation laws and irrigation institutions have included the collection of facts showing the character and amount of the water rights and the methods of their establishment in the different Western States. Having the facts before them, the people of those States have been able to determine what sort of legislation was required for their improvement, and it has been the policy of the Department to let these facts furnish their own argument, the Department confining itself to the statement of the general principles which should underlie the control and management of public water supplies. It is not possible to speak certainly regarding the influence which these investigations have exerted, but it is known that in the eight years since they were begun there has been a progressive interest in

the reform of irrigation statutes and in the laws and customs which determine the relations of irrigators to each other. The facts presented in the official bulletins of this Department have been largely quoted and the laws enacted have been in harmony with the general policy advocated by this Department.

Irrigation and drainage are inseparable. In every irrigated district some lands have to be drained. Without this the soil water rises to the surface and renders the land unproductive from excess of water or alkali. The drainage investigation grew out of need for plans for removing the excess of water coming from seepage and waste on irrigated fields. It has been extended to embrace the entire country, where in many sections drainage is a fundamental necessity if the full productiveness of the soil is to be secured. The drainage problems which have been dealt with have included the preparation of plans and giving expert advice about large projects and the making of studies to determine the feasibility of drainage and the methods to be followed in many parts of the Mississippi Valley.

Experiments are also being made to determine how far drainage can be made to protect hillsides from the destructive effects of erosion. In the whole United States there are about 100,000,000 acres of swamped and overflowed lands which can be reclaimed only through drainage, which will change these from unhealthful and worthless areas into some of the most productive farm lands in the country.

To these two branches of rural engineering there was added last year the study of farm machinery and appliances used in agriculture. The tools and implements used on the American farm cost approximately $100,000,000 a year. The farmer must make this large outlay because it is only through this means that he can offset the scarcity and high price of farm labor; but farm implements are becoming each year more complex and costly and require a greater knowledge of mechanical principles to select and use them. The purpose of this work is to aid the present generation of farmers in acquiring this knowledge and to aid the agricultural colleges and experiment stations in the preparation of courses of instruction for the more effective equipment of the coming generation.

NEW BUILDINGS FOR THE DEPARTMENT.

The need of better buildings for the Department of Agriculture has long been felt. For the past fourteen or fifteen years attention has been called from time to time to the inadequate structures, especially in so far as relates to laboratory uses. Six years ago systematic effort was undertaken to secure buildings commensurate with the needs of the Department. Preliminary appropriations were made for plans, which were followed eventually by appropriations for the buildings themselves. The Department now has under construction two wings,

constituting a part of a series of buildings which, when completed, it is believed will meet the requirements of the work. Every effort has been made to have these buildings constructed with due regard to the important work which the Department is conducting and in recognition of the fact that Washington itself is destined to have a system of public buildings second to none in the world. The present structures, which will cost about $1,500,000, will be completed in two years, and by that time it is hoped that further appropriations will be available for a continuation of the building work inaugurated.

GROWTH OF THE DEPARTMENT.

The history of this Department's growth during the past eight years may be epitomized in the statement that the appropriations for its use have increased from $2,500,000 in 1897 to considerably over $6,000,000 in 1905, and that this increase in appropriations has been accompanied by a much greater increase in the amount of work done. Not only has the work of the Department been vastly augmented, but its scope has been correspondingly broadened and its practical value heightened.

Another interesting evidence of the growth of the Department during the past eight years is afforded by the records of the appointment clerk's office. These show that the total number of persons on the rolls of the Department of Agriculture July 1, 1905, was 5,446. Of this number those rated as scientists and scientific assistants numbered 2,326. On July 1, 1897, the total number of persons on the rolls of the Department was 2,443, of which number those rated as scientists and scientific assistants numbered 925. These figures show an increase in the total force during these eight years of 3,003 persons, while the increase in the number of those rated as scientists and scientific assistants was 1,401.

CONCLUSION.

It has been my gratifying task in the foregoing pages to present to you, and through you to the American people, a pen picture of the American farmer as he is to-day; to make clear the position of the farming industry and its relation to other industries; its wonderful productiveness and its large contributions to the general prosperity the country enjoys.

I have also sought to point out some of the more important work accomplished by the Department, illustrative of the methods by which it seeks to work for the practical benefit of the farmer. The work of this Department is twofold. It must seek to add to the sum of intelligence of the man and to increase the productive capacity of the acre. In this important work it has the hearty cooperation of the State agricultural colleges and experiment stations, all of them working

with the Department of Agriculture toward the same great end. The gratifying evidences of well-being in our farming community, the extraordinary progress made in the past few years, and the rapidly enlarging recognition of the true position of the farming industry in the economic life of this country are mainly the result of this continued and combined effort on the part of these agencies to add to the sum of the farmer's knowledge, and must be regarded as the triumph of intelligence in the application of scientific knowledge to the tillage of the soil. This is so obviously true that it would seem superfluous to urge the generous maintenance of the Department in its grand work. Great as has been the work undertaken and accomplished, gratifying as have been the results, as shown in the first few pages of this report, be it remembered that we are still at the threshold of agricultural development, and that the educational work which has led to such grand results has only been extended as yet to a portion of our agricultural population. There is not an intelligent, patriotic citizen in the Union who will not say with his whole heart, "Let the good work go on."

Respectfully submitted.

JAMES WILSON,
Secretary.

WASHINGTON, D. C., *November 22, 1905.*

THE GYPSY AND BROWN-TAIL MOTHS AND THEIR EUROPEAN PARASITES.

By L. O. Howard, Ph. D.,
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INTRODUCTION AND SPREAD OF THE MOTHS IN UNITED STATES.

All of the earlier works on the injurious insects of Europe have contained references to and descriptions of the so-called gypsy moth (*Ocneria dispar* Linn.). The brown-tail moth (*Euproctis chrysorrhœa* Linn.) is also a native European insect and for many years has been noted as an enemy to fruit trees. Both of these insects have been introduced into the United States in the vicinity of Boston and have multiplied and spread with alarming rapidity.

The gypsy moth was first introduced in 1868 by Prof. L. Trouvelot, of Harvard University, who was experimenting in the crossbreeding of wild silkworms. An egg cluster of the gypsy moth blew out of his window in Malden, and he was unable to recover it. Twenty years later, in 1889, the species had increased to such an extent that the caterpillars were a great nuisance in the city of Malden, and the State undertook an investigation in the hope of exterminating the species. It was found to have spread until it occupied a territory of about 100 square miles, and during the next ten years the State, by constantly increasing appropriations and by the active work of a large number of paid employees, had succeeded in practically controlling all further spread and in greatly reducing the numbers of the insect. In 1900, however, appropriations lapsed, and from that year until 1905 the insect was again allowed to multiply and spread, unhindered save by the operations of private persons. It soon became as numerous as it had been early in the State investigation, and the boundaries of the region inhabited by it widened out greatly, until now it has reached as far west as Worcester and occurs all along the New Hampshire line on the north, extending over into that State at Seabrook, Hampton, North Hampton, and Portsmouth (see fig. 1). It has also made its appearance in portions of Providence, R. I.

The brown-tail moth was first noticed in the early nineties in Somerville, Mass., where it was probably introduced in a shipment of roses from Holland. It multiplied and spread, although the work of the gypsy moth commission was directed against this insect as well as against the gypsy moth down to the year 1900. It has since become

even more abundant and injurious than the gypsy moth, and, owing to the fact that the female flies readily, whereas the female of the gypsy moth does not fly at all, the brown-tail moth has far exceeded the gypsy moth in its spread. It now covers a territory extending from Eastport, Me., on the northeast, as far south as Cape Cod, and to the west

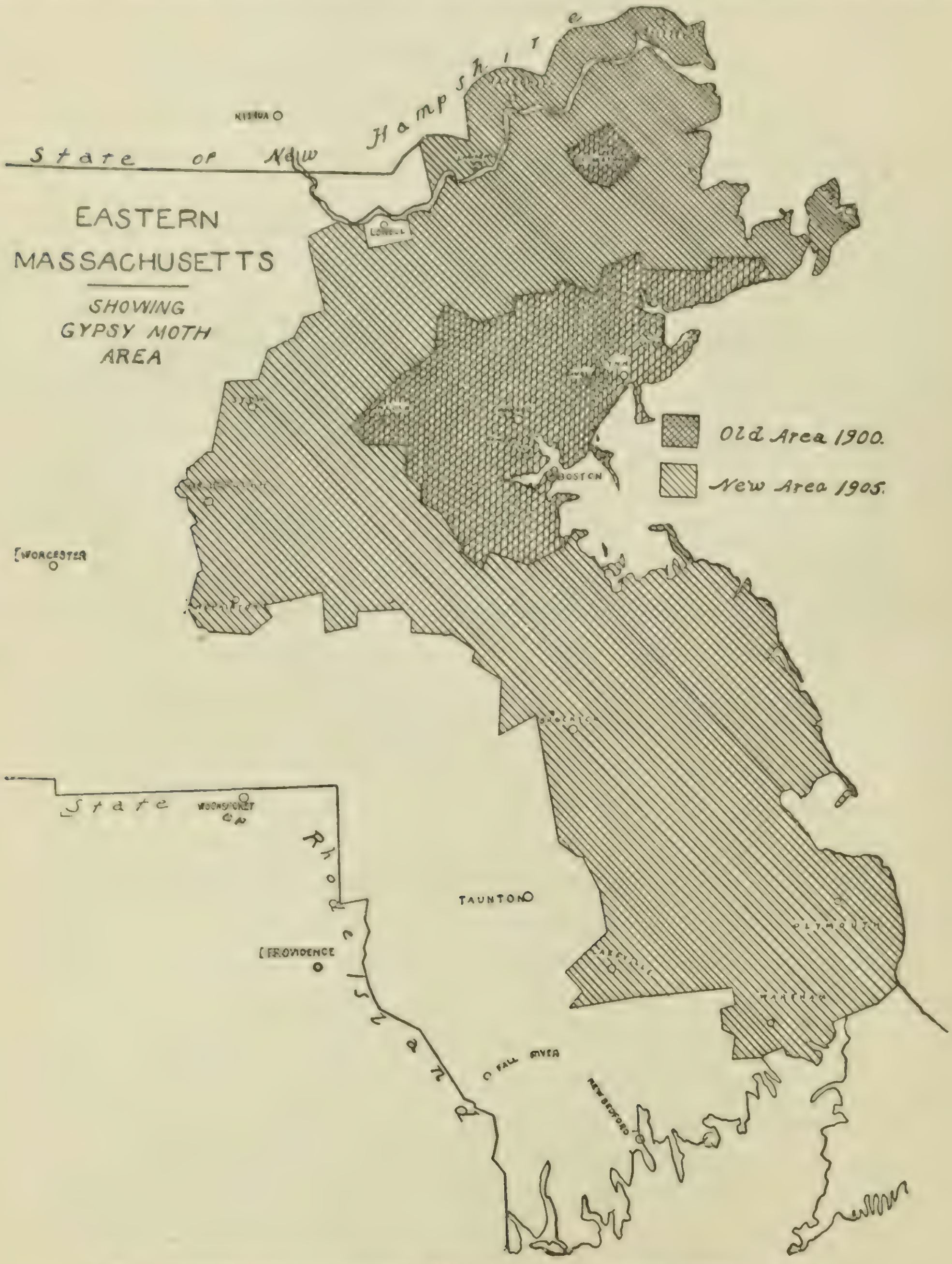


FIG. 1.—Sketch map of eastern Massachusetts, showing gypsy moth area.

as far as Amherst, Mass. It doubtless also exists in many communities in and out of Massachusetts from which it has not been reported.

LIFE HISTORY AND DESCRIPTION OF THE GYPSY MOTH.

The gypsy moth has but a single generation each year. It winters in the egg stage, and the young caterpillar hatches from the egg about

the first of May. It feeds upon the leaves of many different plants. It attacks practically all fruit, shade, and woodland trees, showing some preference for apple, white oak, red oak, willow, and elm. It kills both deciduous and coniferous trees. Woodlands attacked by it in number are stripped bare and many trees are killed. It feeds upon the foliage of shrubs, vines, bushes, and flowers, and will eat grass and garden and field crops. The full-grown caterpillar is 3 inches or a little less in length, and has a dark-gray or sooty color effect. The back is marked with yellow; along the back is a double row of blue spots followed by a double row of red spots—five pairs of blue and six pairs of red. The young larvæ do not show these spots well, but in the full-grown ones they are very evident. About the first of July, or a little later, the larva changes to pupa (Pl. I) in a partial cocoon formed of a few

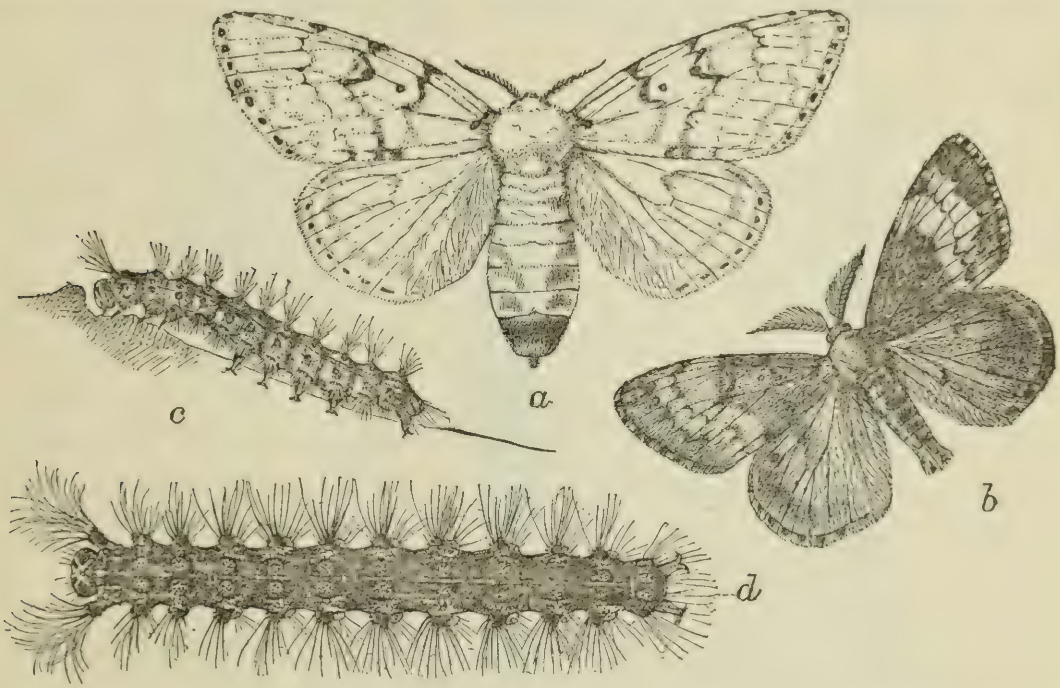


FIG. 2.—The gypsy moth (*Ocneria dispar*): *a*, female moth; *b*, male moth; *c*, halfgrown larva; *d*, mature larva. Slightly enlarged (original).

threads of silk, sometimes connecting leaves together. From the middle of July to the middle of August the winged moths appear (fig. 2). The male is brownish yellow, and has a slender body and a wing expanse of about 1½ inches. It is an active flier. The female moth is nearly white, somewhat spotted with black. It is very sluggish, and its body is so heavy that it can not fly. Its wing expanse is about 2¼ inches. The eggs are deposited by the females shortly after issuing, and are laid in masses, each containing about 500 eggs closely packed with yellowish hair from the body of the female, oval in shape and about 1½ inches long by three-fourths of an inch wide. The eggs are laid on the trunks of trees, on the sides of houses, fences, stone walls, and other places. The females seem especially attracted to recesses where the eggs are

more or less hidden. Large holes in old trees will be found filled with them, and they are often found in the crevices between stones in a stone wall, or in the hollow of an old stump or log.

The larvæ (fig. 2), especially after they reach some size, feed principally at night and try to hide themselves during the day. In daytime they will descend upon the larger limbs and trunk and try to find some place under the bark or in a large hole where they can secrete themselves. It is this habit that has led to the use of burlap bands around the trunks of trees, under which they will hide during the day and where they can be found easily and destroyed.

LIFE HISTORY AND DESCRIPTION OF THE BROWN-TAIL MOTH.

The caterpillar of the brown-tail moth is primarily an enemy of pear, apple, cherry, peach, and other fruit trees, but it is also found commonly upon various shrubs that grow in dooryards; in Massachusetts it has begun to attack the forest trees and now affects especially the oaks. Young oaks—oak scrub—are apparently particularly attractive to it at present.

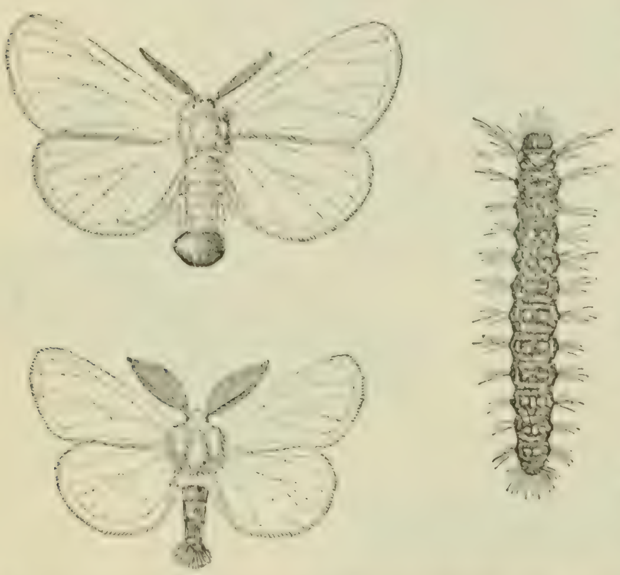


FIG. 3.—The brown-tail moth (*Euproctis chrysorrhœa*): Female moth above, male moth below, caterpillar at right. Slightly enlarged (original).

The insect does not hibernate in the egg stage, as does the gypsy moth, but as the young caterpillar. It has, like the gypsy moth, but one generation each year. The eggs are laid in masses on the under side of the leaves in the latter part of July. The egg masses are brown and covered with hair, and each contains about 300 eggs. The masses are much smaller than those of the gypsy moth, averaging about two-thirds of an inch in length by about one-fourth of an inch in width. The eggs hatch during August, and the young caterpillars feed in clusters on the upper surface of the leaves, a little later beginning to spin their winter webs by drawing together a number of leaves with silk, in which web a large number of caterpillars stow themselves away for the winter. These webs or nests, composed of leaves and silk, will average from 5 to 6 inches in length, and each will contain 200 or more caterpillars. They feed until cold weather, when all enter the web and close the exit holes. They are then about one-fourth grown. Early the following spring, as soon as the buds begin to appear on the fruit trees, they issue from the over-wintering

nests and attack first the buds and the blossoms, and later the foliage. The full-grown larva is about 2 inches long, reddish brown in color, with a broken white stripe on each side and two red dots on the back near the hind end. They will migrate from one tree to another, completely stripping the foliage as they go. When full grown they spin their cocoons either on the tree trunks or within the leaves on the branches of the trees.

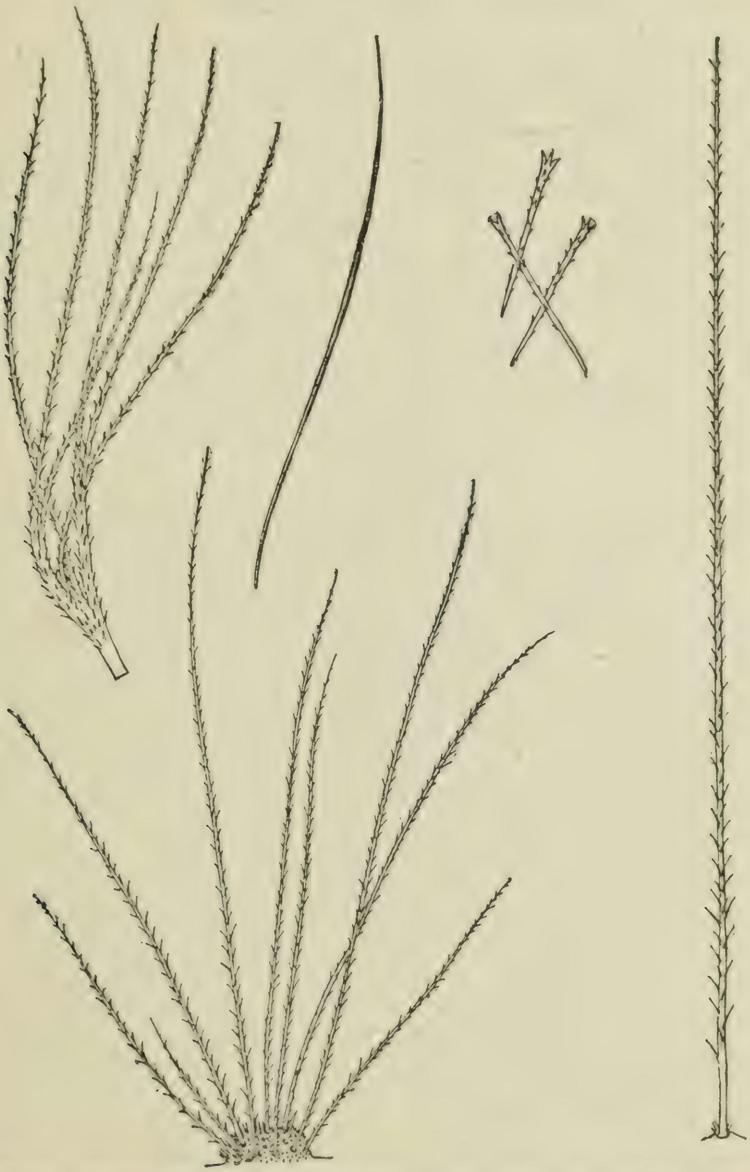


FIG. 4.—Hairs of the caterpillar of the brown-tail moth, highly magnified (adapted from Kirkland).

The moths are pure white, except that the female has a conspicuous bunch of brown hair at the tip of the abdomen, from which it derives the name "brown-tail moth." The female expands about 1½ inches and the male is smaller. Both male and female (fig. 3) fly readily, largely at night, and are greatly attracted by electric lights.

It is not alone by its damage to the foliage of fruit and other trees that the brown-tail moth is a pest. The hairs of the larvæ are finely

barbed and brittle (see fig. 4), and where the caterpillar comes in contact with the human skin the hairs enter the skin pores, break off, and cause a severe irritation. "Brown-tail rash," as it is called, has been very common in eastern Massachusetts for the past few years, and, while few people are made seriously ill by it, it is the cause of great annoyance. The free use of vaseline is said to be the best remedy.

REMEDIES FOR THE GYPSY MOTH AND THE BROWN-TAIL MOTH.

Spraying with Paris green or arsenate of lead is effective during the early summer against the brown-tail moth. It is less effective against the gypsy moth, since this caterpillar seems to be able to absorb larger quantities of arsenic than any other insect known. The ordinary applications of Paris green were found, early in the work of the old State commission, to be entirely ineffective. It was necessary to use so great a strength of the Paris green in order to poison the caterpillars that the foliage of the treated trees was badly burned. It was owing to this fact that arsenate of lead came into use as an insecticide, since this substance may be used in very strong solution without danger of leaf burning.

But better remedies than spraying are to be found for both species. With the brown-tail moth, the habit of passing the winter in the young caterpillar nests affords an easy remedy. As soon as the leaves fall in the autumn these nests stand out conspicuously, and in an orchard or garden nothing can be easier than to cut off and burn these nests with the gratifying assurance that with each one burned 250 caterpillars are destroyed. In large forest areas, however, or where very tall trees are infested, this becomes an arduous and expensive operation.

For the gypsy moth, the most effective remedy is to search for and destroy the eggs during late summer and winter. They are conspicuous from their color, and when one learns the character of the inconspicuous places in which they are sometimes hidden it is not an especially difficult matter to find them and to destroy them with a creosote mixture. When the larvæ are young, arsenate of lead at the rate of 10 pounds to 100 gallons of water will destroy them, but when older they are not so readily affected. For the older caterpillars, as has been before suggested, the tying of a burlap band about the trunk of a tree will result in the capture and destruction of the majority of those present. The burlaps should be examined daily, and the hidden caterpillars destroyed by crushing or by cutting.

INSECT ENEMIES OF THE GYPSY MOTH AND THE BROWN-TAIL MOTH IN AMERICA.

When the State Board of Agriculture of Massachusetts published its large report on the gypsy moth in 1896, there were recorded five American hymenopterous and six dipterous parasites of this moth.

In this report was also recorded the fact that certain predaceous wasps and hornets, ants, and several predatory beetles, several spiders, and several species of predatory bugs feed upon the gypsy moth caterpillars. The percentage of parasitism, however, was slight, and the predatory insects made no impression upon the armies of the caterpillars. In this report also was made the statement that in Europe there are known twenty-seven hymenopterous and twenty-five dipterous parasites, although as a matter of fact a number of the former are hyperparasites—that is, parasites of the true parasites. The question of endeavoring to import the European enemies of the gypsy moth into Massachusetts was considered at that time, and the following paragraph was published under the heading "Importing parasites:"

> No attempt has been made to import parasites thus far, for the reason that the law requires the work to be conducted with direct reference to the extermination of the gypsy moth, and, therefore, the general destruction of the insect would also destroy the parasites. There is no reason why our native hymenopterous parasites may not prove quite as effective as those of any other country, since there is no parasite known which confines itself exclusively to the gypsy moth, and, as has been shown, we have several species which attack it as readily as any in its native country.

The brown-tail moth has also been attacked to some slight extent by American parasites and American predatory insects, but the percentage of parasitism and destruction is extremely small.

Considering that the gypsy moth has now been working in the country around Boston for thirty-six years, it seems obvious that if effective work will ever be accomplished by its American insect enemies some decided showing must have been made by this time; but during all these years the history of the pest has been one of constant increase and spread, except where hindered by actual remedial measures in the hand of man. The hope, therefore, that American parasites will in time accustom themselves to this pest and will eventually hold it in subjection is a remote one.

Although the brown-tail moth has not inhabited this region for as long a space of time as has the gypsy moth, the same general conclusions are warranted. The European parasites of the brown-tail moth are not as well known as those of the gypsy moth, but more than twenty species have been recorded.

EUROPEAN PARASITES AND PREDATORY INSECT ENEMIES OF THE GYPSY MOTH AND THE BROWN-TAIL MOTH.

As indicated in the preceding section, a large number of parasites are known to affect both of these injurious species in Europe, and the same may be said of predatory insects. Both species are old and well-established members of the European fauna, and while always injurious and appearing from time to time in especially injurious numbers, at no

time and in no part of Europe is there an outbreak of these insects comparable to the yearly abundance in New England. In fact, in Europe the status of the gypsy moth and the brown-tail moth may well be compared with the status of some of our common species of American origin, as, for example, the tussock moth (*Hemerocampa leucostigma* S. and A.) or the fall webworm (*Hyphantria cunea* Dru.). Of these insects, one can find specimens every year in or about any of our eastern cities or towns. Occasionally one or both species become so numerous as to attract particular attention and to excite some alarm as to the future of our shade trees; but it almost invariably happens that the year following such an appearance in numbers of either of these species very few are noticed, and it is always several years, and may be many years, before they appear in like numbers again. For example, in Washington City in the year 1886 the shade trees of the city were almost entirely defoliated by the fall webworm; since that time—and nineteen years have elapsed—there has been no occurrence of the species in any way comparable to that one. The insect is seen here and there in small numbers almost every year, but the shade trees have not suffered at all seriously. Again, in 1895, Washington suffered from an extraordinary outbreak of the tussock moth, and many trees were defoliated. The following year the insect was scarce, and although it has occurred rather commonly several times during recent years no especial damage has been done in the intervening time. For two years after the outbreak of 1895 the writer made a study of the conditions of parasitism as related to this species. He found that during the autumn of 1895 the primary parasites of the tussock moth caterpillars bred in enormous numbers in Washington—in numbers so great that in many instances where counts were made 95 per cent of the caterpillars were destroyed. With this abundance of their enemies the caterpillars hatching from over-wintering eggs the following spring were practically annihilated. Then these enemies were themselves destroyed by an extraordinary multiplication of secondary parasites, and these in turn were later reduced by their own enemies, which are called tertiary parasites. The few survivors of the tussock moth were, by the destruction of their primary enemies, permitted to reproduce and to begin to multiply the species. But, although at some future time, through possible weather conditions inimical to the development of the primary parasites, the tussock moth may, and will probably, again become as numerous as it was in 1895, the same round of destruction will again occur.

It is in precisely these ways that the multiplication of the gypsy moth and the brown-tail moth is controlled in Europe. There is a definite interrelation of species which controls the situation and renders both gypsy moth and brown-tail moth innocuous as compared with conditions existing in Massachusetts.

With the cessation of the exterminative measures instituted by the State of Massachusetts, and the indication of the probability that much can not be expected from native American species, it has become evident that one of the best hopes of lessening the damage done by these insects rests in the importation and establishment of the European parasites and other insect enemies.

ATTEMPTS TO INTRODUCE EUROPEAN ENEMIES OF THESE MOTHS.

In the act appropriating for the expenses of the United States Department of Agriculture for the fiscal year ending June 30, 1906, Congress inserted a clause permitting the Secretary of Agriculture to spend an amount not to exceed $2,500 in an effort to import these parasites, and at the same time Massachusetts appropriated $10,000 a year for three years for the same purpose. In the same act the State of Massachusetts provided for the appointment, by the governor, of a superintendent of suppression, with power to appoint agents and assistants and to have general charge of the work of suppressing the moths. The bill also required cities and towns to destroy the insects within their limits under certain regulations and restrictions and pecuniary assistance from the State which need not be mentioned here, but which are displayed in Bulletin No. 1, issued from the office of the superintendent for suppressing the gypsy and brown-tail moths and published by the State printers in Boston in September, 1905. The superintendent appointed by Governor Douglas is Mr. A. H. Kirkland, and he, with the consent of the Secretary of Agriculture, placed under the control of the writer a large part of the parasite fund appropriated by the State.

Knowing in advance the European conditions surrounding the gypsy moth and the brown-tail moth and their parasites, it was decided to visit different parts of Europe during the months of June and July, and to secure the sending of as many full-grown larvæ and pupæ of the gypsy moth as possible to Mr. Kirkland in Boston, with the certainty that a certain proportion of them would be parasitized and that the parasites would probably issue in due time on American soil. There would be no danger in sending unparasitized individuals, since issuing moths could readily be killed. The writer therefore sailed from Boston on the 3d of June and landed in Naples on the 15th of that month. He at once consulted Dr. Filippo Silvestri, the entomologist of the Royal Agricultural School at Portici, 6 miles from the city of Naples. Doctor Silvestri stated that neither gypsy moth nor brown-tail moth had been seen in the vicinity of Naples for some time, but that in 1904 he had been informed by the president of the agricultural society of the island of Sardinia that the former had been unusually abundant in portions of that island. Here was good fortune from the very start, since, as indicated in an earlier portion of this

article, in the year following a rather numerous outbreak of the insect the primary parasites are quite certain to be more abundant than usual.

At the request of the writer, therefore, Doctor Silvestri consented to send his principal assistant, Dr. G. Leonardi, at once to Sardinia for the purpose of making collections. Accordingly, Doctor Leonardi started on the steamer sailing the next day, and his trip was very successful. He collected and later sent by mail to Boston some 1,250 pupæ of the gypsy moth and about 2,500 larvæ. He also sent 200 living specimens of a ground beetle known as *Calosoma sycophanta* L. (fig. 5), a European species with congeneric relatives in the United States, but which has a habit of climbing trees that is not possessed by its American relatives. It is therefore in Europe an effective enemy of tree-inhabiting caterpillars. Unfortunately, these specimens were intrusted to the regular mail, and therefore landed in New York and were shipped to Boston in the ordinary course of affairs; on arrival in Boston all of the beetles were found to have died on the journey. Had they been shipped by direct steamer from Naples to Boston it is likely that some of them would have survived, and this course will be followed in future sendings from Naples. The larvæ and pupæ, however, and their contained parasites were in better condition, and a number of the latter were reared from this material. The most important parasite, and in fact the only one from which may be expected much advantage from the past season's work, is a large tachinid fly known as *Tachina larvarum* L. (fig. 6), and of this species in the neighborhood of 400 larvæ emerged from the gypsy-moth caterpillars and entered the pupal stage in large, oval, dark-colored puparia. In this condition they are resting, and the flies will probably issue in the spring of 1906. This is one of the largest of the European tachinid flies, and is a rather general parasite, laying its eggs upon a number of species of large caterpillars. Not all of the puparia of this Tachina, however, will give out the beneficial parasites, since a number of them prove to have been themselves parasitized by *Chalcis flavipes* Fab. (fig. 7). These latter have been destroyed as

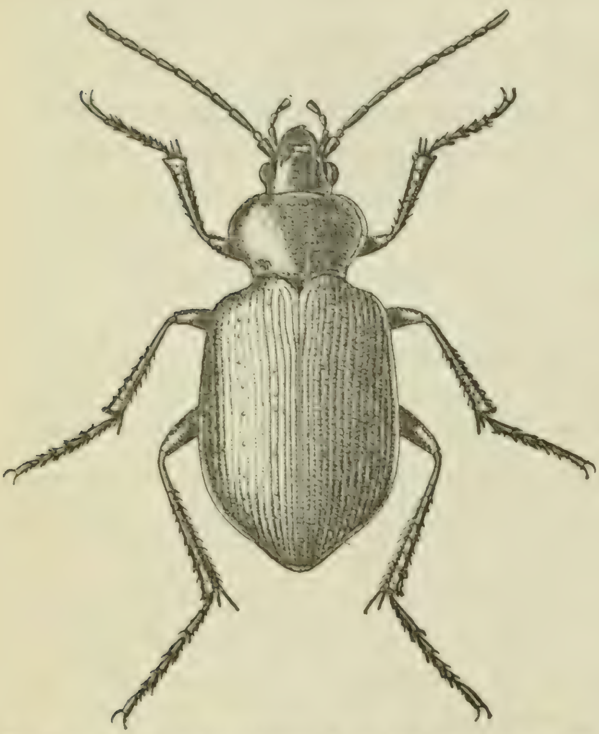


FIG. 5.—*Calosoma sycophanta*, about twice natural size (original).

fast as they have emerged, since their introduction and establishment would seriously jeopardize the success of the establishment of primary parasites of value.

When Doctor Leonardi left for Sardinia the writer started north and stopped at Florence, where he had a long consultation with Prof. Antonio Berlese, the head of the Royal Station for Agricultural Entomology, who had formerly been in charge of the work at Portici. Professor Berlese and his two assistants, Doctor Del Guercio and Doctor Ribaga, were much interested in the quest and promised every possible assistance. They stated that both gypsy moth and brown-tail moth were rare in the vicinity of Florence, and they knew of no locality where they could be found at that time. Professor Berlese stated that some years previously at Portici he had known an army of gypsy-moth caterpillars to be perfectly destroyed by a disease which he identified as the pébrine, so destructive to the domestic silkworm. He promised to make a search during the coming season for diseased caterpillars and to rear a number of moths, which will be microscopically examined for pébrine corpuscles according to the Pasteur methods used in the bacological institutions of Italy and France. Should such moths be found, he promised to send the eggs to Mr. Kirkland in Boston. It would be a particularly interesting development of the work should relief come in this way, since it was partly with the idea of breeding a race of silkworms which would be resistant to pébrine that Trouvelot first imported his experimental gypsy moths into the State of Massachusetts.

FIG. 6.—*Tachina larvarum*, much enlarged (original).

FIG. 7.—*Chalcis flavipes*, greatly enlarged (original).

At the advice of Professor Berlese, who stated that the gypsy moth is more abundant in the Province of Lombardy than it is in Tuscany, the writer proceeded to Milan, and for some days searched through the woodland regions in that part of Italy, but without success. He then proceeded to Vienna, and at once visited the famous Natural History Museum in that city, interviewed the curator of Lepidoptera, Dr. Hans Rebel, and asked his advice concerning a local collector of energy and the proper attainments. Doctor Rebel recommended Fritz Wagner, a young man who is well versed in the subject of the European butterflies and moths and knows all of the best collecting places about Vienna. Mr. Wagner readily undertook the work, and accompanied the writer on several expeditions. The first trip was taken to

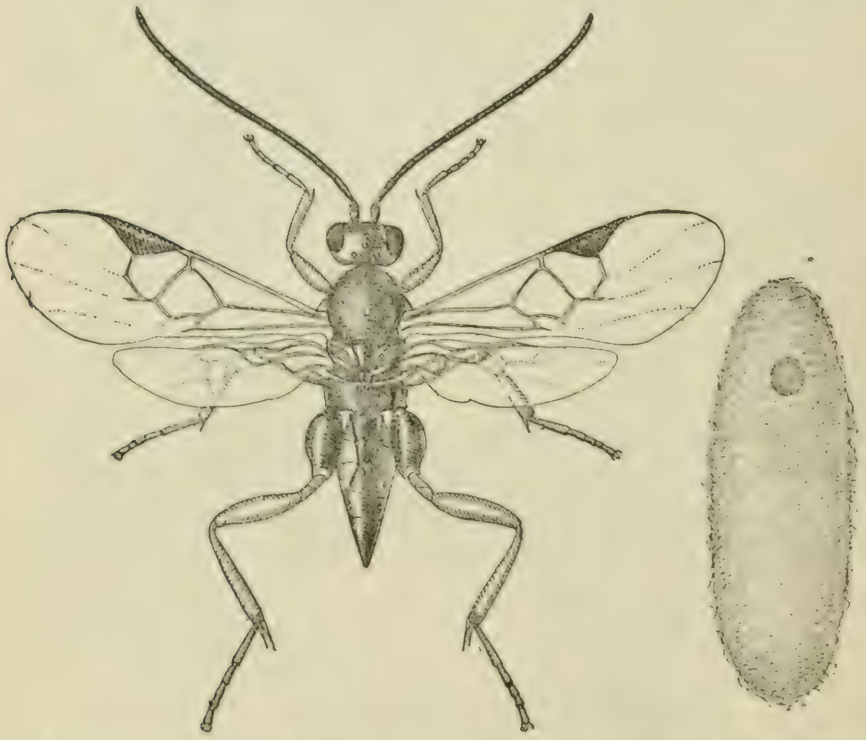
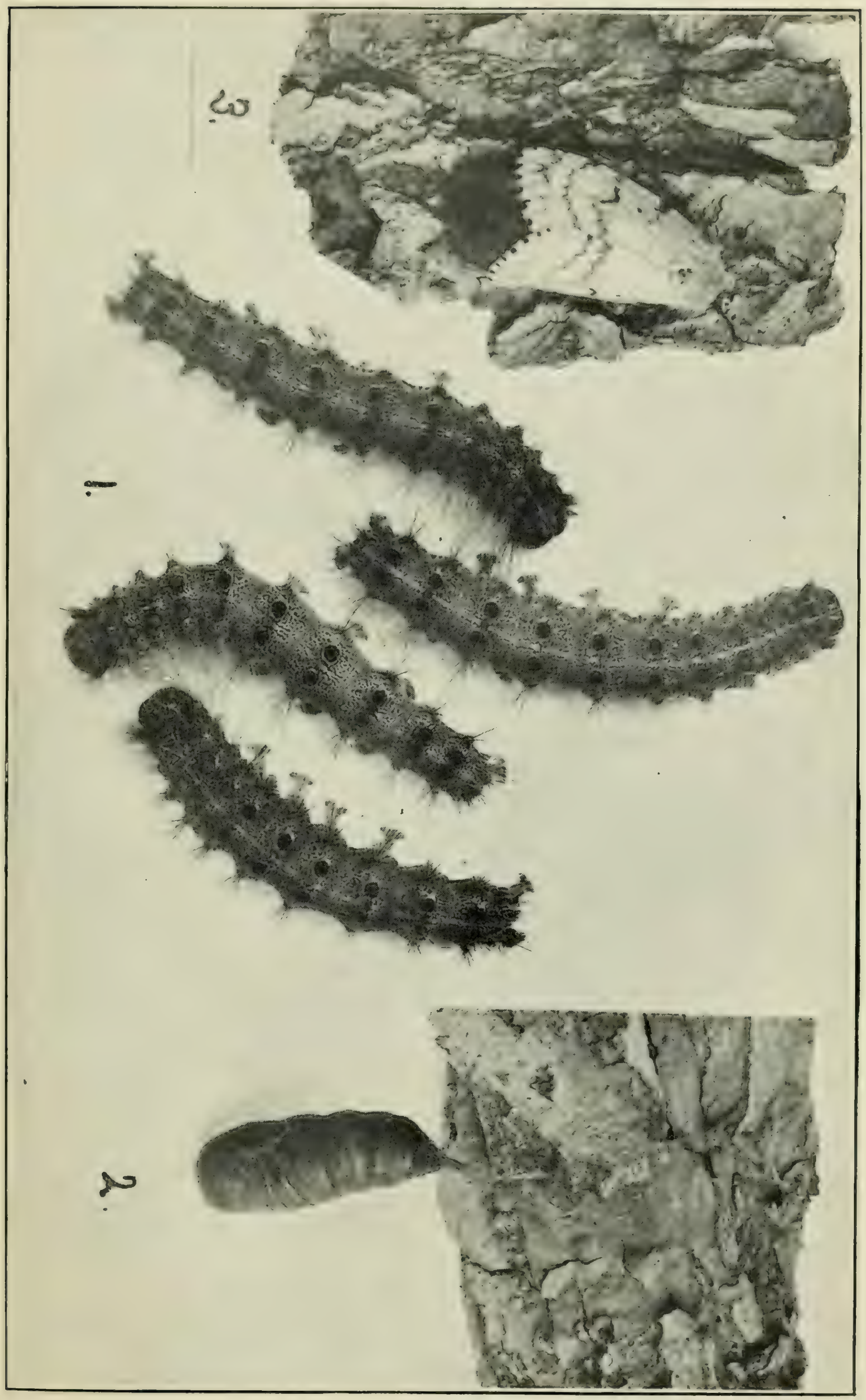


FIG. 8.—*Glyptapanteles fulvipes* and its cocoon, highly magnified (original).

the suburbs of the city, and there the writer found his first European specimen of the gypsy-moth larva. It was resting on the trunk of a locust tree by the side of the street (see Pl. II), and further examination showed that there were 100 or more caterpillars on the trunk and limbs of the same tree. There was some evidence of parasitism, and the white cocoons of a Microgaster parasite (*Glyptapanteles fulvipes* Hal., fig. 8) were found here and there in crevices of the bark. This particular tree, and another one to be mentioned later, indicate very well the condition of the gypsy moth in Europe. Although a hundred nearly full-grown larvæ were present, there was hardly any evidence of defoliation. A trained entomologist walking by the tree would not have noticed that insects had been feeding upon it to any



VARIOUS STAGES OF THE GYPSY MOTH.

[1, Full-grown caterpillars; 2, pupa; 3, female moth laying egg cluster. Natural size (after Kirkland).]

THE GYPSY MOTH IN THE UNITED STATES AND IN EUROPE.

[Above, laboratory building in the town of Saugus, Mass., for use in establishing imported parasites of the gypsy moth and the browntail moth. (Notice the trees defoliated by gypsy-moth caterpillars.) Below, at left, tree near Wagram, Austria, infested by caterpillars of the gypsy moth. Below, at right, locust tree in suburbs of Vienna, Austria, infested by gypsy moth larvæ. (Notice that the trees in the two lower figures do not show defoliation.) (Original.)]

extent. A similar tree in Malden or Medford would have carried not 100 larvæ but probably some thousands, and at that time of the year would hardly have held a whole leaf. These specimens were collected and sent to Boston.

Later, a trip was taken into the country, out by the famous battle-field of Wagram, and here on two roadside trees—poplars—was found another colony of the caterpillars, ranging in size from very small ones to full-grown larvæ. Here there was more extensive evidence of parasitism by Microgaster parasites, and here again, although there must have been 250 or more larvæ on the trees, the evidences of defoliation were very slight—so much so that at a rather short distance the trees appeared in full leaf (see Pl. II). Later, during the remainder of June and July, Mr. Wagner continued the search and sent considerable material to Mr. Kirkland at Boston.

After Vienna, the city of Budapest was visited. At the Natural History Museum in that city, Prof. Alexander Mocsary was consulted. Professor Mocsary is one of the first authorities of Europe on the subject of parasitic Hymenoptera, but was unable to give any new points in connection with the parasites of the gypsy moth and the brown-tail moth. The writer then visited the agricultural experiment station in the suburbs of Pesth, and there found Prof. Josef Jablonowski, the entomologist of the station. By this time it was the 4th of July, and the season in Hungary was already far advanced, being about two weeks or more earlier there than at Vienna. Professor Jablonowski said that gypsy moths had been found in certain localities in Transylvania, but that the adults were already issuing and that the brown-tail moth had been flying for some time. He showed me, however, a large box full of the last winter's nests of brown-tail larvæ, and stated that in the early spring he had bred from these nests many hundreds of parasitic insects. This at once indicated to the writer a very easy way of importing such parasites, since these nests can be collected in numbers and sent to Boston in large packages—a bushel or more in a package—in the late fall or winter season, and Professor Jablonowski consented to make every effort the coming winter to send over a large quantity of them. Taking into consideration the small size of the brown-tail moth caterpillars during hibernation, it seems strange that they should be so extensively parasitized as indicated by Jablonowski. The larger caterpillars in the late spring and early summer would seem more likely to be extensively infested. These winter nests of the young larvæ, remaining alone on the trees after the leaves have fallen, would seem to be an attractive place for small Hymenoptera of various kinds, and it is likely that many of the specimens considered at first glance as being true parasites of the brown-tail larvæ will prove to have been simply other species which have sought the nests for shelter

during hibernation. Nevertheless the experiment must be tried, and true parasites will probably be gained in this way. Professor Jablonowski also promised his best endeavors to send other material during the summer of 1906.

Dresden was the next point visited, and through the kindness of Professor Heller, of the Zoological Ethnological Museum, the writer was placed in relations with Mr. Eduard Schöpffer, a trained collector, who was engaged for the work in hand. Although at the date of the first visit to him the season was already considerably advanced—July 7 was the date of the first call—Mr. Schöpffer had breeding cages in operation in his rooms and in these cages were a number of nearly full-grown larvæ of the gypsy moth. He knew the localities about Dresden where these insects were to be found, and at once began sending specimens to Boston. The forest school at Tharandt, near Dresden, was visited, and Prof. Arnold Jacobi and his assistant, Mr. Behr, were interested in the work, and promised assistance, especially in the matter of sending specimens of *Calosoma sycophanta* and *C. inquisitor* during the coming winter.

Other trips were made in the vicinity of Dresden, and then the journey was resumed to Zurich, where, through the kindness of Dr. H. H. Field, director of the Concilium Bibliographicum Zoologicum, the writer met Miss Marie Rühl, the editor of Societas Entomologica, who is well posted on matters relating to butterflies and moths. Miss Rühl has a large correspondence with entomologists through North Germany, and was engaged as the official agent of the investigation for that part of Europe. She was able, through her own work and that of her correspondents, to send a large amount of material to Boston before the close of the season, and will continue the work.

From Zurich the trip was resumed to Paris, where some time was spent in interviewing Dr. Paul Marchal, the entomologist of the agricultural school conducted under the ministry of agriculture, and other entomologists, and in visiting the scientific societies for the purpose of interesting naturalists in the work. Many trips were taken to towns around Paris, in search of pupæ of the gypsy moth, and to visit local collectors in search of information, after which the writer returned to the United States via London.

The result of the trip has been to demonstrate that it is an easy matter and a comparatively inexpensive one to import the parasites of these two destructive insects in a living condition into the United States. The most important part of the European range of the two species has been visited, and the entomologists have been organized into an active body of assistants in this undertaking. They will continue the work for the next two years, and the writer, with the consent

of the Secretary of Agriculture, expects to visit Europe again in the late spring and early summer of 1906 in order to renew the search, to engage new helpers, and to stimulate operations. There can be no doubt that during the months to come there will be a continual sending of parasitized specimens of different stages of both gypsy moth and brown-tail moth from Europe to Boston.

Just what species will succeed in establishing themselves in Massachusetts is a question for the future to decide. That some of them will so become established there can be little doubt. And, with the European history of these parasites, it seems reasonably certain that, with care to exclude secondary parasites, the primary species will, with the abundance of food to be found in eastern New England, flourish and accomplish, at least in a measure, the result hoped for in their importation.

PREPARATIONS MADE FOR THE RECEIPT AND CARE OF THE PARASITES.

One of the first steps taken by Mr. Kirkland, after consultation with the writer, was to select an old orchard in the town of Saugus badly infested by both gypsy moth and brown-tail moth, where he had a large and strong framework erected over three old infested trees. This framework was tightly covered with wire netting. In this inclosure it is proposed to liberate the parasites of both species after careful examination to remove the secondary parasites. Mr. Kirkland then, after carefully examining the whole range of the infested territory, found a spot in Saugus where there was a good-sized house surrounded by woods in which the trees were all infested by the gypsy moth and fronting a dense growth of scrub oak completely infested by the brown-tail moth (see Pl. II). A competent assistant has been engaged who will live in the house, one-half being fitted up for laboratory purposes. In front of the house stands a large pine tree which, in July, 1905, was completely defoliated by the gypsy-moth larvæ, and which when photographed by the writer, September 21, 1905, had put out sparse new leaves. In the laboratory, in glass battery jars, are the puparia of the parasites received so far from Europe. Some of them will be kept out of doors during the winter and the rest in the laboratory, at a low temperature, however. The brown-tail nests which come in during the winter will be kept at a low temperature, and in the spring, when the buds begin to burst outside and the young larvæ begin their work, it is probable that the parasites will begin to emerge. At that time one of the expert entomologists of the Department of Agriculture will be stationed at the Saugus laboratory for a time, to make certain that no secondary parasites are liberated.

PROSPECTS FOR EVENTUAL RELIEF.

Such is the condition of the experiment in the introduction of the European parasites of the gypsy moth and the brown-tail moth at the time of writing (October 24), and the prospects are on the whole favorable for eventual relief. The relief, however, will not be speedy, and property holders in the infested regions must not relax their efforts to keep the injurious insects down. Observations during the past years have shown that the complete defoliation which results from the attacks of the insects will kill certain varieties of trees in two seasons, and if work against the insects be remitted while waiting for the parasites to develop, the consequent loss will be very great.

HOW PARASITES ARE TRANSMITTED.

By B. H. Ransom,

In Charge of Zoological Laboratory, Bureau of Animal Industry.

WHAT PARASITES ARE.

Animal parasites are animals which live in or upon other animals, temporarily or permanently, and depend upon the latter for nourishment; and since many of the diseases of man and other animals are due to the action of animal parasites, these organisms are of great interest from a practical standpoint. Especially important is a knowledge of their life histories, since the means of preventing parasitic diseases become apparent only after it is known how the parasites causing those diseases are transmitted. Everyone, therefore, and especially persons interested in live stock of any kind, should know something of the various ways in which parasites are transmitted from one animal to another; and it is to aid in the dissemination of such knowledge that the present paper has been written.

It may be stated in advance that animals derive their parasites only from other animals, directly or indirectly, and that in no case are parasites produced by spontaneous generation, but are always the offspring of ancestors similar to themselves. Such ideas as that of the origin of lice in filth, or of the development of intestinal worms from mucus, shreds of meat, straws, etc., mysteriously endowed with life, have long since been proved to be entirely wrong, and we know that lice do not come from anything but other lice, nor worms except from other worms.

There are several hundred known species of parasites occurring in man and the domestic animals, not to speak of thousands of others found in wild animals. They are classified according to their structure, and for the most part belong in the following groups:

(1) Arthropoda.—The principal kinds of arthropoda parasitic on domestic animals are as follows:

(*a*) Flies and mosquitoes. Mosquitoes and many of the flies are parasitic only when adult. On the other hand, only the larvæ of some flies are parasitic, the adults living entirely free. Certain of the blood-sucking flies and mosquitoes are transmitters of other parasites.

(*b*) Fleas.

(*c*) Lice.

(*d*) Ticks. Some species are especially important as the agents by which certain parasitic protozoa are transmitted.

(*e*) Mites. The most important forms are those which are parasitic on the skin and cause mange and scab.

(*f*) Tongueworms, which in spite of their wormlike appearance are related to the ticks.

(2) ROUNDWORMS (NEMATODA).—These worms are unjointed. The adult forms are found chiefly in organs opening directly to the exterior, such as the alimentary canal, respiratory organs, and urinary organs. Some, however, occur in the connective tissues, in the blood vessels, lymphatics, abdominal cavity, etc. The immature stages of some species are found encysted in various locations, walls of the intestines, muscles, liver, etc.

(3) TAPEWORMS (CESTODA).—Adult tapeworms are ribbonlike jointed worms occurring in the intestinal canal. Bladder-worms, which are the immature or larval stage of tapeworms, may be found in almost any organ.

(4) FLUKES (TREMATODA).—These are worms, usually flat and leaf-shaped, and of different sizes according to the species. They are found chiefly in the stomach, intestines, liver, lungs, and blood, but also in other organs.

(5) PROTOZOA.—These are small animals which are usually invisible except under a microscope. Parasitic protozoa are the cause of a number of important diseases among the domestic animals, a fact that has been recognized in many cases only very recently. They occur in various organs, but probably the most remarkable are those found in the blood.

MOSQUITOES.

The mosquitoes belong in the category of temporary or occasional parasites and are practically free-living animals. Except in a few species, only the female (fig. 9*a*) sucks blood, the male living altogether on vegetable juices. As almost everyone knows, mosquitoes propagate by means of eggs laid on the surface of water, and the "wigglers" hatching from these eggs are familiar objects in stagnant pools and rain barrels. The "wigglers" or larvæ (fig. 9*b*) transform into pupæ (fig. 9*c*) and finally into the mature winged insect, all within a few days.

FLIES.

The buffalo gnats and many of the horseflies have a life history very similar to that of the mosquito. The eggs are deposited near water or in moist places and the larval and pupal stages are passed in some cases in water, in others in damp earth.

The botflies are insects which are parasitic as larvæ and free-living when mature. Although animals often seem to be much afraid of these flies, the adult never bites and only the larvæ are parasitic.

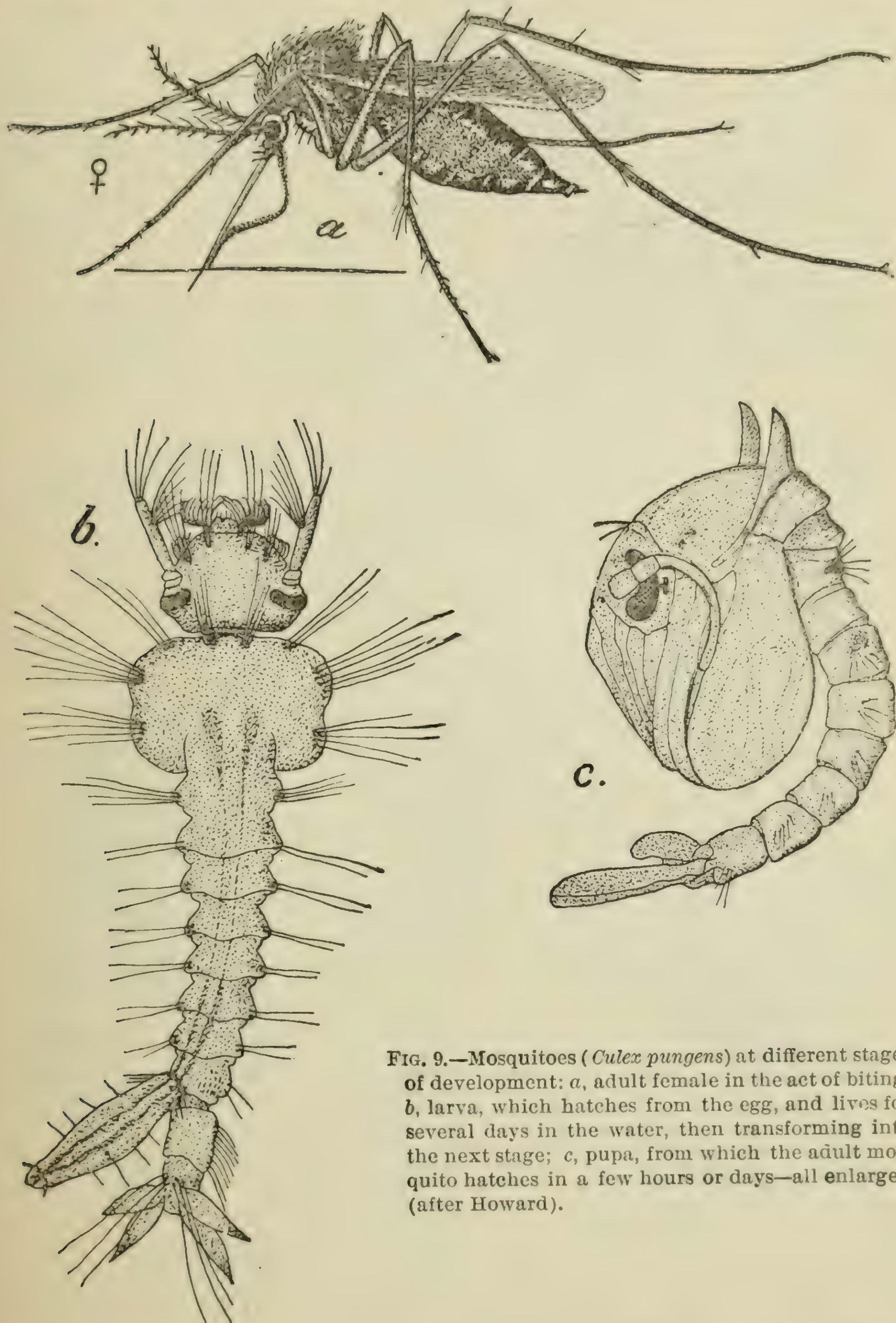


FIG. 9.—Mosquitoes (*Culex pungens*) at different stages of development: *a*, adult female in the act of biting; *b*, larva, which hatches from the egg, and lives for several days in the water, then transforming into the next stage; *c*, pupa, from which the adult mosquito hatches in a few hours or days—all enlarged (after Howard).

The sheep botfly (*Œstrus ovis*) is the adult of the well-known grub found in the heads of sheep (fig. 10). These insects are met with in the mature stage during the entire warm season from May to October.

FIG. 10.—The sheep botfly (*Œstrus ovis*) at different stages: *a*, adult female—enlarged (after Brauer); *b*, larvæ of different ages from the nose and frontal sinuses of sheep, the largest are nearly at the stage when they leave the sheep and transform into pupæ—natural size (after Curtice); *c*, pupa dissected to show the young fly within—enlarged (after Railliet).

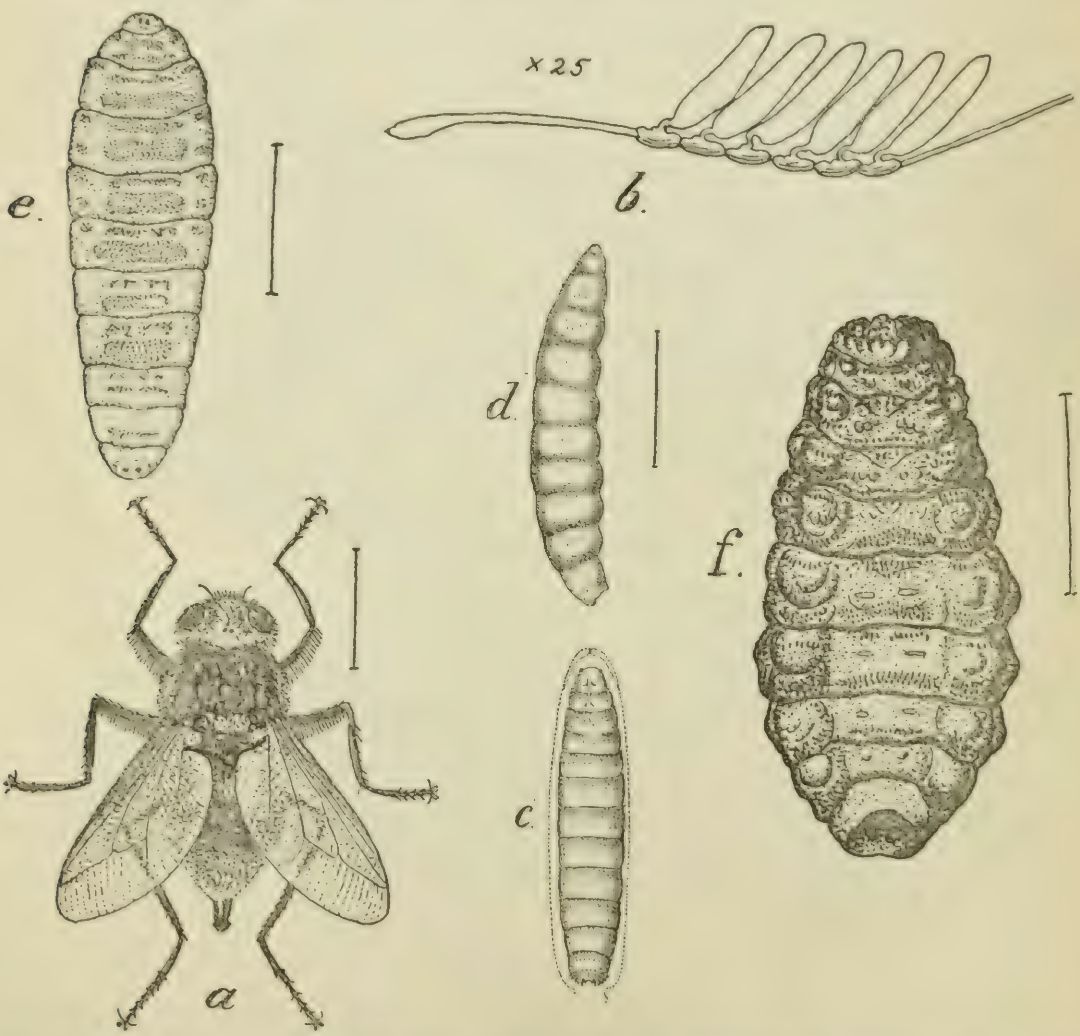


FIG. 11.—The warble fly (*Hypoderma lineata*): *a*, adult female; *b*, eggs attached to a hair, × 25; *c*, larva as seen in egg; *d*, larva from esophagus of an ox; *e*, next stage of larva from beneath the skin of the back; *f*, larva at the stage when it leaves the back of cattle and falls to the ground—all enlarged (after Riley).

The female (fig. 10*a*) deposits her young, already hatched from the egg, directly in the nostrils of the sheep. The larvæ (fig. 10*b*) then crawl up through the nasal passages and finally get into the frontal sinuses,

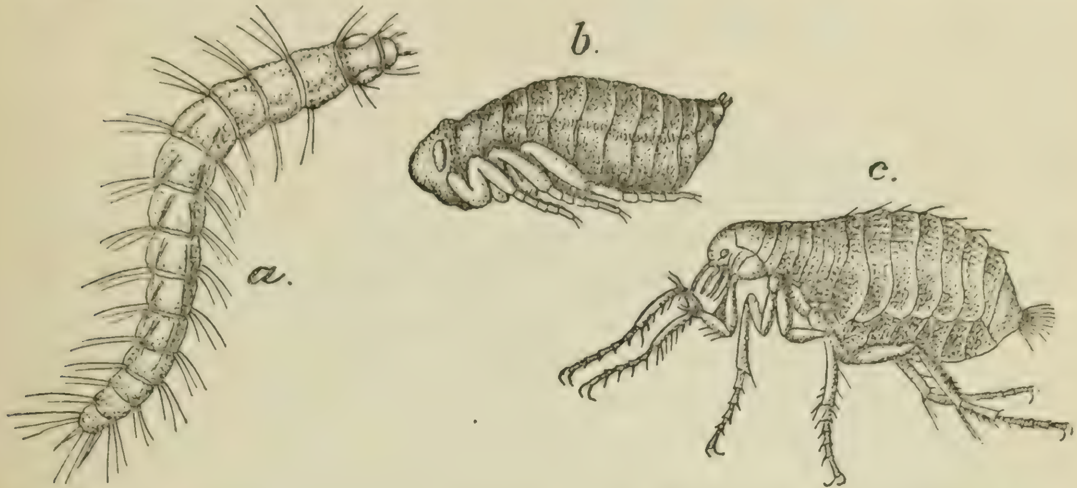


FIG. 12.—Various stages in the life history of a flea: *a*, larva, which lives amid dust and litter; *b*, pupa, found in same localities as larva; *c*, the adult flea—all enlarged (after van Beneden).

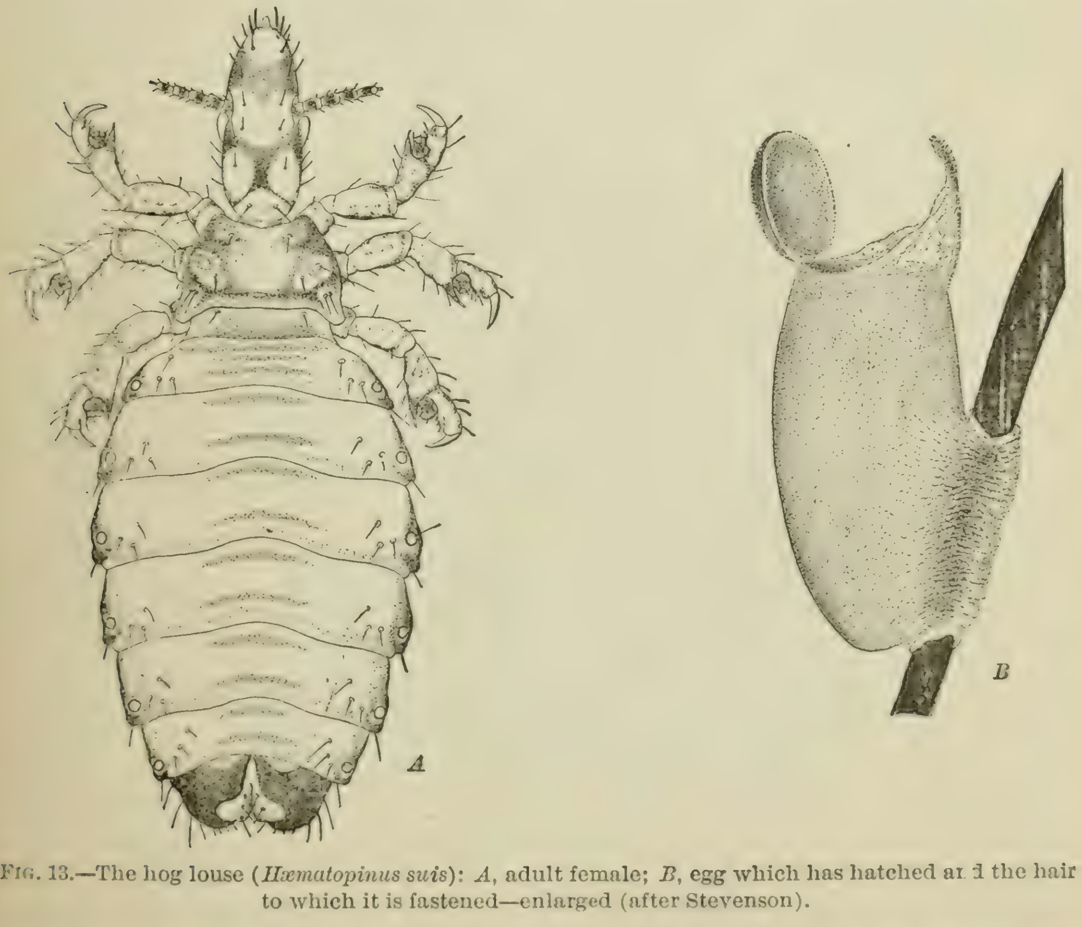


FIG. 13.—The hog louse (*Hæmatopinus suis*): *A*, adult female; *B*, egg which has hatched and the hair to which it is fastened—enlarged (after Stevenson).

which are located between the two plates of the skull just above the eyes. In this situation they grow and develop during a period of about ten months. At the end of this time they desert the frontal

sinuses and travel back through the nose by the way they came. From the nose they are expelled by the sneezing and snorting of the sheep. They then burrow into the ground and pass into a quiescent stage (pupa). This stage (fig. 10*c*) lasts about a month or six weeks. The envelope of the pupa is then ruptured and the mature fly comes forth.

The botflies of horses have a life history very similar to that of the sheep botfly, but slightly more complicated. They deposit their unhatched eggs upon the skin, gluing them to the hairs and usually in regions within reach of the horse's lips and tongue. After a number of days' incubation the eggs hatch and the larvæ are carried by the tongue into the mouth and swallowed. They then attach themselves to the wall of the stomach, duodenum, or rectum, where they remain for several months. Finally loosening their hold, they are carried out of the body in the dung and complete their development in the ground, passing through a pupal stage in the same manner as the sheep botfly.

The grubs known as "warbles," which are common parasites of cattle under the skin of the back, are the larvæ of flies nearly related to the botflies of horses and sheep. The species found in this country, *Hypoderma lineata* (fig. 11), deposits its eggs (fig. 11*b*) on the hair, chiefly on that around the heel. The cattle in licking themselves carry the eggs into the mouth, and after boring through the wall of the gullet, the larvæ (fig. 11*c*, *d*) gradually work their way through the tissues up to the back, where they (fig. 11*e*) finally show up beneath the skin, reaching this point usually in the month of January. Here they grow until March, or even as late as May, and then work through the skin and fall to the ground (fig. 11*f*). After a month passed in the ground as pupæ the adult flies come forth.

The hornfly, which is parasitic upon cattle during the adult stage, deposits its eggs in cow manure and the free-living larvæ undergo their development there, descending into the ground when ready to pass into the pupal stage.

Screw flies deposit their eggs in wounds, exposed openings of the body, or decaying matter, three or four hundred at a time. These eggs hatch in a few hours and the larvæ finish their development in about a week, meanwhile creating serious damage to the surrounding tissues. Burrowing into the ground, the larvæ transform into pupæ, from which the mature flies emerge in from ten to twelve days. Screw flies differ from botflies in so far as their larvæ are not necessarily parasitic, but may develop in various decaying substances as well as in living flesh.

The so-called sheep tick (*Melophagus ovinus*) is in reality a wingless fly. The method of reproduction is rather unusual in that the eggs hatch and the larvæ develop in the body of the adult as far as the pupal stage. When the pupa is expelled, its case soon becomes hard and

glossy, but remains glued to the wool by a sticky substance. The entire life of the sheep tick, unlike that of the other insects so far discussed, is passed on the body of its host, and it is therefore a permanent parasite. It is transferred from sheep to sheep chiefly by direct contact of the animals, and, as a rule, lives only a few days or a week when removed from its host.

FLEAS.

The eggs of fleas are scattered by infested animals in various places, especially in their sleeping quarters. Little maggotlike larvæ (fig. 12*a*) hatch from the eggs and feed upon the decaying organic matter that they find amid the dust and litter in which they live. At the next stage of development they spin about themselves a delicate cocoon and change into a pupa (fig. 12*b*). Finally the mature flea (fig. 12*c*) comes forth from the pupa.

LICE.

The lice (fig. 13A) of various kinds so common upon animals are parasites which pass their entire existence upon their hosts, and are transmitted from one animal to another by direct transfer. They deposit eggs (fig. 13B), which are attached to the hairs or feathers of their host, and the young lice grow directly to maturity after hatching.

TICKS.

Many species of ticks are known which occur on domestic animals and some of them are of particular importance and interest as transmitters of protozoan parasites. The most important tick of this country is the Texas fever cattle tick (*Boophilus annulatus*). The females (fig. 14) fall from their host when ready to deposit their eggs, which are laid in a mass of several hundreds, and hatch after a period of incubation, which varies somewhat according to the temperature. The small seed ticks, or larvæ (fig. 15), which possess only three pairs of legs, are able to live without food for a considerable length of time, but finally die unless they find a host. If a suitable host animal is found, they attach themselves by means of their proboscis, grow for about a week, and then cast their skins, emerging with eight legs. This second (nymphal) stage (fig. 16) lasts about another week, during which considerable growth occurs, and then the molting process is repeated, giving rise to the mature male or female tick, also with eight legs. At this time the female is little larger than the male, but she soon begins to swell out, and finally, about three weeks later, is fully engorged and ready to fall to the ground and lay her eggs.

Normally, Texas fever ticks remain upon the same host until they have grown to complete maturity, but recent experiments have proved that Texas fever ticks taken from an animal at the time of either molt

will continue to develop if placed on other cattle. It has also been found that Texas fever ticks will sometimes develop to the adult stage upon cats and dogs, but as a rule this species is restricted to cattle and other large animals, such as deer, horses, mules, and donkeys.

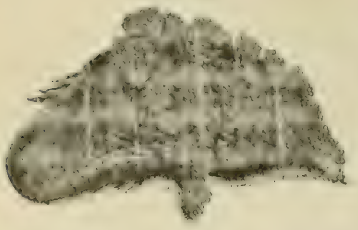


FIG. 14.—A female tick depositing eggs (natural size).

Other species of ticks have a life history somewhat different from that of the Texas fever tick and fall from their host each time when ready to molt, crawling back again upon the same or a different host after molting. Some ticks pass their

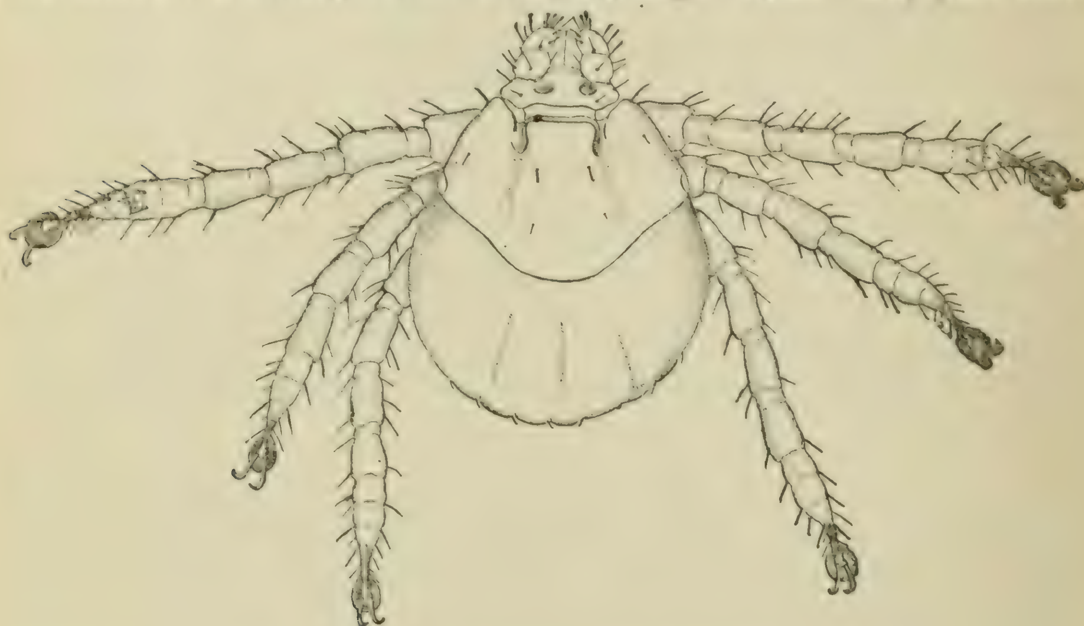


FIG. 15.—Larva of a tick enlarged about 70 times (after Salmon & Stiles).

larval stage upon rabbits and other small rodents, reptiles, birds, etc., and do not attach themselves to dogs and cattle until they have attained the nymphal or adult stage.

MITES.

The well-known little red mite (*Dermanyssus gallinæ*) is one of the most persistent and injurious of the parasites affecting chickens. Although apparently depending entirely upon blood for food, it is not permanently parasitic, attaching itself to its host only at night. As it is a very fertile breeder and can live for months away from its host, it is a very difficult pest to destroy. The eggs are deposited in corners, cracks, and other such places in which the mites hide by day.

FIG. 16.—Nymph of a tick (*Boophilus annulatus*)—enlarged about 10 times (after Salmon & Stiles).

The various species of scab mites (fig. 17) are permanent parasites and undergo all their life cycle on the bodies of their hosts. Eggs are deposited amid the scabs or in the

burrows produced by the mites, and from these are hatched the larvæ, which in due course develop into nymphs, and finally into adults. Transmission of these forms as a rule depends upon contact of the diseased animals with other animals and the consequent transfer of mites or their eggs. Tags of wool on fences are a frequent means of transmission in the case of sheep scab.

TONGUEWORMS.

The tongueworm, so called from its shape, occurs when adult as a parasite in the nasal cavity of various animals, one of the most common hosts being the dog (fig. 18). In its larval stage it is found in the viscera of various animals, especially in the mesenteric glands and the liver. Its transmission from dogs to cattle, sheep, etc., and vice versa, is as follows:

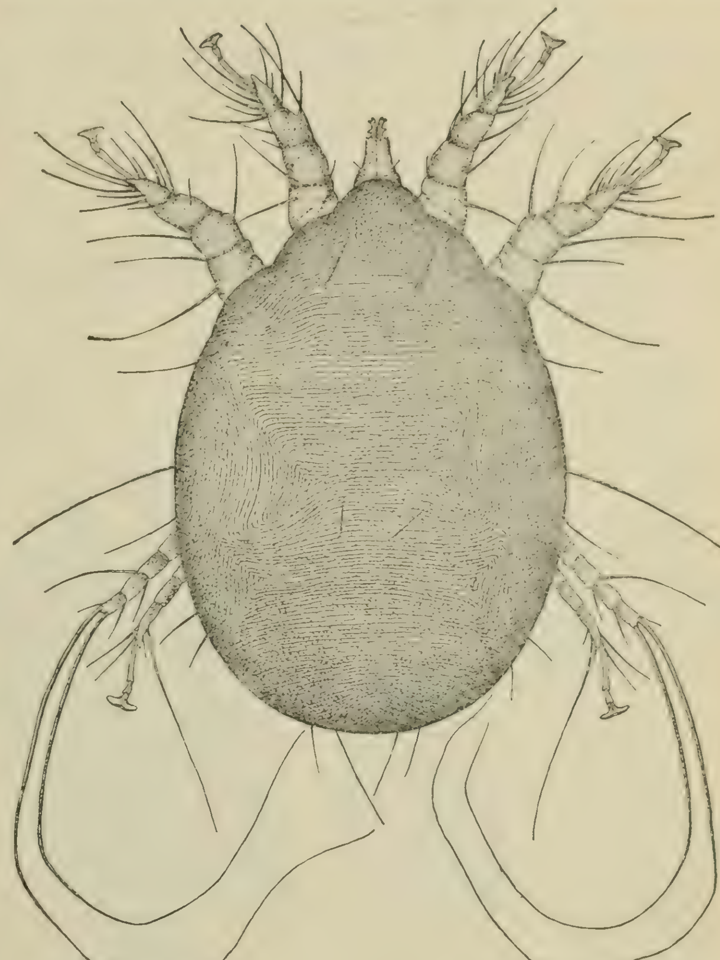


Fig. 17.—Adult female sheep-scab mite—greatly enlarged (after Salmon & Stiles).

The eggs (fig. 20*a*) produced by the adult (fig. 19) are discharged from the dog's nose by sneezing, and thus scattered in various places, from some of which (grass, lettuce, etc.) they are liable to be picked up by various herbivorous animals, including man. The larvæ (fig. 20*b*), having been freed by the action of the digestive juices on the shells of the eggs, migrate to the liver or mesenteric glands (fig. 21), where they undergo considerable development. If organs thus infested are now eaten by a dog, the young tongueworms (fig. 20*c*) gain access to the nasal cavities and develop to the adult stage.

This parasite is one of several more or less dangerous parasites for whose dissemination the dog is responsible, and on account of which dogs, even though apparently healthy themselves, are often the source of great danger to the health of men and live stock.

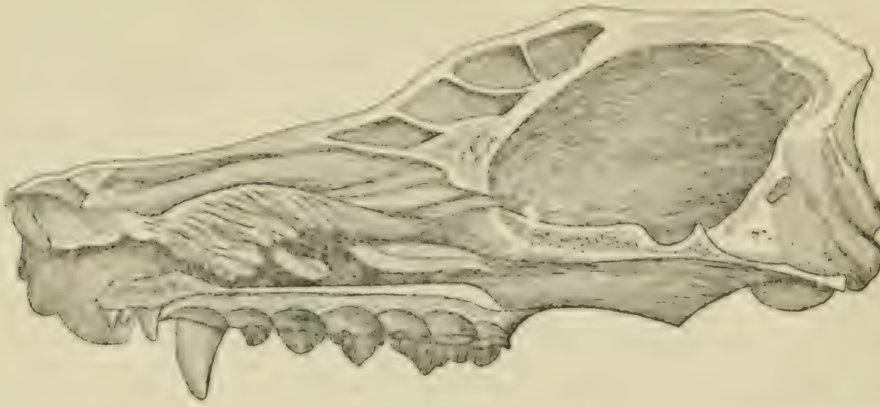


FIG. 18.—Head of dog split in half to show three tongueworms in the nasal cavity—reduced in size (after Colin).

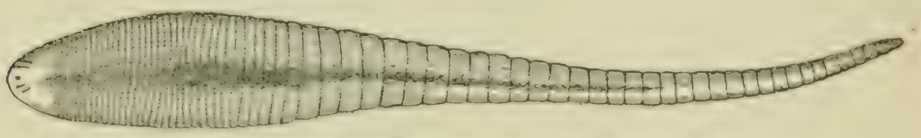


FIG. 19.—Adult female tongueworm—natural size (after Neumann).

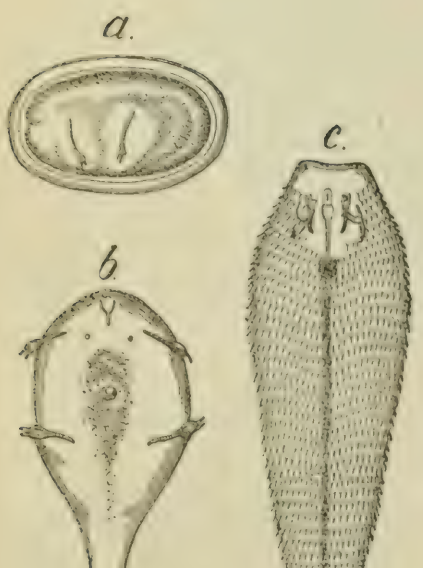


FIG. 20.—Immature stages of the tongueworm: *a*, egg containing embryo—enlarged 200 times (after Leuckart); *b*, embryo as it appears just after hatching in the stomach—greatly enlarged (after Leuckart); *c*, larva as it occurs in the liver and lymphatic glands of sheep, cattle, etc.—enlarged 10 times (after Railliet).

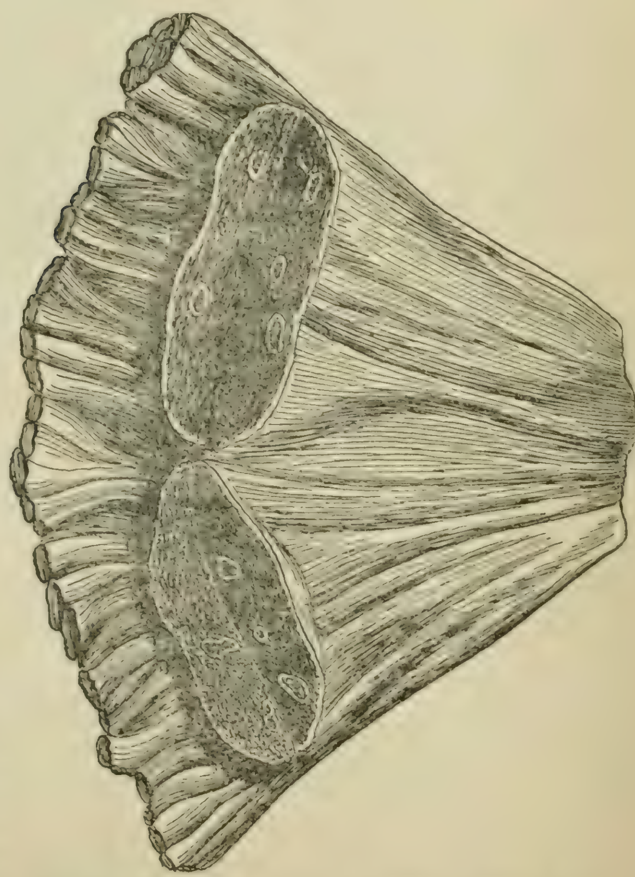


FIG. 21.—Mesenteric glands of a steer infested with the l rvæ of the tongueworm (after Ostertag).

ROUNDWORMS.

Most of the roundworms living in the digestive organs are transmitted from one animal to another by eggs or embryos which, while they may have to undergo a certain amount of development in the

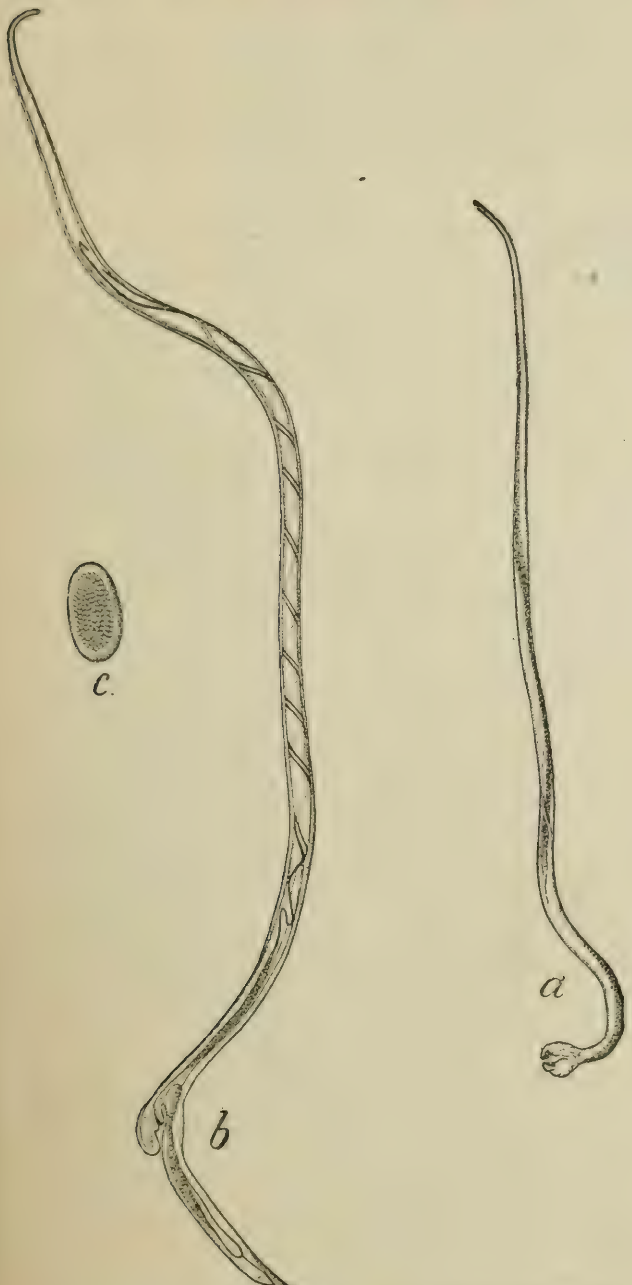


FIG. 22.—Twisted wireworm of sheep (*Hæmonchus contortus*): *a*, male; *b*, female; *c*, egg—all enlarged (after Curtice).

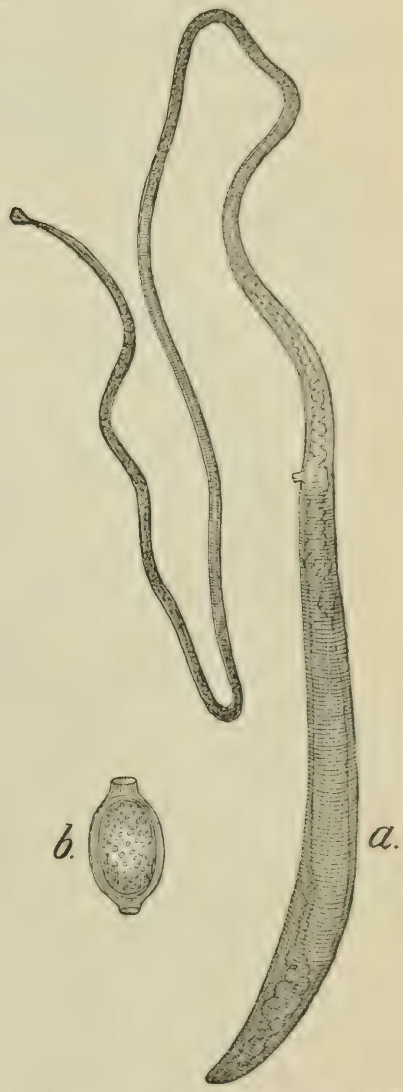


FIG. 23.—Whipworm (*Trichuris affinis*): *a*, adult female; *b*, egg.

outer world, do not require an intermediate host. In such cases animals become infected by swallowing the eggs or embryos in water or food which has been soiled directly or indirectly with the manure of animals infested with the mature egg-producing worm. Although

it is not known certainly, such seems to be the manner in which the stomach worm or twisted wireworm (*Hæmonchus contortus*) of sheep is transmitted (fig. 22). The eggs (fig. 22*c*) are scattered by infested sheep over the pastures, and in a few hours or days they hatch. The embryos are able to live for a considerable time in water or damp earth—just how long is not known—but do not complete their development until picked up again by sheep or cattle, which may happen while these animals are grazing or drinking. It is evident that the draining of damp pastures and the protection of the water supply from contamination with manure are important points in the prevention of infection with this parasite.

In some species of roundworms the eggs are thick shelled and do not hatch until they are swallowed by the proper host. Such eggs are usually very resistant, and will pass through many unfavorable conditions which would prove speedily fatal to thin-shelled eggs and free-living embryos. The whipworms (fig. 23) found in the large intestines of various animals and the pinworm (*Oxyuris vermicularis*) and eelworm (*Ascaris lumbricoides*) of man are all forms with thick-shelled eggs. Such parasites are transmitted by the food or water, or accidentally by other articles, soiled with the eggs.

It has recently been discovered that some species of roundworms which are parasitic in the intestine are not only transmitted by the swallowing of their embryos but also by the penetration of these embryos through the skin. The hookworms, of which a number of species infesting different animals are known, are thus transmitted. The eggs, which are thin shelled, hatch in a few hours after leaving the intestine, and the embryos become free in the water or damp earth. After undergoing a certain amount of growth and development they are ready to develop to maturity, if swallowed; or, if they are brought into contact with the skin, as may readily happen by the soiling of the body with infested dirt, they will wriggle their way into the hair follicles and continue to work through the tissues until they come to a blood vessel. They are carried by the circulation to the heart and then to the lungs. In the lungs they leave the blood vessels and enter the air cells, and, moving outward along the air passages, they finally leave the windpipe, enter the esophagus, then the stomach, and at last, in this roundabout way, reach the intestine.

The life histories of the roundworms found in the lungs of cattle, sheep, and swine are not known, but there are indications that some of these forms pass a portion of their embryonic development in earthworms. The embryos of the worm (*Syngamus trachealis*) whose presence in the windpipe causes "gapes" in chickens (figs. 24–26) also seem sometimes to enter the bodies of earthworms. In this case, however, it is known that earthworms are not necessary intermediate hosts, and that the parasite may be transmitted directly by swallowing

the embryos either before or after they have hatched from the eggs. The eggs or embryos of lungworms reach the outer world in the sputum coughed up from the lungs of their host.

Although direct development is the rule among roundworms, there are many species which must necessarily pass through an intermediate host before they can develop to maturity. *Trichinella spiralis* (= *Trichina spiralis*) is such a form, and a very important one on account of the serious disease known as trichinosis which it produces in man. This parasite is able to live in a large number of different species of animals, the most common hosts, however, being pigs, rats, and human

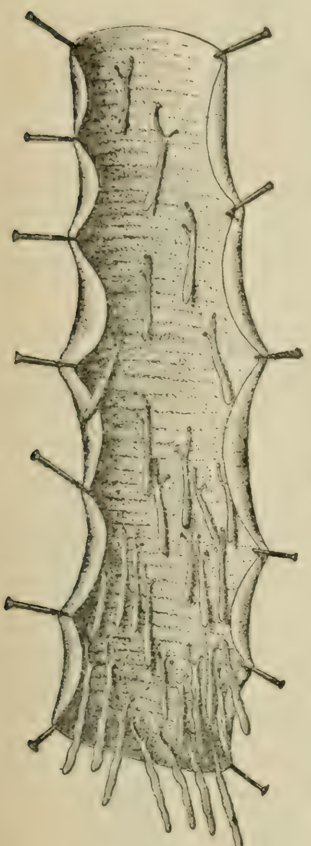


FIG. 24.—Windpipe of chicken split open to show gapeworms attached to its inner surface—enlarged (after Mégnin).

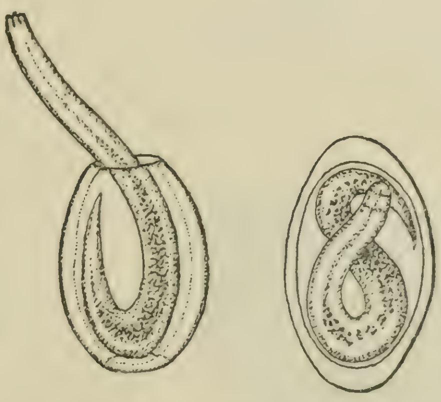


FIG. 25.—Eggs of the gapeworm (*Syngamus trachealis*), one of them hatching — enlarged 260 times (after Mégnin).

FIG. 26.—Gapeworm (*Syngamus trachealis*): *a*, male firmly attached to female, *b*—enlarged 5 times (after Mégnin).

beings. The adult forms (figs. 30, 31), which occur in the intestine, are short lived, but each female during her life of a month or less produces from 10,000 to 15,000 embryos which are already hatched when born. The embryos penetrate the wall of the intestine, work their way through the tissues, and aided by the circulation reach nearly every part of the body. They finally settle down in the muscles (figs. 27–29) and become encysted. During the period of this migration very serious symptoms are produced in man, and in cases of heavy infestation death commonly results. Pigs, however, stand even very heavy infestation fairly well and rarely die. The embryos will remain

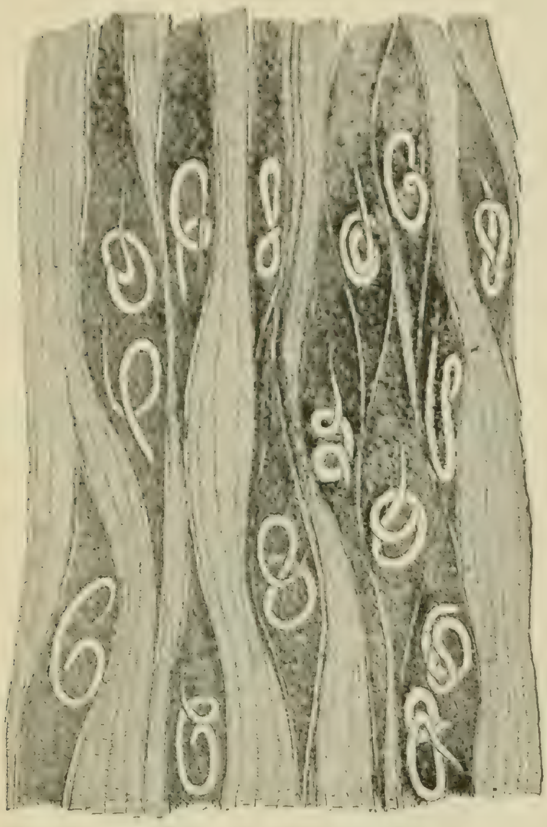


FIG. 27.—Larvæ of *Trichinella spiralis* in muscle, not yet encysted—enlarged (after Leuckart).

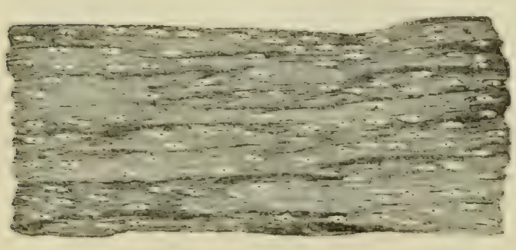


FIG. 28.—Piece of pork showing larvæ of *Trichinella spiralis* encysted in the muscle fibers—natural size (after Ostertag).

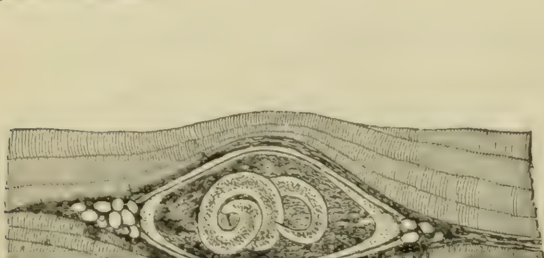


FIG. 29.—Encysted larva of *Trichinella spiralis*—enlarged (after Leuckart).

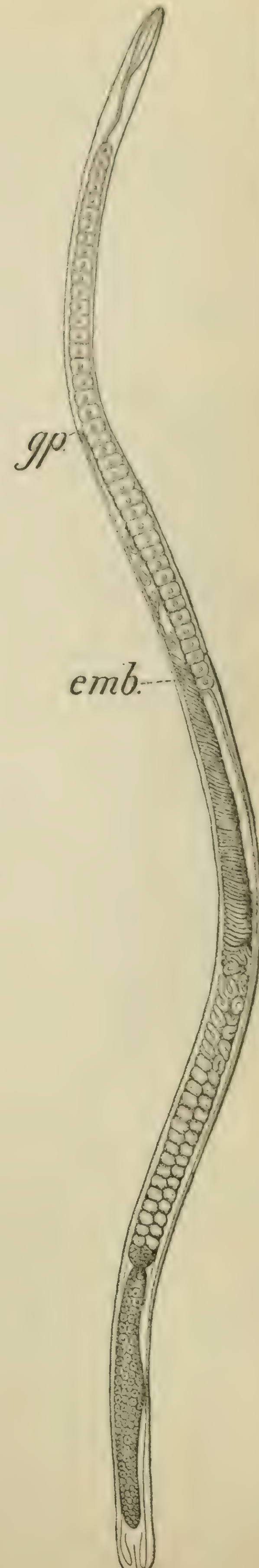


FIG. 30.—*Trichinella spiralis:* adult female showing embryos, *emb*, in uterus; *gp*, genital opening through which the embryos are discharged—enlarged (after Leuckart).

alive encysted in the muscles for as long as ten years, but finally die unless the flesh (fig. 28) containing them is eaten by some animal. If swallowed the embryos are set free, and within a week have grown to maturity and are producing embryos in their turn. From the foregoing it is evident that man acquires the parasite by eating pork infested with the encysted embryos. Such pork, however, is only

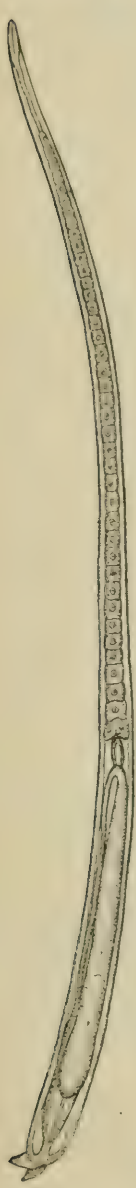


FIG. 31.—*Trichinella spiralis:* adult male—enlarged (after Leuckart).

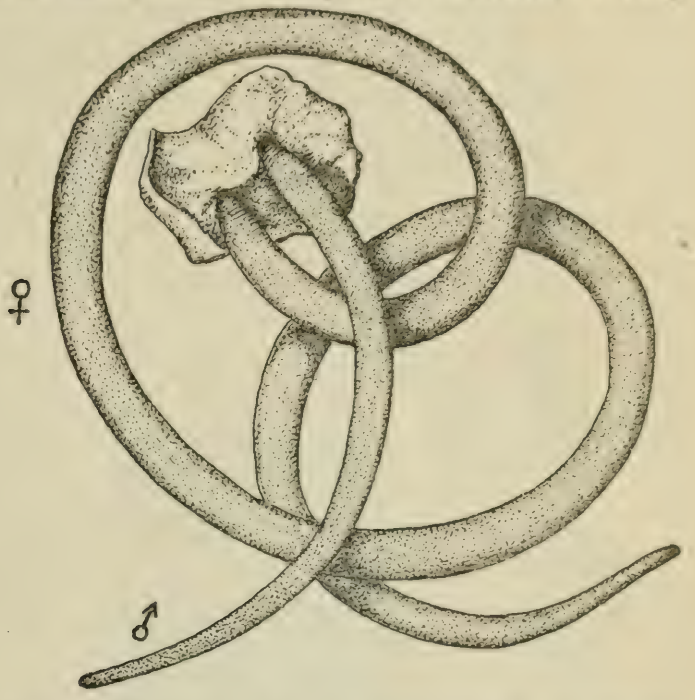


FIG. 32.—Thorn-headed worms (*Echinorhynchus hirudinaceus*) attached to piece of pig's intestine: ♂, male; ♀, female—enlarged (original).

FIG. 33.—Larva of May beetle, in which the intermediate stage of the thorn-headed worm of pigs develops—enlarged one-fourth (after Chittenden).

dangerous when raw or imperfectly cooked; thorough cooking, which kills the embryos, renders the most heavily infested meat harmless. Pigs acquire the parasite in two ways—by devouring the carcasses of infested pigs or by eating infested rats. The feeding of hogs with offal at slaughterhouses is a common way in which the parasite is spread, and rats about slaughterhouses become infested in a similar

way. The practice of keeping hogs at slaughterhouses and feeding them with the uncooked refuse from slaughtered animals can not be too vigorously condemned, as it is one of the principal ways in which

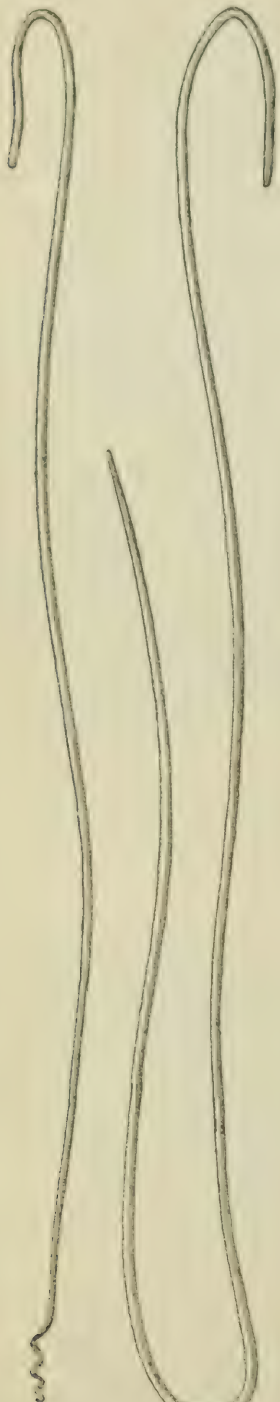


FIG. 34.—Thread worms (*Filaria immitis*) from the heart of a dog, male to the left, female to the right—natural size (after Railliet).

FIG. 35.—Embryo of *Filaria immitis* as it appears in the blood of dogs—greatly enlarged (after Noè).

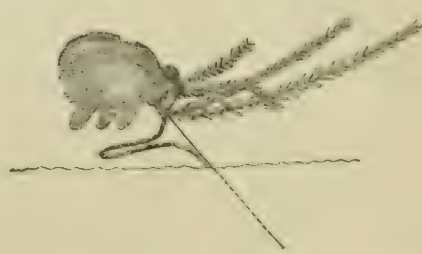


FIG. 36.—Position of the proboscis of a mosquito while biting—enlarged (after Noè).

the parasite is propagated. The parasite is transmitted to rats by the offal of slaughtered hogs, and from one to another by the more or less common occurrence of cannibalism.

The thorn-headed worm of pigs (*Echinorhynchus hirudinaceus*) is the principal representative and one of very few of its class occurring in domestic animals. The thorn-headed worms are sometimes classed with the roundworms proper and sometimes in a separate group. *Echinorhynchus hirudinaceus* (fig. 32) is very common in hogs in the United States, occurring in the intestine, to the wall of which it is firmly fixed by means of its thorny head. Like most other intestinal parasites, it produces eggs which are carried out of the intestine in the droppings. If the eggs thus scattered about over the ground are swallowed by the grubs of May beetles (fig. 33) (large white grubs commonly found in rich soil), they hatch and the embryos become encysted in the body cavity of the grubs. When grubs thus infested are eaten

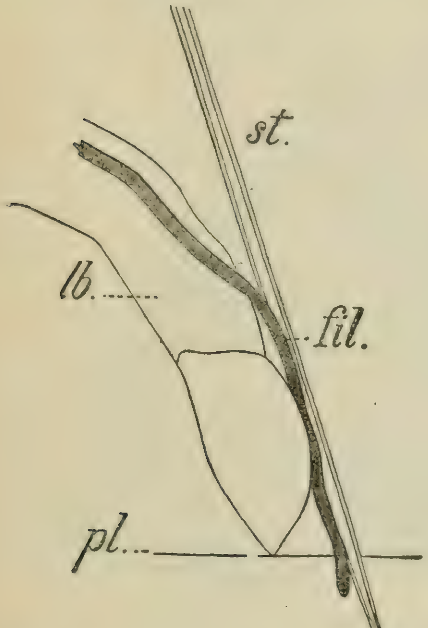


FIG. 37.—Manner in which the embryos of *Filaria immitis* are transmitted to dogs by mosquitoes: *pl*, surface of skin; *lb*, labium of mosquito from which an embryo, *fil*, is escaping; *st*, piercing stylets of mosquito—greatly enlarged (after Noè).

FIG. 38.—Portion of the intestine of a dog infested with echinococcus tapeworms—natural size (after Ostertag).

FIG. 39. — Adult echinococcus tapeworm from the intestine of a dog—enlarged (after Leuckart).

by pigs, the embryos are released from their cysts, and, after fastening to the intestinal wall, continue their development to maturity.

There are a number of species of roundworms occurring in the domestic animals which are found in rather inaccessible places in the body without any direct outlet for their eggs or embryos. In many cases the life history of these species has not been determined, but it is known that such forms commonly deposit their embryos in the blood vessels. For example, one of these (*Filaria immitis*), which (fig. 34) is found in the heart of dogs and is of rather common occurrence in some parts of this country, is known to have the following life history: The embryos (fig. 35), which circulate in the blood stream, are liable to

be sucked up by mosquitoes during the act of biting. If taken thus into the body of certain species of mosquitoes, the embryos continue their development, and when they have attained the proper stage will develop to maturity if returned to the circulatory system of the dog. At the stage when they are ready to leave the mosquito they are found in the part of the proboscis known as the labium, the tip of which, during the act of biting, rests on the skin just behind and in contact with the piercing stylets (fig. 36). The embryos break through the thin membrane of the tip of the labium and enter the body of the dog through the wound made by the piercing stylets (fig. 37); then reaching the blood vessels they are carried to the heart, where they complete their development.

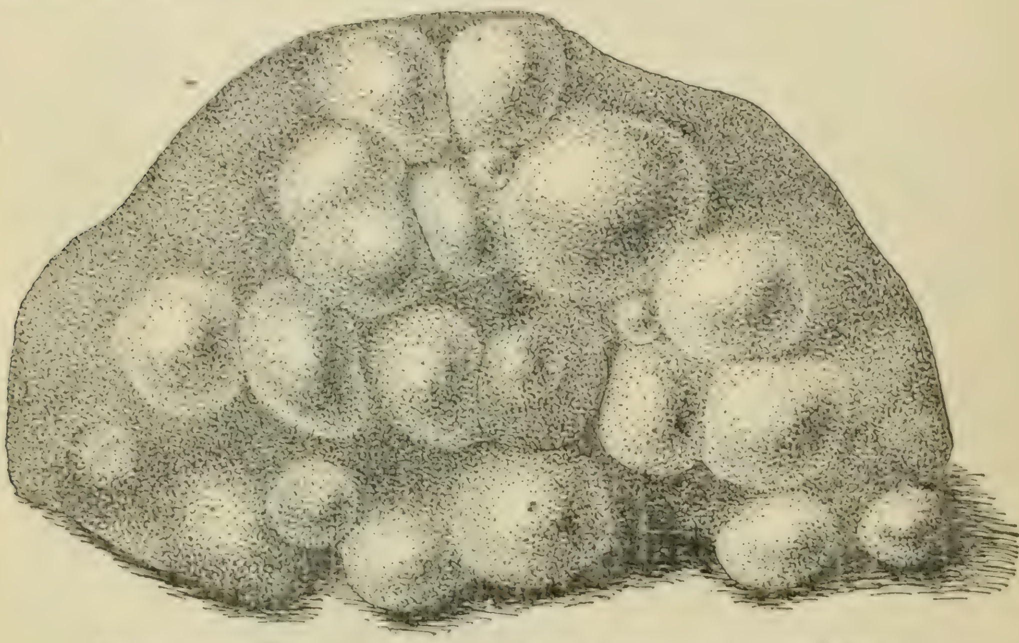


FIG. 40.—Portion of a hog's liver infested with echinococcus bladder-worm—natural size (after Stiles).

A number of other nearly related species of roundworms whose embryos are found in the circulation of their hosts are also evidently transmitted by mosquitoes, and some are apparently transmitted by fleas in a similar manner.

TAPEWORMS.

Tapeworms of every species whose life history is known, with few exceptions, pass a portion of their life history encysted in the tissues of some animal before attaining maturity in the final host. The encysted stage, or bladder-worm, commonly occurs in animals which serve the final hosts for food. Thus one of the tapeworms of man passes its intermediate stage in cattle; another in hogs. The cat has a tapeworm whose intermediate stage is found in rats and mice. Two of the tapeworms of dogs pass their bladder-worm stage in rabbits, and many of the tapeworms of birds occur in insects during their

intermediate stage. In each case the intermediate host becomes infected by swallowing the eggs from the mature tapeworm which are scattered about in the droppings of the final host, and the final host becomes infected from swallowing the bladder-worm which is encysted in the tissues of the intermediate host.

Three of the tapeworms of dogs are of particular interest, because their intermediate stages occur in live stock. The intermediate stage of one occurs also in man.

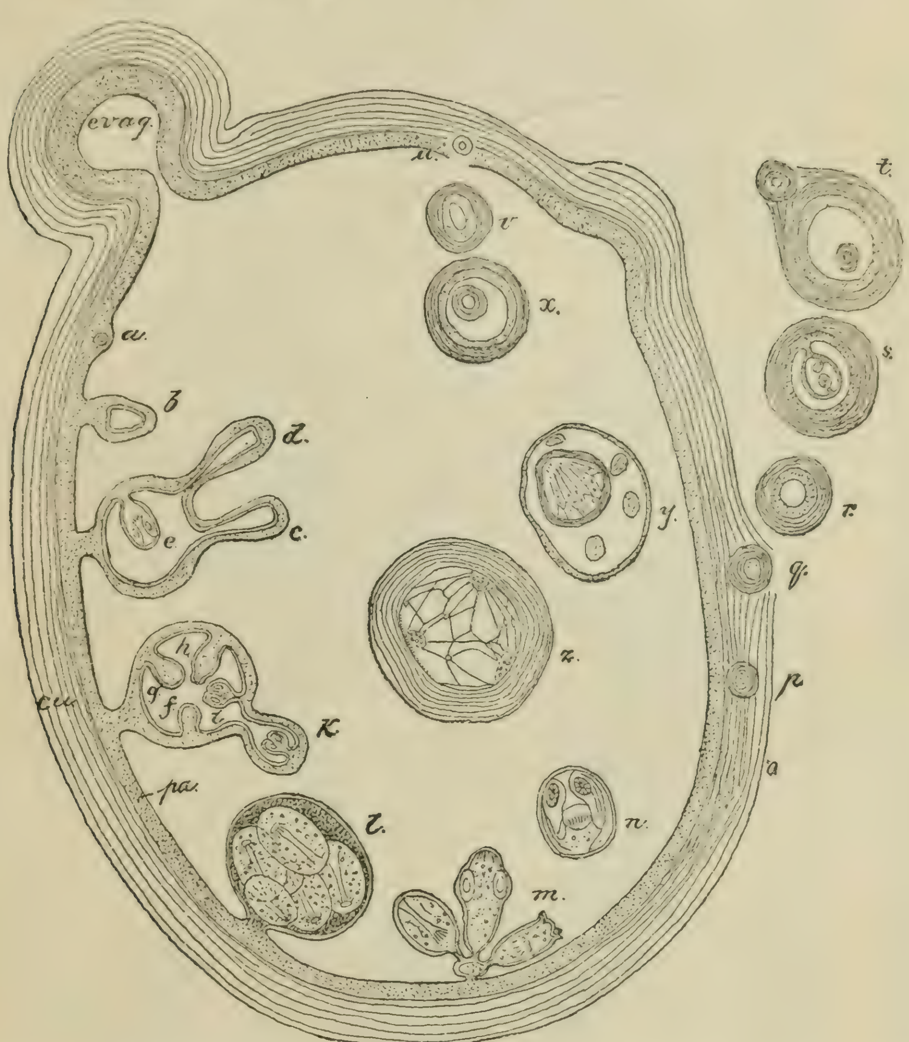


FIG. 41.—Diagram of an echinococcus bladder-worm: *cu*, thick external cuticle; *pa*, parenchyme (germinal layer); *c*, *d*, *e*, development of the heads, according to Leuckart; *f*, *g*, *h*, *i*, *k*, development of the heads, according to Moniez; *l*, fully developed brood capsule with heads; *m*, the brood capsule has ruptured, and the heads hang into the lumen of the hydatid; *n*, liberated head floating in the hydatid; *o*, *p*, *q*, *r*, *s*, mode of formation of secondary exogenous daughter cyst; *t*, daughter cyst with one endogenous and one exogenous granddaughter cyst; *u*, *v*, *x*, formation of endogenous cyst, after Kuhn and Davaine; *y*, *z*, formation of endogenous daughter cysts, after Naunyn and Leuckart; *y*, at the expense of a head; *z*, from a brood capsule; *evag*, constricted portion of the mother cyst (after R. Blanchard, 1886, p. 426, fig. 257, slightly modified).

The adult echinococcus tapeworm (figs. 38, 39), a tiny creature a fraction of an inch long, is comparatively harmless to the dog which it infests, but its intermediate stage is one of the most fatal parasites known, especially to man. It is transmitted to cattle, sheep, man,

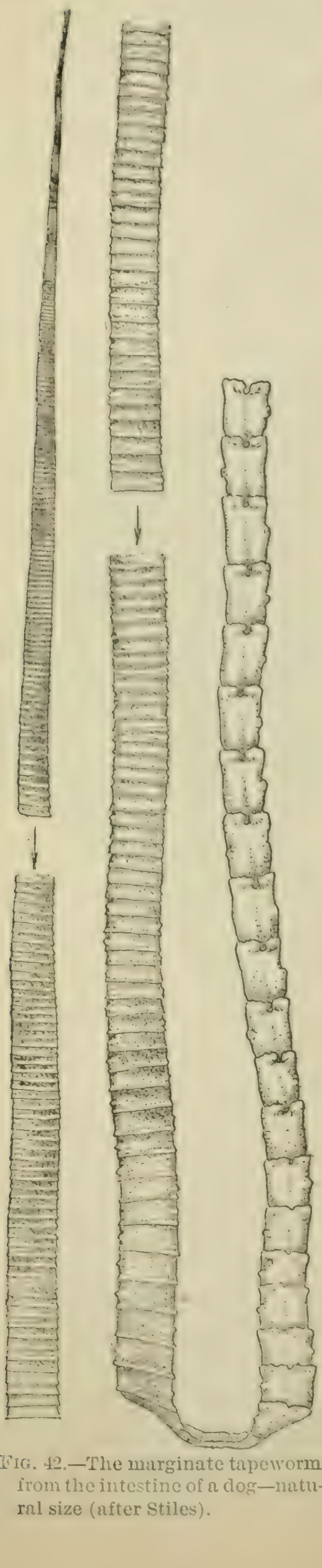


FIG. 42.—The marginate tapeworm from the intestine of a dog—natural size (after Stiles).

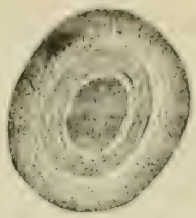


FIG. 43.—Egg of the marginate tapeworm with six-hooked embryo—greatly enlarged (after Stiles).

FIG. 44.—The thin-necked bladder worm, the intermediate stage of the marginate tapeworm; from the body cavity of a steer—natural size (after Stiles).

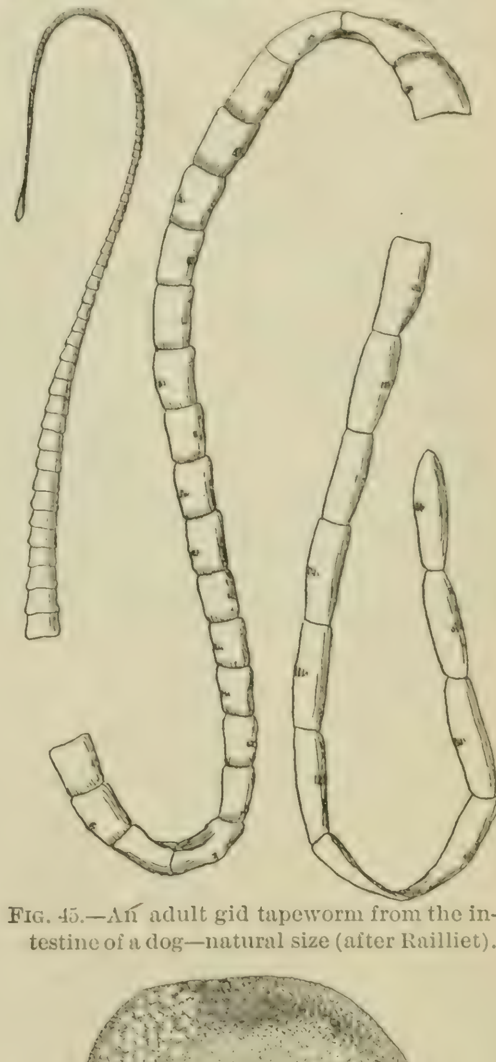


FIG. 45.—An adult gid tapeworm from the intestine of a dog—natural size (after Railliet).

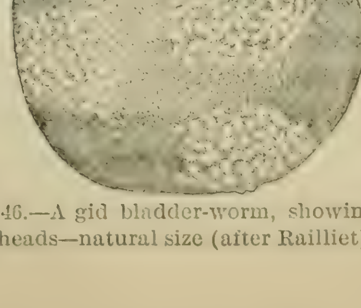


FIG. 46.—A gid bladder-worm, showing the heads—natural size (after Railliet).

and other animals by the eggs of the tapeworm, which may be conveyed by various articles contaminated by infested dogs, such as grass, water, raw vegetables, etc., while the dogs become infested by eating the carcasses of animals infested with the bladder-worm stage. House dogs infested with this parasite are a source of great danger to human

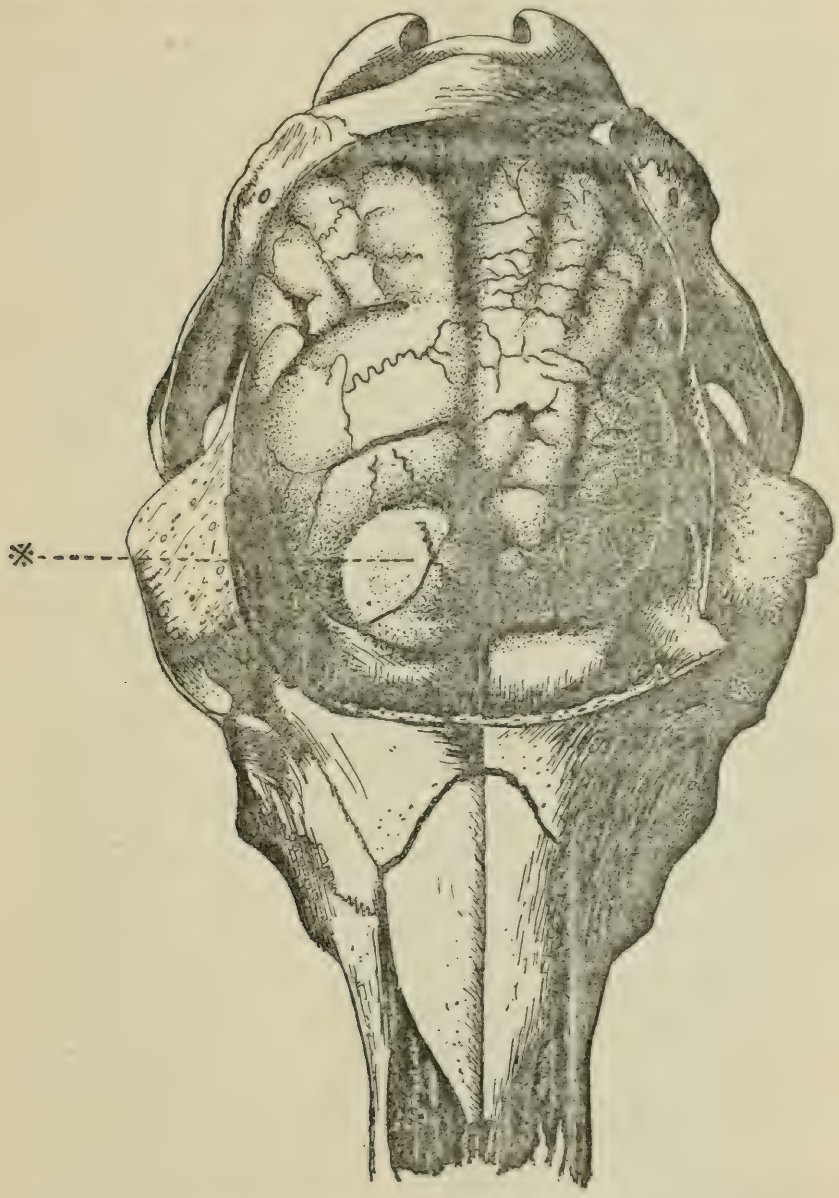


FIG. 47.—Skull of a sheep, showing the brain, infested with a gid bladder-worm—two-thirds natural size (after Railliet).

beings. In petting them the hands are very liable to pick up some of the eggs with which the hair of the dog may be soiled, or the dog in licking himself may get some of the eggs upon his lips and tongue and later transfer them to some one's hands or face, from which they may readily get into the mouth. An egg of this tapeworm, having been swallowed, hatches out in the stomach or intestine. The embryo then works its way out of the alimentary canal by means of six tiny hooks with which it is supplied, and after more or less wandering

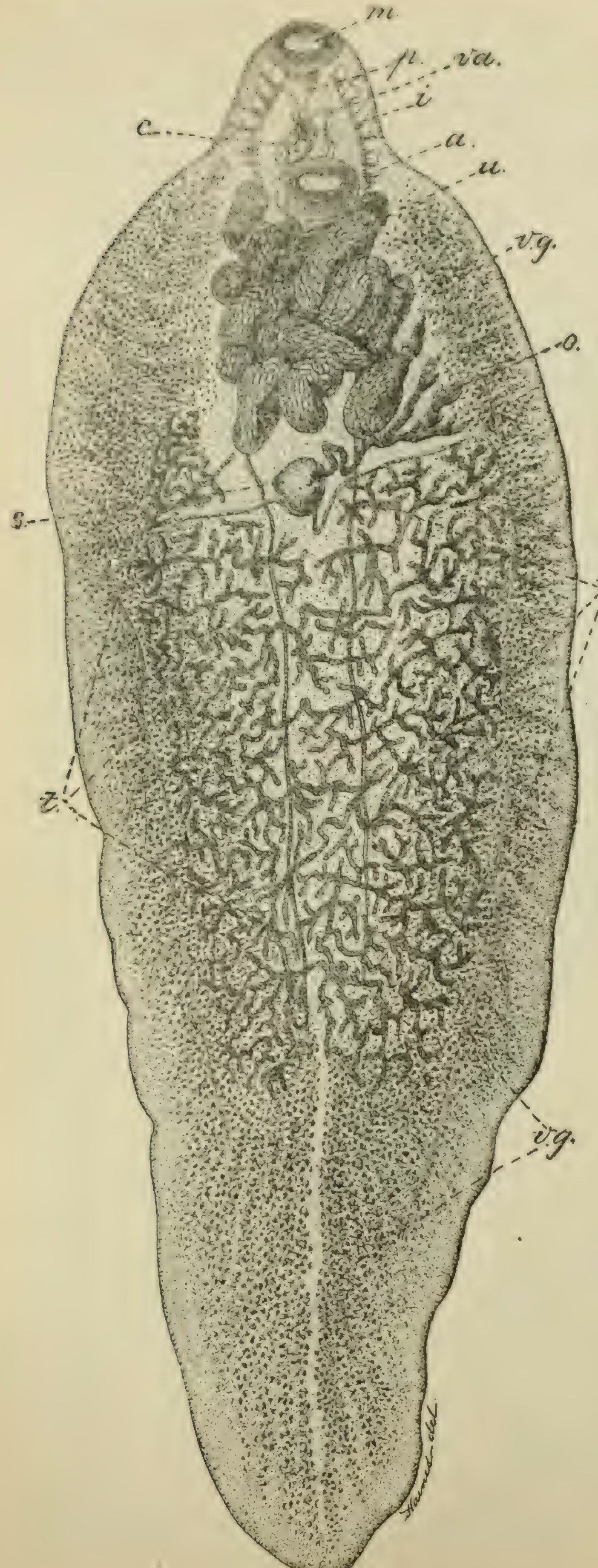


FIG. 48.—The common liver fluke, enlarged to show the anatomical characters: *a*, acetabulum; *c*, cirrus pouch; *i*, intestine; *m*, mouth with oral sucker; *o*, ovary; *p*, pharyngeal bulb; *s*, shell gland; *t*, profusely branched testicles; *u*, uterus; *va*, vagina; *vg*, profusely branched vitellogene gland (after Stiles, 1894, p. 300).

through the tissues finally settles down in the liver, kidneys, lungs, or almost any organ of the body. At this time it is scarcely more than 0.001 inch in diameter, but in the course of time it may attain a comparatively enormous size, growing slowly but surely, and as it grows pressing more and more upon the structures amid which it is located, causing enlargement of the infested organ, displacing other organs, impeding the circulation, and producing various other disturbances (figs. 40, 41). The growth of the parasite continues indefinitely, and although it may be many years (fifteen to twenty) before death is produced, about one-half of the cases in man prove fatal within five years. In Iceland echinococcus disease is very common and from 1 to 3 per cent, some authorities state 10 per cent,

of the population are killed by it. It is also more or less common in the various European countries, in Egypt, in India, and in Australia. Fortunately, it is comparatively rare in this country, but unless proper precautions are taken it is liable to become more prevalent in the future. Some of the more important measures of prevention are:

(1) The destruction of stray and superfluous dogs.

(2) The proper disposal of the viscera of slaughtered animals, so that infested organs can not be eaten by dogs.

(3) Careful feeding of dogs.

(4) The chances of infestation in the case of man may be greatly reduced by handling dogs as little as possible, and by banishing them from dwelling houses.

The intermediate stages of the gid tapeworm (figs. 45, 46) and the marginate tapeworm (figs. 42–44) of dogs occur in live stock, but are not transmissible to man. The mode of transmission is essentially the same as that of the echinococcus parasite.

The thin-necked bladder-worm (fig. 44), which is the intermediate stage of the marginate tapeworm, is very common in this country, but seems to do little damage, except in cases of heavy infestation in young stock.

The gid bladder-worm, on the other hand, is a very dangerous parasite. It develops in the brain or spinal canal, sometimes attaining the size of a hen's egg (figs. 46, 47). Sheep are more commonly attacked, though cattle and other animals are not exempt. The disease produced is commonly known as "gid," on account of the behavior of infested animals, giddiness or turning in a circle being a frequent symptom, resulting from the pressure of the bladder-worm on the brain. Nearly 100 per cent of the animals infested ultimately die, and flocks of sheep are sometimes almost entirely annihilated. This parasite had never been reported in the United States until recently, but it is now known to be present, although it is probably rather rare as yet.

Some tapeworms are transmitted by the external parasites of their hosts, as, for example, the double-pored tapeworm of the dog, which passes its intermediate stage in fleas and lice. The skin, hair, and bedding are of course more or less soiled with the eggs of the tapeworm. Fleas and lice are consequently liable to become infested while feeding, while the dog in turn acquires the parasite from swallowing infested lice or fleas.

Concerning the life history of the tapeworms of herbivorous animals, such as those of sheep, cattle, and horses, we are still altogether ignorant. Whether they have a cycle of development like other tapeworms and pass their intermediate stages in some small animals, such as insects, which are liable to be swallowed accidentally, or whether their

life history is something very different, has never been determined, and although this question has been a subject of experiment and investigation for many years, it still remains to be solved.

FLUKES.

The flukes have as a rule very complicated life histories. The adults live usually in places opening more or less directly to the exterior, commonly in the intestines or liver and sometimes in the lungs and air passages. There are also forms living in the blood vessels of whose life history practically nothing is known.

The common liver fluke (fig. 48) of sheep, occurring also in cattle and other animals, including man, may be taken as an example to illustrate the life history of flukes. This worm, usually located in the liver, produces eggs (fig. 49) which find their way through the gall ducts to the intestine and finally to the outer world. The eggs which fall in damp places hatch, giving issue to embryos (fig. 50) which swim about in the water until they find a snail. The embryo (fig. 50) bores into the body of the snail by means of a spine with which it is provided and there settles down. If the snail is of a species suitable for a host, the embryo grows rapidly and becomes a saclike structure called a sporocyst (fig. 51) and within it develop half a dozen or more bodies known as rediæ. These rediæ break through the wall of the sac and work their way through the tissues of the snail and finally settle down again in some organ, usually the liver. Within each redia (fig. 52) there are developed either other rediæ or forms known as cercariæ, fifteen to twenty in number. As these cercariæ (fig. 53) develop they escape through a little opening in the redia, and finally leave the body of the snail and swim about with great agility in the water by means of their tails, looking very much like microscopic tadpoles. The cercaria soon settles down on some object submerged in the water—a blade of grass, for example—loses its tail and becomes surrounded by a protective cyst (fig. 54). When this encysted stage is swallowed by a sheep, it grows in size, develops sexual organs, and becomes a mature egg-producing fluke.

From the foregoing, it is evident that the principal elements in the transmission of the liver fluke are moisture and certain species of snails. In the absence of either of these the transmission of the parasite is an impossibility, and since snails, as well as the free-living stages of the liver fluke, are dependent upon moisture, the drainage of damp pastures is one of the most important points in the prevention of fluke disease.

PROTOZOA.

Probably less is known in general concerning the parasitic protozoa than any other group of parasites, and most of the known facts are of very recent development.

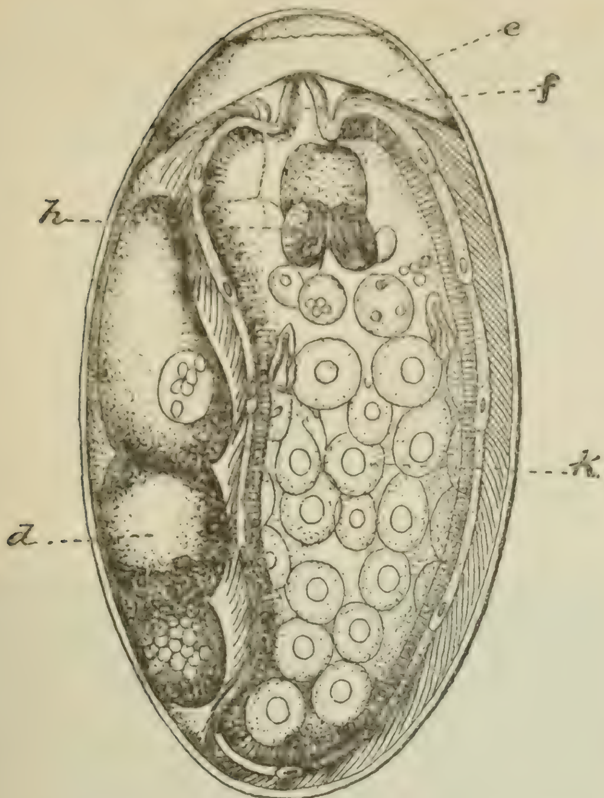


FIG. 49.—Egg of the common liver fluke, containing a ciliated embryo (miracidium) ready to hatch out: *d*, remains of food; *e*, cushion of jelly-like substance; *f*, boring papilla; *h*, eye spots; *k*, germinal cells. × 680. (After Thomas, 1883, p. 283, fig. 2.)

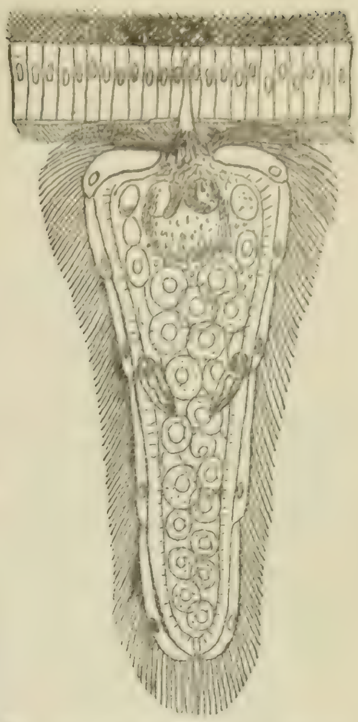


FIG. 50.—Embryo of the common liver fluke (*Fasciola hepatica*) boring into a snail. × 370. (After Thomas, 1883, p. 285, fig. 4.)

FIG. 51.—Sporocyst of the common liver fluke from the body of a snail, containing rediæ in course of development—enlarged 200 times (after Leuckart).

FIG. 52.—Redia of common liver fluke, containing cercariæ—enlarged 150 times (after Leuckart).

The protozoa, such as the amebæ and coccidia, which infest the alimentary canal, are transmitted in a very simple way in contaminated food or water. It is not known how the protozoa called sarcocysts, which occur in the muscles of various animals, are transmitted.

FIG. 53.—Free-swimming cercaria of the common liver fluke—greatly enlarged (after Leuckart).

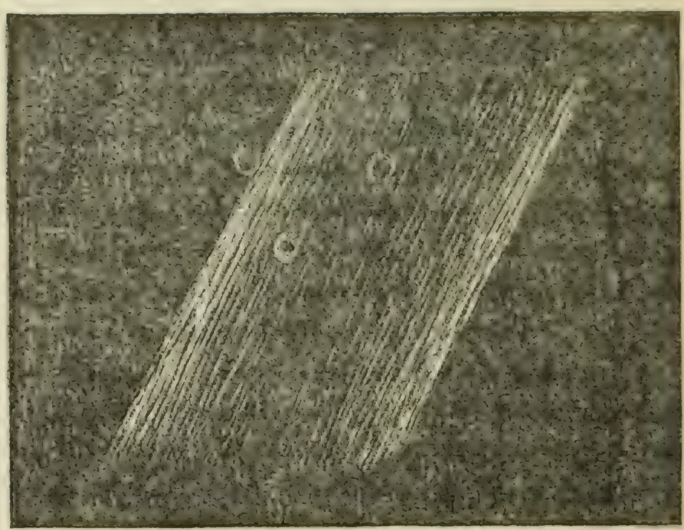


FIG. 54.—Portion of a grass stalk with three encysted cercariæ of the common liver fluke — enlarged 10 times (after Thomas).

The most important parasitic protozoa, and those with the most interesting life histories, are undoubtedly those occurring in the blood.

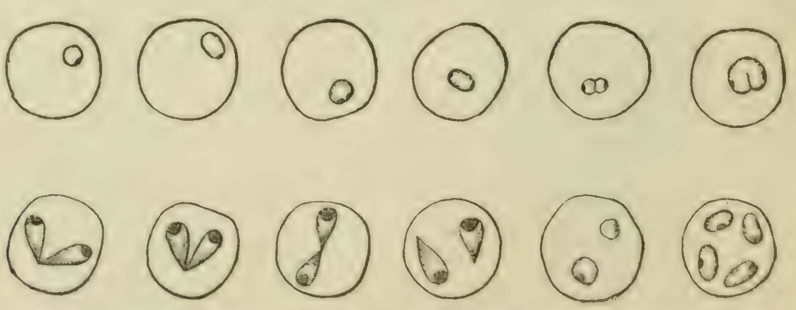


FIG. 55.—Blood corpuscles of an ox containing Texas fever parasites—enlarged about 1,500 times (after Laveran & Nicolle).

It was only a little over ten years ago that the principal method of their transmission was discovered.

Smith & Kilborne, of the Bureau of Animal Industry, during their investigations of Texas fever, a disease which they showed to be due

to a protozoan (fig. 55) parasitic in the blood, proved conclusively that this disease was transmitted by a certain species of tick, and since this discovery (announced in 1893), which was the first of the kind, ticks or blood-sucking insects have been shown to act as agents of transmission in various other protozoan diseases.

FIG. 56.—Trypanosomes—enlarged about 2,000 times (after Laveran & Nicolle).

The authors named discovered that the young ticks produced by ticks belonging to the species *Boophilus annulatus* that have matured upon cattle harboring the Texas fever parasite in their blood are infectious, and if they attach themselves to susceptible cattle will transmit

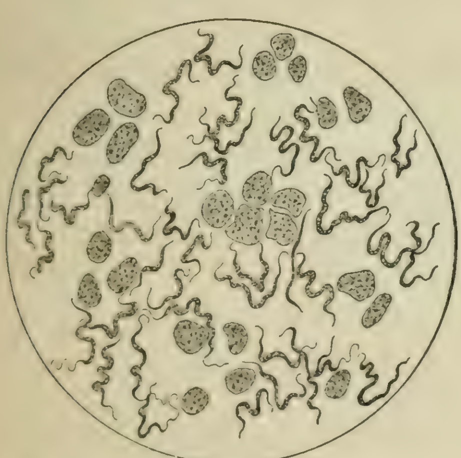


FIG. 57.—Trypanosomes among blood corpuscles—enlarged 700 times (after Rouget).

FIG. 58.—The tsetse fly of Africa, which transmits a certain species of trypanosomes very fatal to live stock—enlarged $2\frac{1}{2}$ times (after Bruce).

to them the parasite. The infection is thus handed down from one generation of ticks to the next following generation, and evidently passes through the eggs.

A disease of dogs and another of sheep similar to Texas fever are transmitted in much the same way as the latter by certain species of ticks. Chickens in Texas and other southern localities, where the chicken tick (*Argas miniatus*) is prevalent, suffer with a disease which,

though somewhat different from the Texas fever group of diseases, seems to be due to a protozoan transmitted by the ticks.

Though the fact that Texas fever of cattle and similar diseases of other animals are transmitted by ticks has been perfectly established, no one has yet succeeded in tracing the protozoan parasites, possibly on account of their very small size, during that portion of the life history spent in the ticks. In the case of a number of other protozoan parasites, however, it has been possible to determine more perfectly the various stages in the life cycle.

The life history of the parasite which causes malaria in man, for example, is now very well known. Certain kinds of mosquitoes (of the genus *Anopheles*) while sucking blood from malarial patients take up at the same time some of the malarial parasites. If these parasites are at the proper stage they undergo certain changes and bore into the wall of the stomach of the mosquito, where they become encysted. Within these cysts are formed a large number of slender bodies known as sporozoites, which, after the bursting of the cysts, migrate to the salivary glands of the mosquito. These sporozoites are the infecting stage of the parasite, and when the mosquito bites again they are injected with the saliva into the blood, and a new case of malaria is begun. Birds are subject to parasites resembling the malarial parasite of man and likewise transmitted by mosquitoes.

Blood-sucking flies, as well as mosquitoes and ticks, also play a part in transmitting protozoan diseases. The parasites known as trypanosomes (figs. 56, 57) are in some cases transmitted by flies and mosquitoes. The fatal effects of the bite of the tsetse fly (fig. 58), from which formerly so many cattle and horses died in Africa, are not due to any poison secreted by the fly, but to a disease caused by a species of trypanosome, which is injected into the blood at the time of the bite and multiplies there. In a similar way fleas and sucking lice also seem sometimes to transmit trypanosomes.

SOME WAYS IN WHICH THE DEPARTMENT OF AGRICULTURE AND THE EXPERIMENT STATIONS SUPPLEMENT EACH OTHER.

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INTRODUCTION.

Although the act establishing the agricultural experiment stations made them practically independent of one another and of the Department of Agriculture, the relations of these two great agencies have in reality been very close. They have been drawn together by a common purpose, and as their work has progressed they have often found themselves in positions of mutual helpfulness and dependence. They have developed together. Together they have demonstrated the utility of agricultural investigation and shown its practical importance to the farmer and the horticulturist. They have laid the foundation of a science of agriculture as a basis for teaching, and have won the confidence and appreciation of the general public to such an extent as to make their continued development possible.

The period covered by the experiment station movement in this country has seen a great change in the Department of Agriculture, both in character and in material equipment. The Department has become in effect a great experiment station, with probably the largest personnel and the most liberal appropriations of any institution of its kind. Congress has year by year increased its appropriations for investigations independent of its administrative work, and its organization has steadily developed along the lines of a central experiment station. But it has lacked some of the characteristics of an American station in its equipment and methods of work, and these differences, together with the wide distribution of the stations throughout the country, have made the reciprocal relations of the Department and the stations the more important.

SOME POINTS OF DIFFERENCE.

While the Department of Agriculture is very strongly equipped in laboratory facilities and men in particular lines, in other directions it has developed to little or no extent. For example, it has unexcelled facilities for studying animal diseases, but has no flocks and herds for

studying problems of feeding and management. It has laboratories and experts for studying diseases of plants and questions relating to plant physiology, but until quite recently it has had no lands of its own for field experiments or culture work upon a practical scale. It has specialists in fruit and vegetable production, but their field work, if done at all, must be done at arm's length. In other words, it is strong in laboratory facilities and in experts in many lines, but it has very little provision at Washington for carrying on experiments upon a practical basis or under field conditions. This is undoubtedly wise, as conditions at Washington would be representative of only a small fraction of the country, and the Department must work for the whole country. Through the experiment stations it can extend its work and its influence to every State and Territory.

Furthermore, the administrative functions assigned to the Department have had an influence in developing it in special directions, to the exclusion of some other phases more local in their relationships. These things have served to bring about to some extent a division of work, which has left many large questions of important practical bearing almost entirely to the stations. The latter are usually strong in their provisions for practical work and for the testing of theories on a practical basis. Nearly all of them have farms at their disposal, with experimental fields and orchards and live stock of different kinds. They have the advantage of a close association with practical farming operations and intimate relations with the farmers. They therefore have the real problems of their sections brought home to them in a variety of ways.

But beyond their superior facilities for practical experiments and their advantageous relations, the stations have often been well equipped for scientific work, some excelling in a particular direction and others being strong in other lines; so that in both the practical and the scientific phases of the work the stations, taken together, have supplemented the Department's facilities.

THE DEPARTMENT'S ADVANTAGES.

On the other hand, the Department has had a great advantage over the stations in material resources, and in its ability to develop strongly on the scientific side of large questions affecting the whole country. Its total appropriation amounts to four or five times that of the combined funds of the experiment stations from all sources; and while a not inconsiderable part of its funds are for administrative and inspection work, for making weather observations and predictions, the collection of statistics of agricultural production, purchase of seeds for Congressional distribution, and the like, the large amount of money provided specifically for investigations in other lines gives it a great material advantage.

Moreover, the Department's funds are under the control of a single set of officers, who have quite large liberty in their administration; whereas the $1\frac{1}{2}$ million dollars available to the experiment stations is distributed among fifty-four institutions, and has to be subdivided among as many sets of officers. Hence, the amount which any individual station can devote to a particular line of research is small compared with the amount which the Department might elect to devote to a single purpose.

The Department also has larger freedom to work where it will, rather than to divide its energies equally among the different States, and this again enables it to undertake large enterprises and organize work along special lines. It is in a position to take a somewhat broader general survey of the field and of the relative importance of special undertakings. It can often point out these things in such a way as to secure appropriations and inaugurate new lines, which can be carried on with the stations' cooperation.

The vastness of the agricultural regions in whose interests the individual stations are working is rarely realized. Even along the Atlantic coast we have on an average only one station for every 24,000 square miles, and in several of the large agricultural States of the Middle West the area is twice as great as this. While the Department works for the whole country, it is at liberty at any time to throw its energies largely into a particular section, or to concentrate upon special problems, as emergency or expediency may advise. It can, therefore, do many things which the stations could not undertake, and hence it is in position to relieve them or to aid them in very many ways. In many respects its facilities for investigation work are unexcelled, and it can provide specialists, expensive apparatus, and collections which give it a great advantage.

For example, the provisions for entomological studies at Washington are far in excess of those which any station could expect to afford in its laboratories, and the stations have availed themselves of these facilities in a variety of ways. The Department has far superior facilities, as it has far greater funds, for plant introduction, and can send specialists to remote parts of the world in search of promising kinds or varieties of plants or those more resistant to drought, disease, and other conditions. But the suggestion for the need of these introductions has often come from the stations' experience and observation; and in testing their suitability to particular localities and adapting them to special needs the stations are the most natural agencies through which to work.

A case in point is the search for varieties of flax resistant to a very troublesome disease which prevails in North Dakota. The North Dakota station worked out the nature and cause of the disease and the fact that after a time it rendered the land unfit for flax production,

Finding no way to control it without abandoning culture on the infected land, it turned to the Department for aid in securing resistant strains, and the latter in turn sent the station specialist abroad on this mission, defraying the expense of the trip and the introduction of material.

Without attempting to compare in any way the work or the influence of these two agencies, it may be of interest to note a few typical examples of their work, both independently and in cooperation. This will serve to show in a measure the important relations which they hold to each other and to the promotion of American agriculture.

SOME FEATURES OF STATION WORK.

The development of the method of preserving green feeds in the silo has been led in this country by the experiment stations, quite independently of the Department. It has been the subject of extensive and widespread experiment. The stations have developed the methods of producing and handling green silage crops, so as to secure the greatest amount of food material and the minimum loss in curing, and have worked out the problems relating to the feeding of these materials. They have gone to the very bottom of the subject and determined the character and cause of the changes in the silo, devised suitable and economical methods of silo construction, and shown the practical applications of the system. Little advantage could be taken, at the outset, of the work done in other countries, because the crops used and other conditions were so very different. A vast amount of pioneer experimenting and investigation has been required, and repeated demonstrations under varying conditions have been necessary to overcome prejudices and propagate the system.

An enterprise of such breadth and involving such a variety of conditions required work all over the country by a large number of specialists. As in many other undertakings, there was a distinct advantage from having men scattered over the country, working with a certain independence and individuality, and approaching the question with their own local conditions clearly in mind. A certain amount of repetition of experiments was inevitable, and this, instead of being unnecessary duplication, was an important phase in the local adaptation of the system.

Again, the development of the scientific basis of dairying may be regarded as quite distinctly a station undertaking. Their work has included researches on the chemistry of milk and dairy products, probably more extensive in character than in any other country. They have developed and brought into almost universal use a simple method for rapidly determining the fat content of milk, which has revolutionized the method of paying for milk and has had a great influence in improving dairy stock. They have made elaborate investigations

in cheese making and curing, which have shown the cause and indicated the best conditions of ripening, and have carried on extensive experiments in practically every stage of butter making and creamery management. Perhaps in no branch of agriculture has the experimental work been more extensive or productive of more tangible and striking results. The study of the bacteriology of dairying has led to a consideration of the sanitary conditions surrounding the production and handling of one of the most common articles of food; it has shown its relation to public health and the far greater need of sanitary inspection of dairies than for conformity of the product to a legal standard of composition.

Of late the Department has taken up dairy work in cooperation with the stations, in studying the conditions of cold storage of cheese, the manufacture of soft cheeses, and other questions; and it is working independently on other commercial problems. It can take up many of these matters in a large way much better than the stations could, and can afford, if necessary, to wait for results. In this way it can supplement the stations' work, the foundation of which has been so well laid.

EXTENSION OF THE DEPARTMENT'S WORK.

On the other hand, the Department has taken a leading part in this country in the study of animal diseases, their cause, transmission, and prevention. It has been led into this very naturally by its quarantine and inspection work, and has established a reputation for its investigations which is world-wide; but in several lines it has been ably seconded by the experiment stations. The latter have not only propagated its work and contributed to it by observation over a wide territory, but in some important instances they have extended it and brought it to a practical conclusion.

The study of Texas fever serves to illustrate this. The Bureau of Animal Industry demonstrated the disease to be due to a protozoan blood parasite, and showed the cattle tick to be the carrier of the disease. Following many experiments by the Department and the stations to get rid of the tick by dipping, the Missouri and Texas stations, working together, developed a successful method of blood inoculation for securing immunity to the disease. The Southern stations made extensive experiments to test and demonstrate its efficiency, and to determine the conditions for carrying out the inoculation so as to increase its efficiency and decrease the danger of loss of animals.

Here, then, is an illustration of the practical advantages of both agencies. Either alone might not have developed a practical method of immunization, but the Department's work furnished the basis for such a method, which was then worked out and developed by the stations independently of the Department, as they were on the ground, and

the matter was one of very great importance to the live-stock interests of their sections.

The Department and the stations also supplement each other in the breeding of plants for particular conditions or uses. While this work has sometimes been cooperative, it has often been carried on independently, different crops being used to a large extent. Thus, while the Department has led in the breeding work upon cotton and citrus fruits, the Illinois station inaugurated work in corn breeding which has been extended to several other stations, and the selection of corn for seed, to improve both the yield and the quality, has been carried on and exploited in practically all the corn-growing States.

The Department is also breeding and selecting tobacco, sugar beets, cowpeas, oats, wheat, and other cereals, in some cases in cooperation and in others independently. New varieties of wheat originated by the Minnesota station have proved of special value for the northwestern wheat section, and are now successfully grown on fully a half million acres, being estimated to yield from 1 to 2 bushels more per acre than the varieties they are replacing. Other stations are breeding wheat for milling quality and composition, flax for yield of fiber and of seed, sugar cane for sugar content and tonnage, and the South Dakota station has been for several years conducting breeding experiments with horticultural crops on an extensive scale. These are only a few of many lines. Systematic work in plant breeding and selection is now carried on by over half the stations in the country.

EXTENDING STATION WORK.

Several years ago the Department provided funds for the elaboration of a respiration apparatus for studying problems in human nutrition, and when this had been perfected it contributed largely to the construction of an apparatus of that kind for studies in the problems of animal nutrition. The feeding experiments had reached a point where these physiological studies were imperative, but no single station felt able to undertake them in view of the expense of constructing the apparatus and the time and expense required for the experiments. The Department made this work possible by building an apparatus at the Pennsylvania station, and has provided funds for several years past for the conduct of experiments, which are carried on jointly by the Department and the station.

The above instance is only one of several in which the aid afforded by the Department has enabled the stations to organize their work more broadly. Among other instances may be mentioned the establishment of a department of farm mechanics at the Wisconsin station, which was a distinct result of Department cooperation; the inauguration of irrigation investigations in California, of cotton-culture experiments in Texas, rice studies in Arkansas and South Carolina, horse

breeding work in Colorado, and experiments in making European cheeses in Connecticut.

The investigations in human nutrition, which have been carried on quite largely in cooperation with the experiment stations, would very likely not have been made except for the initiative furnished by the Department and the appropriations which it secured for that work. Such practical studies of wide application as the relative value of ordinary and whole-wheat flour, the place of cereal foods in the diet, the losses in preparation and cooking of foods, economy in the purchase of articles of diet, and many others, have been carried out at the stations in cooperation with the Department. The latter has not only furnished funds to aid in the work, but has printed the reports and given wide publicity to the undertaking.

A central agency like the Department can best collect the statistics of agricultural production at home and abroad, study the requirements of export trade in agricultural products, and call attention to imports which might be produced on our own soil. From this it is but a step, and a natural one, for the Department to secure and introduce the necessary materials for a new line of production, stimulate interest in it, and encourage practical trials looking to the establishment of the new industry. In the same way its knowledge of commercial conditions will lead it to suggest changes or improvements in the methods of marketing products, which will require experiments and practical tests and in some cases trial shipments. The problems of supplying a foreign demand, the marketing of products, and the increase of foreign trade in agricultural products are natural functions of the Department, as they concern the whole country.

SERVICES OF THE STATIONS.

On the other hand, there are very many things which the Department could not have carried to practical conclusion, certainly not with the success that has been achieved, had it not been for the favorable conditions and cooperation afforded by the stations. This union of effort and resources has been an economy of the Department's funds in carrying out its work, and has served to bring it closer to the farmers.

For example, if in its sugar-beet work the Department had been obliged to rely upon cooperation with farmers as a means of determining the range of adaptability of this crop and the practicability of its cultivation, vastly more time and expense would have been involved, and a large proportion of the trials would have been of no value owing to failure to follow directions. There would also have been an absence of constant trained observation upon the growing crops and of carefully weighed deductions at the close of the trial. As it is, the facts were secured mainly by the sending out of the beet seed

and the extension of the franking privilege to the stations. The dissemination of alfalfa growing is also an illustration of successful cooperative effort in which the stations took a prominent part. Not only the adaptation of the crop to different localities had to be determined, but the best methods for putting in the seed and securing a stand, and these matters have been the subject of a large number of experiments at the stations.

In arid farming the Department and the stations have supplemented each other in an important way, for while the Department has introduced many of the things which are proving successful in developing farming under restricted rainfall, the stations have exploited these crops in their regions, tested their adaptation, and even conducted special branch farms as a basis for their intelligent introduction. Such farms are maintained at State expense, for example, in North Dakota, South Dakota, Utah, Kansas, and Nebraska, and in several other States on a less formal basis.

New plants and crops can not be safely introduced from remote regions without preliminary experiments to show their value and to adapt them to the new locality; and the experiment stations, which will be called upon sooner or later to advise farmers regarding their culture, are the natural and most suitable agencies through which these preliminary trials can be made. Such trials, like practical experiments in other lines, have a value which does not attach to tests made by farmers unless the latter are closely supervised and controlled, for they are conducted under suitable conditions by trained observers, competent to interpret the results.

These things show the intimate relations which almost inevitably exist between the work of the Department and the stations. Consciously or unconsciously, these two agencies depend in a large degree upon each other for suggestions, for materials, and for results, and their activities are guided as a matter of course by these reciprocal relations. The advances in agricultural science are so complex as to their source that it is often difficult to assign the credit equitably, because there have been so many contributory causes, the real value of which it is often difficult to measure. This country is so large and represents such a diversity of conditions that almost any recommendations beyond the most general in character need to be adapted to the locality. And in connection with this adaptation or fitting into the practice, new problems arise which call for attention.

It is for these reasons that the Department has come to adopt the plan of working more largely through the stations when it enters their respective States. If it is to effectively reach the farming people with its results and their applications, it must have the assistance of some organized agencies of standing which are scattered over the country and have a permanent location and constituency. Realizing this, it

has very naturally taken advantage of the facilities afforded by the experiment stations, with their knowledge of local conditions and their intimate relations with representative and progressive farmers.

COOPERATION IN AGRICULTURAL EXPERIMENTATION.

While the higher and more abstract research can be most successfully conducted by individuals working independently, there is a large class of work, of the kind most common, which can be advantageously made the subject of cooperation. By this means the special qualifications and advantages possessed by each agency are combined, and the duplication of resources and facilities is avoided. Such cooperation can be carried out upon terms of equal partnership, and in such a way as to be mutually advantageous to both parties. The results are often more reliable and of more widespread interest and application.

Much work of this kind has been done in the past, and cooperation has become an increasingly important factor in carrying out the Department's inquiries and demonstrations in the States. Congress has recognized its importance also, and it has provided for it in the wording of the agricultural appropriation act, which suggests a closer bond of union than is indicated by the act establishing the stations.

The appropriation act for the present year mentions the agricultural experiment stations no less than fifteen times, outside of the clause making specific appropriation for them. These references provide for cooperation between them and the Department in the extension of work, and place the aid of the latter at the disposal of the stations in a variety of ways. For example, the appropriations for conducting experiments in animal breeding and feeding, for continuing the work in plant breeding and selection, for testing plant introductions, for studying the influence of environment upon the composition of cereals and sugar and starch producing plants, for determining the adaptability of grape stocks, for studying market conditions affecting the fruit and vegetable trade, for the improvement and extension of cereal production, for work upon grass and forage plants, for drainage and irrigation investigations, for work in connection with the ravages of the cotton-boll weevil, and for studies on human food and nutrition—all make specific mention of the experiment stations as cooperating agencies.

But the lines of work to which cooperation has extended are in fact far more diverse and comprehensive than indicated by the Congressional act. For several years past cooperation has embraced the culture of field crops and vegetables of various kinds, of special crops like cotton, rice, and sugar beets, the breeding and adaptation of cereals and other plants, the control of insect pests and plant diseases of various crops, the water requirement of crops and its application, alkali reclamation, feeding and breeding experiments with animals, experiments in butter and cheese making and curing, and various

phases of arid farming. In fact, it has included in a broad way well-nigh every branch of work of the more immediately practical kind. Last year fully fifty different lines of work were in progress which involved active cooperation between the Department and forty-six of the stations, and in very many other enterprises there were mutually helpful relations which were not sufficiently formal to be designated as cooperative undertakings. Frequently the cooperation on a single subject extended to a half dozen or more stations.

In planning this work it has been found desirable in some cases to form a group of stations to investigate a problem affecting a whole region. Thus, for example, a group of stations in cooperation with the Bureau of Plant Industry has been engaged in investigations of the breeding of varieties of cereals adapted to the Northwest. In other cases two or more branches of the Department have combined to work in conjunction with a single station, or with several stations, upon some complex problem. It is evident that a great variety of effective combinations can be made.

The underlying principle in all this cooperative work is a union of facilities and resources, whether these be funds, men, equipment, or relationships. It recognizes that each party has something to offer which will strengthen the undertaking or make it more effective, either locally or in a National sense. The Department usually has the advantage in point of funds and the broader survey of the general field, and it can often place a larger number of specialists and assistants in the field, whereas the stations have the plant for carrying on the work, whether the experimental field, greenhouse, feeding stable, or dairy be required; and they also have a superior knowledge of local conditions. It is in the full recognition of these special qualifications and reciprocal relations that the great strength of our American system of experimentation lies.

STATE AID.

In some cases the initiative for cooperative work comes from the Department; in others, from the stations themselves or the people of their States. In several instances the States have made special appropriations to their stations for the express purpose of promoting cooperation upon some particular subject. This has been true, for example, of the irrigation work in a number of the Western States.

The States are now supplementing, to a greater extent each year, the funds which the Federal Government appropriates for agricultural investigation through the State experiment stations and through the Department at Washington. For example, the Indiana legislature a year ago provided an annual appropriation of $25,000 for the station, of which $5,000 is for feeding work, especially beef production, $5,000 for dairy experiments, and $5,000 for experiments in crop and soil improvement, this work to be done to a considerable extent about

the State. In Iowa an appropriation of $15,000 a year was made to the station, together with $3,500 a year for two years for good-road experimentation, $55,000 for a new dairy building and equipment, and $20,000 for additions to the dairy farm and equipment. The State of Missouri made a biennial appropriation of $15,000 for the station, and $15,000 additional for cattle and swine barns, an agricultural machine laboratory, and for starting a soil survey.

These are only a few of many illustrations which might be cited, but they serve to show the liberal tendency of the States in providing for the promotion of agricultural experimentation within their borders. In all, the experiment stations received last year from their States and from other sources than the Federal Government, over $800,000, or considerably more than they received directly from the Federal Government. While the total amount of their funds is small in comparison with the appropriations to the Department, other material advantages which the stations enjoy serve to make them powerful allies of the Department in the various branches of agricultural investigation.

DISSEMINATION OF INFORMATION.

Complete success is not attained in agricultural experimentation unless the results in their practical application are brought home to the farmer and he is led to better methods of farming. This is a side of the work which applies with special force to the experiment stations, on account of their relations with their constituents and the benefits which are expected. It is not enough that a station should discover new facts or principles; it must show definitely how these can be utilized in practice, or made a part of the system of the particular region. If it fails of doing this it does not meet the full expectations of the people for whom it is working, and subjects itself to criticism. The same would apply to the work of the Department in the long run, although the immediate demand for results is less evident.

In the dissemination of useful information some of the most striking illustrations are found of the ways and the extent to which the Department and the stations supplement each other's efforts in behalf of the American farmer. The effort to reach him effectively is often one of the most difficult tasks, and hence a number of different agencies have been developed. These may be classified roughly under (1) publications, (2) talks and addresses at meetings and farmers' institutes, and (3) practical demonstrations.

PUBLICATIONS.

The Department and the experiment stations combined constitute the greatest publishing agency for agricultural literature in the world. The extent of their activities in this direction will be brought out by a few statistics for the past year.

The Department of Agriculture last year issued 476 different publications, aside from reprints. These aggregated about 20,500 pages of matter. Including the reprints, approximately 12½ million copies of bulletins and reports were issued during the year. Nearly half of these were Farmers' Bulletins prepared especially for popular consumption, to which should be added the Yearbook, which was issued in an edition of half a million copies.

The experiment stations of the country last year published 461 bulletins and reports (exclusive of newspaper bulletins and pamphlets), and these aggregated something over 16,000 pages of matter. The number of copies issued was approximately 6½ million, and they were distributed to farmers and others on the regular mailing lists of the stations. These mailing lists combined now contain a total of 731,400 names.

In other words, the stations as a whole issued nearly as many new bulletins and reports as the Department, aggregating 16,000 pages as compared with 22,000 pages in the Department publications; and the aggregate number of copies of the stations' publications was approximately half that of the Department's issues. To a very large extent the station publications were based on new experiments and investigations, and presented results of direct interest to progressive farmers and horticulturists.

The number of bulletins and reports issued by the stations has remained about the same for the past ten years, but the editions have greatly increased with the demand for the publications. Stringency of funds has often prevented the stations issuing as many bulletins as they otherwise would. In several instances the States have come to their assistance by providing for their printing, but where there is no special provision of this sort the expense for printing and mailing has about reached the maximum which can be afforded without crippling the experimental work. It is especially fortunate, therefore, that the Department is in position to give wider publicity to the work of the stations by summarizing it in popular bulletins, which are sent out freely. These make the results available to people who would otherwise not be reached, and furnish a convenient basis for newspaper articles and talks which popularize the work.

The Department has also provided permanent records of experiment station work in the form of a card index and of a monthly periodical. The latter gives a current record of the station and Department literature, and also reviews the work of similar nature which is being carried on abroad. This is fully indexed, and is issued in a liberal edition. The preparation of such a review could not well be carried out under private auspices. It serves not only to give prominence to the publications of the stations, but to make the investigations more efficient by keeping Department and station workers posted on the progress of

agricultural investigation throughout the world. It is one of the Department's voluntary contributions to agricultural experimentation and research in this country.

PRACTICAL DEMONSTRATIONS.

Only part of the farmers are reached through the medium of bulletins and reports. Others require to be shown or to have the message brought to them. For this reason practical trials and demonstrations under actual farm conditions are becoming a somewhat more prominent feature of the work of both the Department and the stations. The Department has not until recently entered upon this demonstration work in a systematic way. It has relied upon the stations for this, and when it entered upon such work it naturally sought the assistance of the stations, as being more familiar with local conditions and problems and standing in closer relation to the farmers. Within the past few years it has established farms or areas for demonstrating diversified agriculture and farm management. While conducted on private farms, these have usually been established and directed in cooperation with the stations.

The Department has also conducted demonstrations upon a variety of other subjects, either in cooperation with the stations or independently. Among others, mention may be made of demonstrations in alkali reclamation, the preparation and management of land under irrigation, the growing of cereals and forage plants, crops for arid farming, the cold curing of cheese, and keeping butter.

Many of the stations' experiments have been conducted on their own fields, or in their own stables, upon a sufficiently broad basis to approximate farm conditions. For example, new crops have been grown on considerable areas, to show their cost of production and their value in the market; feeding trials have been conducted with carload lots of animals, which could be shipped to the stock yards where they would be sold in competition with other lots and compared upon the block; and dairy experiments have been conducted in the station creameries on such a scale as to make the products and the results entirely comparable with commercial conditions. Experiments in immunizing cattle against Texas fever have been made with large numbers, frequently furnished to the station for the purpose; and the value of irrigation in sections where the rainfall is deficient or poorly distributed has been demonstrated on a dollar-and-cents basis.

More recently the stations have gone out among the farmers, selecting localities for the demonstration of matters especially applicable. Such demonstrations upon the importance and the manner of spraying potatoes have been made in Maine and in New York, the spraying and care of orchards in New York, the fertilizer needs of the soil in Illinois and elsewhere, the feeding of steers in Iowa, the advantages of seed treatment in preventing smut in Wisconsin, and the like.

In a number of States organizations for agricultural experimentation have been formed, which are under the general direction of the stations; and in at least two States (Iowa and Kansas) the county poor farms have been turned into demonstration farms for illustrating new crops, methods of culture, and general farm management.

In its demonstration work the Department has made use of the stations' findings, as it has in its popular publications; and similarly in such work the experiment stations have made use of the sum total of general information without reference to its source. The sole object has been to bring home to the farmer in a forcible way some of the important results of agricultural experimentation which were applicable to his conditions. These demonstrations have had an important influence, for they have not only appealed to many farmers who would not otherwise be reached, but the fact of the results being obtained in their midst and under conditions analogous to their own has made them more convincing to the farmers of a neighborhood.

FARMERS' INSTITUTE WORK.

Never has there been such a campaign of popular education among the farmers as during the past year, and never probably at any previous time have the farmers been in so receptive a mood and so well prepared to profit by this effort. Special trains have been run through a whole section of a State for the purpose of instructing the farmers along the route in the importance of seed selection in growing corn, wheat, and potatoes; and we have also had dairy and good-roads specials of similar character. These trains have carried a corps of men to give popular talks, with material for illustrating the same. The novelty of the undertaking has aroused interest, and a great deal of good has been done, especially by way of inspiration. This form of extension work originated at the agricultural colleges and experiment stations, and the men who have taken part in it have been for the most part officers holding positions in both institutions.

In other States excursions have been run to bring farmers to the college and station, in order that they might see for themselves what was being done, and have the aims and applications of the experiments pointed out to them. In North Dakota, for example, these annual excursions have been a feature for several years past, and are run at the instance of the college and station officers. The railroads offer greatly reduced rates, usually one-half cent a mile, assign the necessary cars for the purpose, and turn the whole matter of arranging the plans and schedules over to the director of the station. Excursion centers are located, usually about two in a county, and a reliable farmer is appointed to select the 50 persons who are to be brought from each center. This number must include some 12 or 15 young men who expect to remain on the farm, and a certain number of women.

Not over 400 of these excursionists are brought to the station in a single day. In the forenoon they are divided into parties and conducted around the station fields, barns, dairy, etc., by guides. In the afternoon they gather for a meeting in the assembly hall, where questions are answered and brief talks given upon seed selection, conservation of moisture, value of rotation, and similar topics. These excursions cover a period of nearly three weeks, beginning early in July. Something like 5,000 excursionists are brought to the station during this period, and owing to the care exercised in selecting the excursionists and in handling them while at the college, the good results have been increasingly apparent.

The regular farmers' institutes are becoming better organized and systematized each year, with the result that they have greatly increased in efficiency. In most States they now afford a very valuable means of instructing the farmers in improved methods and practices, and in bringing the results of the stations' work home to them in an effective way.

In 29 States the management of the farmers' institutes is entirely in the hands of the agricultural colleges and experiment stations, and in 43 States and Territories the college and station officers took a prominent part in the work last year. About 347 station men assisted regularly in the institute work, devoting to it in the aggregate nearly 2,700 days. In one State alone (Missouri) the station specialists last year delivered 223 addresses at farmers' institutes and similar meetings.

There is great demand for the services of station men for institute work, as they have a message to carry to the farmers and are in position to give advice upon a wide range of practical questions. The great majority of the farmers now go to the institutes to be instructed, and these meetings afford opportunity for the oral presentation of the stations' work and results. Attendance upon them, however, is often a serious inconvenience and interruption to the station men, and it is becoming evident that to a larger and larger extent a separate staff of institute workers will need to be provided.

Thus far the Department has taken very little active part in farmers' institute work in a systematic way. It has contributed funds toward the holding of farmers' institutes in Texas for the purpose of extending diversified farming in regions where the boll weevil is destructive, and in connection with its demonstration farms in the Southern States it has held meetings which have brought together the farmers in the respective localities. At these meetings the purposes of the work and the advantages and practicability of diversification have been pointed out. A Department expert last year lectured for six weeks upon the subject of pure seed and seed adulteration, in connection with the Pennsylvania farmers' institutes. Arrangements for other specialists to cooperate in this way and to explain the work of the Department in various lines have been under contemplation; and in the aggregate a

quite considerable number of men have been sent out to institutes and farmers' meetings in response to special requests.

The activities of the Department in this direction, however, have lacked the advantage of being systematic and continuous. There is believed to be great opportunity for useful development in this direction, which would be helpful alike to the Department men and to the institutes of the country. In this way the results obtained by the Department could be brought more prominently to the attention of the farmers of the country in much the same way that the station results now are, and the specialists would come into direct contact with the more intelligent class of people in whose interests they are working.

CONCLUSION.

It will be seen from the above survey that some features of work are being carried on primarily by the Department, some by the stations, and some by the two agencies working in cooperation; but the conclusion is evident that there is a mutual interdependence which has affected the work of both to a very great degree, and has contributed materially to its scope, efficiency, and application in practice.

The work of the stations in various lines has brought out clearly the necessity for more fundamental investigations, many of which are too costly for the individual stations to undertake. This affords opportunity for the Department, with its large material resources and greater freedom of concentration, to conduct investigations whose results will be of National importance. It thus opens up a field of great usefulness.

Considering the limited material resources of the stations, we may well marvel at the amount of work they have brought to successful conclusion and the very potent influence they have had upon American agriculture. This has been made possible by the favorable conditions in which they have been placed, the numerous advantages they have enjoyed which are not expressed in terms of dollars and cents, and by the union of forces for teaching and experimentation. To this has been added the exercise of rigid economy in the matter of salaries and general maintenance.

But to no small degree is the success of the experiment station movement due to the paternal attitude of the Department of Agriculture, its interest in promoting this movement, and the direct aid it has given in subsidizing the stations, in furthering cooperation, and in many other ways. The general propaganda for agricultural investigation which the Department has been conducting, combined with the publicity given to such work by station publications and activities, has aroused widespread interest and confidence, and helped prepare the public mind for still greater progress.

HOW TO GROW YOUNG TREES FOR FOREST PLANTING.

By E. A. Sterling,
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THE FARMER'S NEED OF A HOME NURSERY.

Forest planting by small landowners is an important line of forest work, and in many sections of the United States is a recognized adjunct to successful agriculture. It had its beginning long before forestry became a subject for general economic consideration, and the settlers of the Middle West planted trees for years before there was a professional forester in this country or recognition of the subject by the National Government. The results are now apparent in the form of planted groves and windbreaks of mature trees in many regions, particularly in the prairie States. In Nebraska alone the average of the returns of the assessors for 1903 and 1904 showed an area of 286,000 acres of planted timber.

Many mistakes were made by the early tree planters, and much of the timber now standing is of little commercial value, because the primary desire was for quick effects, which were secured by using rapid-growing species of poor quality and short life. From the standpoint of protection very satisfactory results were obtained, but in future planting the use of trees which will not only serve for protective purposes, but also produce timber of higher value for posts, fuel, and lumber, is strongly urged.

The farm windbreaks and shelterbelts and the small planted groves which furnish fuel, fence posts, and repair and construction material constitute one of the less striking phases of American forestry to-day. Considered, however, from the standpoint of the greatest good to the greatest number, their value to the vast host of citizens who follow agricultural pursuits becomes apparent, and their contribution to the prosperity of the West is realized.

Practically every section of the country can be helped by more intelligent and extensive forest planting by small landowners. By this means the abandoned farms of New England can be made productive, the best kinds of shelterbelts and woodlots secured in newly irrigated sections, the needed protection given to field crops and the necessary wood material produced cheaply on the treeless plains and

prairies, and the whole country made more attractive as a place of habitation. With the development of the semiarid West through the reclamation of large areas by irrigation and dry farming, an entirely new field for forest planting as a farm crop is opened up. One of the functions of the Forest Service is to encourage this work by determining the species most suitable for every situation and region, and by giving advice as to the most economical and effective methods of planting and protecting the young trees.

One of the most potent influences which retard forest planting on farm lands is the difficulty experienced in securing suitable planting material save at almost prohibitive cost. Until recently very few nurserymen attempted to raise forest tree seedlings, and the demand was so uncertain that high prices were charged as an offset to the uncertainty attendant upon the disposal of the stock. The high initial cost of nursery-grown seedlings, the expense of shipment, and the uncertainty of receiving the young trees when wanted have had a very discouraging effect on the small planter, and the establishment of plantations has been curtailed in consequence. On the other hand, home production of young trees has seemed too difficult a task for the novice; while the rush of farm work at the time seed beds should have the most attention, together with the lack of reliable information as to how to grow forest seedlings, has generally checked all efforts along this line.

It is the object of this paper to show that it is not difficult or impracticable to grow the young trees needed for ordinary farm planting. If a corner of the garden is devoted to this purpose and as much care and attention is given to the work as is necessary for the successful production of common garden truck, there is no reason for failure.

The suggestions here given are intended to apply only to the production of young trees for home use, and by the simplest methods which will insure success. The use of home-grown nursery stock should greatly reduce the initial cost of a plantation, whether it be composed of 500 or 50,000 trees, and should result in more extensive forest planting on the waste places on farms, and in general for purposes of protection and wood supply. The care necessary to grow successfully young trees for planting, and the time required, which is one year for broadleaf trees and two or three years for evergreens, are more than compensated by the saving in cost and the better results secured.

COLLECTION, PREPARATION, AND CARE OF SEEDS.

The fundamental step in growing young trees is to secure good seeds of the species desired. If fruiting trees are close at hand, the seeds may easily be collected; otherwise they can be ordered from seedsmen for delivery when needed in the spring. The short-lived

seeds of silver and red maple, elms, willows, and river birch, which mature in the spring, are rarely handled by dealers, and should be collected promptly when mature and planted at once. The fruit of all other important species ripens in late summer or fall, and, with the exception of the aspen and cottonwood, may be preserved over winter.

The short-lived seeds can best be collected by catching them in sheets or blankets as they fall or by sweeping them up from the ground. Acorns and nuts can easily be gathered from the ground, while pods, seed balls, cones of all kinds, and fruits of the cherry, hackberry, and ash can be most easily secured by picking from the trees when mature. All acorns from the white oak group should be collected as soon as they fall, for they will soon germinate if left on the ground. In collecting, care should be taken to gather seeds only from vigorous, well-formed trees, and to be sure of the identity of the species. This is essential, particularly in the case of catalpa, because the hardy catalpa (*Catalpa speciosa*) is the only form worthy of propagation, yet it is hard to distinguish it from many hybrids. In case of doubt, specimens of seeds should be sent to the seed-testing laboratory of this Department, where they will be identified and their vitality determined without charge.

With many species some treatment is necessary in order to separate the seeds or nuts from their covering. The hulls of the hickories may be removed readily when the nuts begin to dry; walnuts may be run through a corn sheller or forced through an auger hole when green to free them from the thick shuck, or they may be placed in piles until winter to allow the shucks to rot; the seeds of pulpless pods, such as the black locust and catalpa, should be shelled out by hand when dry; the fleshy fruits of honey locust, Osage orange, mulberries, etc., require macerating in water until the seeds are separated, after which they should be spread in thin layers and dried slowly. The thin-scaled cones of evergreen trees and of the yellow poplar (tulip tree) and birches open readily in most cases upon drying. The cones should be spread on a smooth surface in the sun or in a warm room, and, when open, the seeds may be shaken out and the cones removed. In the case of the firs, yellow poplar, and birches, however, the cones fall apart when dry. A few of the pines, as the jack pine, pitch pine, knobcone, and others, have cones which will not open without artificial heat, but they rarely come into consideration in a home nursery. In separating seeds from the scales, wings, or dirt with which they may be mixed, a sieve can be used, and in many cases light dirt may be removed by pouring the seeds from one receptacle to another in a current of air.

The seeds of nearly all species are better for a little careful drying after they are gathered or extracted, to remove all superficial moisture. This is preferably done in a cool, airy place where the seeds

can be spread in thin layers and stirred frequently. An earthen floor is the best place for nuts and acorns. Since weevils are very destructive to most nuts and acorns, all seeds of this kind should be treated with carbon bisulphid before being put into winter storage.

Upon the care given to the winter storage will largely depend the vitality of the seeds in the spring. The pines, spruces, larches, firs, cedars, birches, mulberries, locusts, Osage orange, black cherry, and catalpa should be stored in sacks hung in a cool, dry place away from mice and rats. All acorns and nuts should be layered, or "stratified," in sand, preferably in a pit out of doors, where they will be subject to thawing and freezing. Good drainage is absolutely essential. The best plan is to dig a pit about 18 inches deep, place 5 or 6 inches of coarse sand or gravel in the bottom, on this spread a layer of nuts not to exceed 3 inches in depth, and then fill in above with leaves, chaff, or straw, with 6 or 8 inches of dirt on top, well rounded so as to shed water. If mice or squirrels are likely to disturb the nuts, the sides of the pit should be lined with boards. The smaller seeds, such as sugar maple, hackberry, boxelder, red cedar, coffeetree, yellow poplar, and ash, can also be kept most safely by layering in sand, although they will retain much of their vitality if kept in a uniformly cool, dry place. If stored in sand, it should be in boxes either in a cellar or in a cool outbuilding.

THE TIME TO PLANT.

Nursery planting should ordinarily be done in the spring. The exact time varies with the location and season, but a good rule is to plant the tree seed when the soil and weather conditions are such as would be favorable to the planting of early vegetables.

TWO KINDS OF NURSERY REQUIREMENTS.

The forest trees adapted for farm planting fall into two groups which require very different methods of nursery treatment. The first group is composed of conifers, or evergreens, which must be grown in partial shade, left in the seed beds two years, and preferably once transplanted to open nursery rows before they are set in their permanent places; the second comprises the broadleaf or deciduous trees, which may usually be grown without shade (Pl. III) and set out permanently the first spring after planting, when they are 1 year old.

Each of these groups will be treated separately, and the suggestions made general to cover as nearly as possible the wide range of country and the varied conditions under which planting is advisable.

CONIFEROUS TREES.

Under this head the trees which would ordinarily be grown for forest planting are white, red (Norway), pitch, jack, Scotch, western yellow (bull), Monterey, and Coulter pines; white, red, Colorado blue,

and Norway spruces; European larch; arborvitæ; and balsam and red fir (Douglas spruce). The nursery methods outlined would apply as well to the less commonly used species.

THE NURSERY SITE.

In the selection of a nursery site it should be the aim to have a convenient location where there will be no danger of disturbance by stock or birds, and where the soil is a moderately fertile sandy loam, well drained and as free as possible from weeds. For a nursery with a productive capacity of a few thousand seedlings there is seldom a better location than a section of a vegetable garden. If the ground is lacking in fertility or is covered with sod, it should be enriched and thoroughly worked, as for a garden site. Knowing the number of young trees desired, the area necessary can be roughly approximated by figuring on 3,000 seedlings per 100 square feet of ground, the assumption being that about half of this total space will be covered by seed beds, the other half by walks and paths. In nearly all regions it will be found convenient to have the nursery near a windmill or other source of water supply.

SIZE AND PREPARATION OF SEED BEDS.

The most satisfactory width for evergreen seed beds is 4 feet. This is convenient for weeding and transplanting, and permits the use of the usual lath shade screens. The beds may be of any length which will give the required ground space. Instead of having one long, solid bed, it may be broken up into 12-foot lengths by paths a foot in width. If several beds are made parallel, they should be separated by walks 2 feet wide. On sloping ground the beds should run crosswise to the slope, in order to minimize washing during heavy rains.

The preparation just prior to planting need in no wise differ from that which would be given an onion or lettuce bed—a thorough spading and raking, sufficient to pulverize the soil and leave the surface smooth and moist. On dry, sandy soils it is not advisable to make raised beds, but where drainage is desired the top of the bed should be a few inches above the general level of the paths.

PLANTING THE SEED.

For small seed beds, sowing in shallow drills will usually be found preferable to broadcasting. The drills should run across the beds and be from 4 to 6 inches apart. Double drills 1 inch apart with a 6-inch space between them are sometimes used. The drills can be marked conveniently by using a board 4 to 6 inches wide, according to the space between the rows, and using one side as a straightedge along which a stick can be dragged in making the drill. A somewhat more rapid method is to nail small three-cornered cleats to the bottom of a broad board, at the required distance apart, and mark the drills by pressing it down on the top of the bed. For example, if the drills are

to be 4 inches apart, a 12-inch board should be used with three cleats, one on the edge and the two others at distances of 4 and 8 inches, respectively, from it, the edge without the cleat being placed at the drill last made in moving the board. Handles on top will facilitate its use.

Where the soil is free from weed seeds, and a high production per unit of ground space is desired, broadcast sowing may be practiced. Jack pine and Monterey pine have been found to do particularly well when sown in this manner. The seeds which are sown broadcast may be covered by scattering or sifting fine soil over the surface to a depth of about one-fourth inch, or by merely pressing the smaller seeds into the ground with a board.

The depth at which seeds should be planted depends upon the size of the seed, character of the soil, and conditions of moisture. In sandy soil and in dry climates where the beds are not sprinkled they should be planted deeper than in heavier soil or where rain is abundant. A good general rule is to cover all seed to a depth of about twice their diameter. The ordinary tendency is to plant too deep.

QUANTITY OF SEED REQUIRED.

The amount of seed to be used depends on the species and the percentage of germination. For example, 1 ounce of western yellow pine seed will suffice for 16 linear feet of drills, while an ounce of the smaller seed of Scotch pine and larch will cover about 60 linear feet of drills, or one-third to one-half pound will be sufficient for 100 square feet of seed bed when planted in 4-inch drills. With white pine three-fourths of a pound will be required for the same space, while with fir, on account of its low germination percentage, 2 to 2½ pounds should be used. As a rule the firs, larches, hemlock, white cedar, and red cedar, on account of their lower germination percentage, and white pine, because it germinates slowly and may lie over until the second year, should be planted proportionately thicker than other species. With the above-named species the seed should be so scattered in the drills as to form a continuous row, so that on the average, if placed end to end, the seeds would all touch each other. With the other species, such as spruces, larch, and all pines except the white pine, the average number planted should be such that a seed should alternate with an open space equal to its width.

PREPARATION AND PROTECTION OF THE SEED.

In sowing most coniferous seeds no preliminary treatment is necessary, except that in certain cases it is wise to coat them with red lead, to prevent their being dug out and eaten by birds and squirrels. Red cedar seeds, however, should be soaked for four or five days in warm water, followed by two days' soaking in lye made from wood ashes. Even with this process the red cedar is a difficult tree to grow, and its use is not recommended. In all cases provision must be made to

protect the nursery from birds and animals. In semiarid regions provision must be made for watering the beds, either by hand sprinkling with a watering pot or by the use of a hose. Subirrigation is seldom advisable.

PROTECTION OF THE SEEDLINGS.

A thin surface dressing of fine gravel or coarse sand applied just after the seed is sown has been found to be effective in preventing the young seedlings from "damping off." The seed bed should be kept as uniformly moist as possible, in order to insure prompt germination, and artificial shade should be provided from the time the seeds are sown.

Under normal conditions seeds should begin to break the ground in from ten days to three weeks after planting, the time depending on the species, soil and climatic conditions, and depth planted. In the case of white pine the bed should not be disturbed, even though no plants appear for a longer period than this. Weeding should begin as soon as the plants are well up, and should be continued throughout the season. When conditions of drought prevail, the surface between the rows should be loosened frequently to assist the conservation of moisture. "Damping off" will be the greatest danger to threaten the young plants. By keeping the ground stirred and removing the shade frames to let in light and air during damp, cloudy weather, the danger can be somewhat reduced.

In regions where the winters are severe it is advisable to mulch the seed beds in order to protect the seedlings from cold drying winds and to prevent their being heaved out by frost in the spring. Leaves, moss, chaff, or any similar substance which is free from weed seeds, will serve as a mulch. The beds should be covered 3 to 4 inches deep. The mulch may be prevented from blowing by laying pieces of boards or sticks crosswise between the rows. It should be removed at the beginning of the growing season. In the Southwest and on the Pacific coast, or wherever the ground does not heave and the cold is not severe, mulching may be dispensed with.

One of the prime essentials in growing coniferous seedlings is to keep them under partial shade the first two years, while they are in the seed beds. When transplanted, the shade may be dispensed with. The desired shade is usually secured by a frame covered with laths (fig. 59). The simplest form is a frame 4 by 12 feet, made of 2 by 2 inch sticks, across which laths are nailed, each lath alternating with an open space the same width. This frame is supported on posts or edgings so as to be about 18 inches above the seed beds. In a permanent nursery the frames are often hinged to posts, which enables them to be readily moved, but in the home nursery a more simple support will serve the purpose. These frames should remain over the beds except in cold, cloudy weather, when the plants show a tendency to "damp off."

TRANSPLANTING SEEDLINGS.

Except a few rapid-growing California pines, all evergreen seedlings should be kept in seed beds until 2 years old. At the end of this time they should be transplanted to nursery rows or set out in their permanent sites. The best young trees for planting are those which are 3 years old, once transplanted, but it is a most decided economy of time and cost to use 2-year-old untransplanted seedlings when this can be done successfully. Where the planting site is favorable, and grass and weeds will not crowd the young trees, satisfactory results may be expected from the use of 2-year-old plants. If western yellow, Coulter, or Monterey pine of this age is used, it is an excellent plan to root-prune the seedlings in the beds when they are 1 year old or the fall before they are set out. Root pruning with other species also is beneficial, but not absolutely essential. The roots should be pruned with a flat spade or a tool which is made especially for the purpose.

FIG. 59.—Protecting young seedlings from the sun by means of shade frames.

They should be cut off from 6 to 8 inches below the surface of the ground.

To secure 3-year-old, once-transplanted stock the seedlings should be dug from the seed beds the spring of the second year and set out in the open 4 to 6 inches apart, in nursery rows. These rows may be 6 inches, 1 foot, or 3 feet apart, according to whether hand or horse cultivation is to be given them. Parallel rows 1 foot apart permit the use of hand cultivators. For a small number of trees closely spaced rows in a bed of any convenient size are probably best. In transplanting, the greatest care should be exercised to keep the roots from becoming dry even for a moment, by carrying the seedlings, roots downward, in pails containing several inches of water.

BROADLEAF TREES.

This group includes the commonly planted broadleaf trees, such as the maples, locusts, catalpa, ashes, elms, Osage orange, mulberries, oaks, chestnuts, walnuts, and hickories. In the nursery these trees

SMALL NURSERY OF BROADLEAF SPECIES SUITABLE FOR A FARM.

[The rows of seedlings are 39.5 feet long and 2.5 feet apart. Courtesy of Iowa State College.]

require no shade and should be planted in their permanent places in the field when 1 year old. This should be done in the spring. The methods outlined below apply to the short-lived seeds of cottonwood, elms, willows, and silver and red maple, which must be planted as soon as mature, as well as to seeds which may be kept over winter.

The directions given under coniferous trees (p. 186) for the selection of the site and the preparation of the ground for a nursery of evergreens will in general hold for broadleaf trees as well. One essential point of difference is that to grow the same number of seedlings more ground space will be required in the broadleaf than in the evergreen nursery. Although shade frames are not necessary, it is advisable to locate the seed beds for broadleaf species to the east or north of trees or buildings, where partial protection from the sun will be secured. (Pl. III.)

PRELIMINARY TREATMENT OF SEEDS.

In order to secure prompt germination, preliminary treatment must be given certain of the broadleaf-tree seeds prior to planting. Those with thin seed coats, such as the ashes, maples, elms, Osage orange, basswood, yellow poplar, and catalpa, need no treatment. On the other hand, those with thick, strong shells, as the walnuts, hickories, oaks, and chestnuts, germinate freely only when preserved in sand out of doors during the winter, so that the shells become softened and partially decayed or are opened by frost. Another class of seeds, such as the locusts, coffeetree, mulberries, and hackberry, require soaking in hot water in order to become softened enough to sprout quickly. The best plan is to place them in water heated nearly to the boiling point, about 2 quarts of seeds being used to each pail of water. The mixture should be stirred until cool and then allowed to stand four or five days, at the end of which time the seeds found floating on top should be skimmed off and planted immediately, and the process should be repeated with the remainder. It is very essential that seeds thus treated be planted without being allowed to dry out, and it is equally necessary that those stored in sand over winter be placed in the ground as soon as they are removed from the sand.

PLANTING THE SEEDS.

The seeds of the common broadleaf trees should be planted in long rows. If only two or three thousand are to be grown, the rows may be a foot apart and the cultivating may be done by hand. For greater quantities it is best to have the rows 2 feet apart when a hand cultivator is to be used, or about 3 feet apart for horse cultivation. The general arrangement and treatment should be similar to that given peas when grown for market. With ordinary success 100 linear feet may be expected to produce about 300 trees.

As with conifers, the spacing of the seeds in the row depends largely on the germination percentage. In general, fresh nuts and

acorns of good quality should be planted 2 to 3 inches apart in the row, while the ashes, maples, catalpa, elm, hackberry, locusts, box elder, Osage orange, and others with an average percentage of germination above 50 should be spaced from three-fourths inch to 1½ inches apart. Those of abnormally low germinating power, as the basswood and yellow poplar, should be sown three or four seeds deep. Except in the case of short-lived seeds, which mature in late spring or early summer, all nursery planting should be done as early in the spring as the ground can be worked.

The rule as to depth of planting already given for coniferous seeds holds good also for broadleaf species. The depth should never be greater than three times the diameter of the seed. In dry seasons, or if a period of drought follows planting, moisture can be conserved and germination hastened by covering the rows with a mulch of straw or leaves. This should be carefully removed as soon as the seeds begin to break ground. Frequent cultivation should be given throughout the first season in order to kill the weeds and to keep the ground loose and moist.

TRANSPLANTING SEEDLINGS.

Most hardwood seedlings will be large enough to set out in the field the first spring after sowing. An exception must be made in the case of a few of the slower-growing trees, as the elms and birches, or when dry weather, late planting, or an unfavorable location prevents the seedlings from making a normal growth. As a rule, if the average height is above 8 or 10 inches the seedlings should be transplanted to the permanent site the spring they are 1 year old. If held in the nursery, they should be carefully root-pruned in the spring or fall of the second year. The nut trees, oaks, and catalpa form long, fleshy taproots, about one-third of which should be cut off before the trees are set out in the field.

Where the winters are mild, the seedlings will be sufficiently protected if the dirt is hilled up against them to a depth not to exceed 6 inches, just before the ground freezes. In more severe climates they should have a covering of straw, leaves, or moss to a depth of 6 inches to a foot.

In general it may be said that young trees can not be grown successfully without rather careful attention. Yet it is certain that seedlings can be grown in connection with the vegetable garden at only a slight expense of time and material, and by methods very similar to well-known garden practice. The cheapness of the young trees thus produced should enable the small landowner to plant much more extensively, and to realize a good profit by the protection afforded his buildings or crops or by the utilization of waste land for the production of wood material.

DIVERSIFIED FARMING IN THE COTTON BELT

I. SOUTH ATLANTIC COAST.

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INTRODUCTION.

There are few portions of the United States in which it is possible to produce a greater variety of agricultural products than in the territory comprising the States of North Carolina, South Carolina, Georgia, and Florida. Large quantities of farm produce of various kinds are now shipped to other sections, the principal exports being the products of the cotton plant; garden vegetables of all kinds; fruits, particularly berries and peaches; and, from the more southern points, pineapples and oranges. In addition, the growing of rice has at various times become an important factor in the agriculture of the coast counties.

It is not the object of this article to call attention to what has already been accomplished in diversifying the agricultural products of the States mentioned, but rather to point out lines along which still further progress can be made. There has been a remarkable advance in the agricultural development of the South during the past fifteen years, and more particularly during the past five years. More attention is now paid to the diversification of crops on individual farms; better methods of tillage have been adopted, and a more intelligent use of the manurial resources of the farm has been made. These changes have resulted largely from the teachings of the agricultural colleges and experiment stations and the persistent agitation in the press of the desirability of diversified farming. There are still, however, some more or less radical changes which might be made to the advantage of both country and city populations. That these can be made, the history of the past few years renders certain.

To those who are not familiar with conditions in the cotton-growing sections of the country, it may seem strange that cotton occupies so important a place on the ordinary southern farm. The people of the South generally recognize the desirability of growing other crops than

cotton, but it is not at all a simple matter to do this. In addition to the natural conservatism of the agricultural classes—a condition not altogether to be regretted and due largely to the risk involved in undertaking new lines of farming—the South has to deal with a labor problem which, in some of its phases, is not met with elsewhere in this country.

In the old days, when the soil was not exhausted and the demand for cotton exceeded the supply, the cultivation of this staple was immensely profitable. Then the necessity of maintaining soil fertility was not realized; planters did not know that continuous cultivation without restoring to the soil the humus it originally contained would result in its sterility. Consequently, a single-crop system of farming developed. Perhaps it would be more accurate to say that the system consisted of two crops, cotton and corn, cotton being much the more important. Furthermore, cotton is an easy crop to grow, suffering less from neglect than almost any other plant, and many of the laborers adapted to its cultivation are incapable of the proper management of dairy cows or other classes of live stock. Therefore, for several generations the labor of the South was trained to grow cotton and to look upon this crop as the only source of income. The laborers of to-day naturally object to innovations, and particularly to the introduction of methods the purpose of which they do not clearly comprehend. It follows that, in order to make any radical changes in the type of farming which prevails over most of the cotton-growing section, it is necessary to train the available labor in entirely new channels and to give it a sense of responsibility not heretofore necessary. These facts account in a large measure for the continuance of cotton and corn in the position they have so long occupied in the agriculture of the South.

Another factor of importance in the continuance of a single type of farming is the lack of markets for crops other than cotton and its products. This, of course, is due entirely to the fact that cotton has occupied so large a place in the markets of the South. A large proportion of the tenants and small farmers must anticipate their next crop to supply the necessities of life. Cotton being the one reliable cash crop of most sections, it is difficult to obtain advances on other produce. Although there are extensive markets for all kinds of farm products throughout the South, except in the case of a comparatively small number of articles they are now supplied from distant regions. Experience has shown, however, that local products, when of good quality, can establish themselves in the home markets.

A very good instance of this is found on one of the diversification farms conducted jointly by the Georgia Experiment Station and the Department of Agriculture. About sixteen years ago the owner of this farm undertook to convert it from a cotton farm into a dairy farm.

The change was completed in about ten years. Butter has always been the leading dairy product on this farm. At first there was great difficulty in disposing of the butter, and it had to be shipped here and there, wherever a market could be found. At the present time this farm not only makes up all its own milk, but buys as much more from neighboring farms, and produces about 5,000 pounds of butter a year, which is all sold to one large store in Atlanta, and the purchaser says he would take double the quantity if he could obtain it.

All are familiar with the results that follow in a section of country devoted to the production of a single money crop when the price of the one staple goes below the cost of production. This has frequently occurred in the cotton-growing States, bringing great hardship to tenants and small farmers who depended solely on cotton for their income. But this is not the only evil that accompanies a single-crop system of farming. The lack of farm animals and their manure has led to great impoverishment of the soil in many sections. Not only has the fertility of the soil been reduced to a minimum, but the gradual rotting out of the humus originally present (which is always a result of clean culture), together with the shallow plowing which is prevalent in many localities, has left the soil in such a mechanical condition that in the more rolling portions of the country torrential rains cause serious washing.

As a means of overcoming this tendency to wash, a system of terracing has been developed, the fields of many hillside farms resembling a series of stair steps. When these terraces are properly laid out and well cared for, they prevent serious washing of the soil. This, however, is not a satisfactory way of remedying the difficulty. In the first place, the terraces occupy no small part of the area of the fields; and, secondly, they render the cultivation of the remainder much more expensive. The experience of the dairy farm previously referred to, which is located on a red-clay soil decidedly hilly in character, has demonstrated that with a proper system of handling the soil these terraces, except on very steep hillsides, are wholly unnecessary. On the farm in question deep plowing is always practiced, and the soil is kept stocked with humus by the addition of large quantities of barnyard manure. The terraces have been plowed up and there is no washing.

The greatest needs of the group of States discussed in this paper may be summed up in greater diversification of crops on each farm, more live stock, better methods of tillage, and more attention to means of preserving the fertility and good mechanical condition of the soil. Those who are familiar with agricultural conditions in other parts of the country will realize that there are few sections about which the same may not be said.

As is usually the case in a region that has devoted its energies to the production of a single crop, the first efforts at breaking away from old methods often consist in going largely into another single-crop system of farming rather than in the production of a greater variety of crops on each farm. In different communities different crops become leaders. In some parts of the cotton-growing sections peaches have become the staple product; in others, strawberries; in others, one or more truck crops. As a result the evils of the new system are frequently greater than those of the old. Market conditions are uncertain; no one knows how much of the new crop can be disposed of at a profit; expenses are often greatly increased; and failure to sell to advantage is likely to be followed by an inclination to return to the former system.

The risk in the exclusive production of truck and fruit is particularly great. These crops may very properly form a considerable proportion of the product of every farm, and in particular localities they may constitute the main reliance of the farm, but there should be other agricultural interests which can be relied upon in case of disastrous market conditions for fruit and truck. The development of the peach industry in some portions of the South Atlantic States during the past decade has been remarkable. Conservative men who are familiar with market conditions are, however, beginning to fear overproduction. It is therefore unwise for a farmer to depend wholly upon peaches for his income.

In the case of truck crops there are several difficulties to be met. In the first place, at the present time there is no means of learning how much of any one particular crop the markets will demand. There are no statistics to show farmers how much of any one vegetable is under cultivation. The growers are not organized in such manner as to prevent congestion at any particular point. A proper organization for the sale of truck crops would add enormously to the possibilities in the profitable production and large consumption of these crops. There is entirely too much difference between the price received by the farmer and that paid by the consumer in the city, due to expensive methods of handling and marketing produce. Much would be gained were the production and marketing of truck crops throughout the South so organized that every community could know how much of each crop every other community was planting, and during the market season where others were sending their products.

Again, if the present great cost of marketing perishable farm products could be reduced to a reasonable amount, thus lowering the price to the consumer, and at the same time methods of distribution could be adopted which would supply each market with what it would consume, there is every reason to believe that the markets would absorb much more than at present, thus enabling the farmer to greatly

increase his acreage and at the same time receive remunerative prices. Any such organization must be effected largely by the growers, but the Department of Agriculture can only aid in the collection of statistics of production and consumption, and this it is endeavoring to do.

The greatest desideratum in the diversification of farm products in the South is the development of live-stock farming. This would give much greater stability to agricultural industries. It would help to supply extensive home markets and thus keep money at home, and at the same time would add greatly to the fertility of the soil and thus increase production. It has been fully demonstrated on many farms that one-third of the land now devoted to cotton can be made to produce as much cotton as is now grown on all of it, while the other two-thirds of the acreage is capable of producing the forage needed for farm stock, the fruits and vegetables required for home use and local markets, and with few exceptions all other food supplies which are now imported from other sections. There is less danger of the over-production of live-stock products than of perishable crops like fruit and vegetables, for the former have the whole world for a market. While it would take some time to develop a satisfactory system of marketing live-stock products, even for the home markets of the South, it is possible not only to do this, but to find outlets in foreign countries for any quantity of such products which the South is likely to produce in the near future.

The beginning of diversification on cotton farms in the South should be the effort to supply home needs, as far as these may be supplied from the farm. After that the aim should be to supply local markets. By the time these demands are met, outlets will open for any surplus that may be produced, except in the case of the most perishable products.

There is an enormous demand in the South for pork and its products and for good milk, butter, and cheese. Pork can be produced in the South more easily than any other live-stock product; and, while it would not be wise to devote a farm exclusively to hog raising, it is desirable that every southern farmer should produce enough pork for home consumption and a little for sale. Dairy products present some special difficulties because of the character of labor required on dairy farms and the necessity for the use of considerable quantities of ice, but prices are good and the demand is almost unlimited, so that these difficulties may be overcome.

In the production of beef for southern markets conditions are peculiar. This class of meat is not eaten so much in the South as elsewhere, and, excepting a few wealthy people in the cities, consumers will not pay the high prices necessary to justify the production of a good quality of beef. Still, the quality demanded by southern markets can be produced at home cheaply. The presence of the cattle

tick which conveys Texas fever is a serious obstacle to the development of beef production in the South, but methods have been devised for eliminating the tick, and it is hoped that the States interested will take up the subject of tick eradication so vigorously that danger from this source may become a thing of the past. If the tick could be exterminated so that southern cattle could be shipped to northern feeders at any season without danger of spreading contagion, there would be a wider field in the South for the production of young cattle to be fed in the great corn belt of the North. The South can produce these young cattle more cheaply than the North and could sell them, under favorable conditions, at a fair profit. While, under present conditions, beef production in the South can not be made as profitable as dairying and hog raising, it is still highly advantageous to cotton growers to feed a few steers. Even if no direct profit is made from this practice, the manure produced will add greatly to the yield of cotton and other crops.

One important factor of live-stock farming should not be overlooked in considering this outlet from the single-crop cotton-growing system. Should any particular class of live stock become unprofitable, the forage crops produced on the farm could be used for another class of stock, and the labor which had been trained to care for one class would find it comparatively easy to undertake the management of stock of any other kind.

AGRICULTURAL DIVISIONS.

THE MOUNTAIN REGION.

The country lying between the southern border of Virginia and the Gulf coast may be divided roughly into five regions. The first consists of that portion along the northwestern border which is at a considerable altitude and in which cotton does not form a staple crop. The agricultural lands in this section are found in the valleys and coves among the mountains. In general these lands are naturally quite fertile. For many years corn has been the principal agricultural product, little attention being given to maintaining soil fertility. This section is eminently adapted to all kinds of live-stock farming, such as dairying and the production of beef cattle, hogs, sheep, and goats. Such forage crops as corn, cowpeas, sorghum, and timothy and clover are all easily produced. Wheat and oats may also be made important crops in this section. It is also well adapted to fruits, particularly apples, and there has been considerable development in the production of this class of fruit in recent years.

THE PIEDMONT SECTION.

Adjacent to the mountain region and extending coastward is the Piedmont section. This is timbered for the most part with deciduous trees, such as oak, elm, tulip, etc. The country is more or less rolling, varying from hilly sections adjacent to the mountains to more

level areas to the eastward. In some respects this region is one of the greatest in agricultural possibilities in the South. The climate is particularly salubrious, the soil is naturally good, and the variety of crops that may be grown is very extensive. In addition to fruits, which are already produced in considerable abundance, cotton and corn are the staple crops, but cowpeas, sorghums, wheat, oats, Bermuda grass, orchard grass, and the vetches are all well suited to conditions existing here. The production of truck crops sufficient to supply the local demands is entirely feasible. This section is fortunate in having located in it a large number of cotton mills and other manufacturing industries, all of which furnish markets for farm products of all kinds. It is probable that cotton should continue to be a leading crop in the Piedmont country, but there is no question that it would be advantageous to develop all kinds of live-stock farming.

THE PINE WOODS BELT.

Lying between the Piedmont section and the coast is a wide belt, covered for the most part by evergreen timber, and known as the Piney Woods or the Pine Woods Belt. The lands are level or gently rolling, and are usually more or less sandy in texture, the proportion of sand increasing toward the coast. This section is eminently adapted to the production of all the forage crops mentioned for the Piedmont section. Moreover, it is well suited to the growth of all classes of truck crops and small fruits. There has already been extensive development in the production of strawberries, cabbages, potatoes, beans, peas, and other garden crops. It is here that the need of organization in the marketing of perishable products is most felt. The development of various types of live-stock farming is just as desirable here as it is elsewhere, on account of the necessity for farm manures in the production of the classes of crops adapted to this section. There are no special difficulties not already mentioned in the development of any type of live-stock farming. Forage of all kinds can be produced cheaply, and expensive barns are unnecessary. Interest in live-stock farming is becoming quite general throughout the Pine Woods Belt.

THE RICE COUNTRY.

Along the South Atlantic coast the country is drained by numerous small streams that flow from the mountains to the ocean. Around the mouths of these streams are extensive tracts of marsh lands which have been redeemed from tide waters by means of dikes. From the earliest days these lands have been devoted to the production of rice. For the most part the soils are a deep, rich muck, overlaid in most cases by a thin layer of river sediment varying from a few inches to 3 or 4 feet deep, the latter at the mouths of the longest rivers.

So long as the price of rice is satisfactory these lands are extremely profitable. During the past few years, however, owing to the enormous development of rice production in Louisiana and Texas, the price of rice has been so low that many rice growers have had to abandon their lands. In addition, a few growers have had to contend with a serious disease in their rice fields. At present no other crops that can be made profitable on these lands are known. It is believed that this is largely due to the fact that we have no knowledge of the behavior of these soils when treated in any other manner than that demanded by the rice plant. Extensive investigations are now in progress with a view to determining the adaptability of these lands to other crops and working out methods of handling this soil that will adapt it to crops other than rice.

THE GULF COAST REGION.

The section of the South Atlantic coast lying immediately adjacent to the Gulf coast, and including all of central and northern Florida, may be considered as an extension of the Pine Woods Belt previously described. The soil is somewhat more inclined to be sandy, and was originally occupied, for the most part, by open pine woods. The absence of frost, except for a brief period in midwinter, adapts the section to an entirely different class of crops from those grown in the pine woods farther north. The leading forage crops are the velvet bean, beggarweed, Mexican clover, Bermuda grass, and sorghum. This region is well adapted to the production of cassava, though the agricultural status of this crop is yet somewhat doubtful. There are two factories in Florida which manufacture starch from cassava roots, and a few farmers are growing this crop for stock feed. Other crops which have been recently introduced, and which have shown themselves adapted to the section, are Guinea grass, Para grass, and Hawaiian redtop. Sugar cane thrives throughout the section, as it does also in most of the Pine Woods Belt. Here it is used mainly for the manufacture of sirup, which is of very fine quality, though its adulteration with glucose has prevented the development of an export market for the product. This section is eminently adapted to the growth of winter vegetables, an industry which is already highly developed, while in the southern part of the territory the production of pineapples and oranges has long been an important industry. Florida produces a larger percentage of live-stock products than any other cotton-growing State. This consists principally of beef, the market for which is found in Cuba. It is not produced on farms, but rather on the extensive ranges in the pine woods. There is much need for the development of dairying in the Gulf coast country, and there is room also for considerable hog raising. With a proper systematization of the production and marketing of truck crops, there would be an opportunity for the extensive development of trucking throughout the entire coast region.

II. ALABAMA AND MISSISSIPPI.

By M. A. Crosby,

Assistant Agriculturist, Bureau of Plant Industry, in Charge of Diversification Farms in Alabama and Mississippi.

INTRODUCTION.

The gradual depletion of soil fertility in the cotton-producing areas of the Southern States has resulted chiefly from the one-crop system in general practice and the absence of any scheme of crop rotation into which the production of forage and soil-renovating crops enter. Where cotton is grown exclusively on the same land year after year without the use of any intermediate crop, the clean culture necessary for the production of this crop has the effect of rapidly exhausting the humus or organic matter of the soil, and will continue to do so until a different system of farming is adopted. This does not mean that the production of cotton must necessarily be restricted, for cotton is and always will be the staple product of a large portion of the South; but it means that if soil fertility is to be increased, or even maintained, the southern farmer must adopt a system of more diversified farming and increase the organic matter of his soil by the use of soil-renovating crops and manure from stock fed on the farm.

A system of diversified farming involving some branch of animal husbandry will do more for the permanent upbuilding and general improvement of the agriculture of the South than any other factor. No section of the country is better adapted to the production of pasture, hay, and silage crops, and corn and oats yield abundantly on soils that are kept fertile.

The climatic conditions are such that it is possible to have the ground occupied with some growing crop the entire year, thus making it possible to hasten greatly the soil-renovating process by the use of winter cover crops. These will not only furnish pasturage for the farm animals during the winter months, but will at the same time take up and hold all available plant food in the soil, much of which now leaches away and is wasted where the ground is left exposed to the washing effect of the heavy winter rains.

TYPES OF DIVERSIFIED FARMING.

There are several types of diversified farming which it is possible to develop in Alabama and Mississippi. These vary all the way from a two-crop rotation to a type of stock farming in which a large variety of crops is grown, all of which are fed on the farm and thus converted into meat or dairy products.

The type of farming which will be the most practicable for any one man to follow will depend greatly on the capabilities and tastes of the

individual, the character of his land, and the facilities for getting the produce to market. A man with no knowledge of dairying or liking for dairy work could not be expected to succeed in that line of farming; and, even though he were well suited for conducting a dairy, it would not be practicable for him to engage in the business unless he were favorably situated with reference to markets.

DIVERSIFICATION OF CROPS.

COTTON IN ROTATION.

The man who does not wish to keep live stock, except such as is necessary for conducting the farm operations, and who wishes to grow cotton for his main crop, may greatly increase the fertility of his soil by adopting some scheme of crop rotation. The simplest system to meet a requirement of this kind is the two-crop rotation, with cotton as the major crop and some winter-growing legume, such as bur clover or vetch, for the intermediate soil-renovating crop.

Simple as the method is, the rapidity with which the producing capacity of the soil may be increased by this system is astonishing. It enables the farmer to grow cotton on the same land each year and yet to increase the fertility of the soil. One farmer, known to the writer, having a farm of the red-hill land common to a large portion of northern Alabama and Georgia, increased the cotton-producing capacity of his soil from one-third of a bale per acre to two bales per acre simply by growing a crop of bur clover on the land each winter. He adopted this method some eight years ago and, except for the original cost of the bur clover seed, has been to no extra expense, as the clover has reseeded itself each year. Vetch is another excellent crop to rotate with cotton, and some planters prefer it to bur clover for this purpose. If either is used a large amount of excellent winter pasturage is to be had for the farm animals.

More satisfactory rotations, however, are those which involve the use of a greater diversity of crops, thus making cotton more of a surplus crop and distributing the income of the farm over a greater portion of the year. Such crops as corn, cowpeas, sweet potatoes, winter cereals, and vetch can be worked into various rotations to good advantage.

In this connection, the production of hay is also well worth considering. There is more truth than fiction in the old saying that "the southern farmer spends his summers fighting grass to grow cotton to buy hay with." One frequently sees a man and a mule struggling to rid a cotton field of grass, which, if left and cut for hay, to be used on his own farm, would save him more than the cotton grown in the same ground is worth. Except in the Johnson grass region there are few communities in these States that produce their own supply of hay. Where freight rates are not prohibitive, the prevailing high price of

hay throughout the South offers good inducements for branching out in this industry.

On account of its feeding value and the heavy yields produced, alfalfa, where it succeeds, is without doubt the most valuable hay crop that can be grown. On the black prairie soils of Alabama and Mississippi it yields from 3 to 6 tons per acre each year, and the value of a season's crop is frequently more than the market value of the land on which it is grown. In Perry County, Ala., land that would not sell for over \$25 an acre produced, during the past season—an unfavorable one for alfalfa—over 5½ tons of fine hay, worth at least \$10 a ton.

Johnson grass, where it is already established, is an excellent hay crop, but on account of its weedy nature and the difficulties attending its eradication it is not to be recommended for sowing. Vetch or vetch and oats, sown broadcast and disked in on a Johnson grass meadow in the early fall, will make a good growth during the winter, keep down the growth of early spring weeds, and add materially to both the bulk and value of the first cutting of hay. Vetch may also be grown to good advantage with some of the winter cereals—oats, rye, wheat, or barley—and such a combination makes a very good quality of forage. Other good hay crops for the South are cowpeas and sorghum, grown either separately or together; peanuts, German millet, and along the Gulf coast Mexican clover and velvet bean.

TRUCK GROWING.

Where good markets are accessible and shipping facilities favorable, truck growing, intelligently conducted, is a very profitable business. The level sandy and sandy loam lands of Alabama and Mississippi, especially in the Gulf coast region, are generally well adapted to this branch of agriculture, and the area devoted to strawberries, cabbage, turnips, tomatoes, lettuce, and similar crops is being largely increased each year. The greatest drawback to the trucking industry in this section is the prohibitive rates charged by the refrigerator-car companies. Another difficulty is the danger of the overproduction of one or more of these perishable crops.

Truck growing combines well with general farming, for the principal truck crops are off the land in time to permit the growing of a second and, in some instances, even a third crop. Corn, sorghum, cowpeas, sweet potatoes, and in some instances even cotton may be grown after the removal of a crop of lettuce, cabbage, tomatoes, radishes, or even Irish potatoes.

A successful farmer with whom the writer is acquainted grows cabbage, cotton, and turnips on the same land in one season. In a favorable year he has produced \$200 worth of cabbage, 2 bales of cotton, and \$75 worth of turnips per acre. All his cultivated land is made to produce at least two crops each year.

ANIMAL PRODUCTION IN DIVERSIFIED FARMING.

The most desirable type of diversified farming, however, is one involving some branch of animal husbandry. In many respects the South offers exceptional opportunities for the development of hog raising, dairying, and the production of beef cattle. The cotton farmer who contemplates going into any branch of animal husbandry must remember, however, that all kinds of stock require pure water, and must have feed. The practice of letting animals shift for themselves and pick a living as best they may is not a part of successful stock raising.

HOG FARMING.

The South uses more pork in proportion to the number of its inhabitants than any other section of the country, and yet the bulk of this meat comes from the great corn belt of the Middle West. Hog raising is a type of farming to which a large portion of the South is very well adapted, and there is no reason why the southern farmer can not produce at least enough pork for home consumption.

The chief requisites for successful hog raising are pure water, a good pasture with plenty of shade, and a soil sufficiently fertile to grow feed crops at a small expense. There are few sections in the South where such conditions are not found. While it is true that the southern farmer can not produce corn as cheaply as his brother farmer in Illinois, Iowa, or Missouri, he has the advantage of having at his command a much greater variety of meat-producing plants and a season of almost continuous pasture. Alfalfa, Bermuda grass, lespedeza, and white clover furnish the best summer pasture; and vetch, bur clover, rape, and the winter cereals will produce an abundance of winter grazing. One acre well set in alfalfa will furnish grazing for 15 to 20 head of hogs from April to September. A 7-acre alfalfa pasture in central Alabama furnished grazing from March 28 to September 25 for 115 to 123 hogs, and also produced during this period nearly 6 tons of fine hay.

By arranging for a succession of such crops as sorghum, cowpeas, peanuts, chufas, artichokes, and sweet potatoes, to be fed in connection with good pasturage, the animals may be kept in a thrifty, growing condition all the time. With all these feeds at his disposal, the southern hog grower can fit his animals for market with much less corn than can the northern or western grower.

DAIRYING.

Dairying is without doubt the ideal type of diversified farming, in that it distributes the income from the farm quite evenly throughout the year and at the same time builds up the fertility of the soil more rapidly than any other type of farming. The opportunities for developing the various branches of the dairy industry in the South are

exceptional, to say the least, for there is always a lively demand for high-class dairy products of all kinds in the cities and larger towns. In the cities and towns which are now popular resorts there is an ever-increasing demand for all kinds of dairy products at fancy prices, at least during the tourist season.

The fact that forage can be produced cheaper, in greater variety, and also in greater abundance in the South than in other sections, and the further fact that pastures may be provided the greater part of the year, should have an important influence on the development of the dairy industry in this section. It is as easy for the southern dairyman to grow two crops of forage each year on his tillable land as it is to grow one crop in the North.

With such crops as Bermuda grass, alfalfa, lespedeza, cowpeas, sorghum, vetch, oats, and rye for pasture, soiling, ensilage, and hay, and with corn and cotton-seed meal for concentrates. the question of feed is easily solved.

In deciding what branch of the dairy industry to follow, one must be governed largely by markets and shipping facilities. Near a town or city, where there is always a good demand for milk, the retail milk trade will probably prove most remunerative. By careful attention to business and always delivering a first-class article the dairyman will have no trouble in creating a demand for his product. In some of the southern cities a man with a reputation for handling only clean, pure milk will have no trouble in disposing of all he can produce at 40 cents per gallon.

For the dairyman located at some distance, say 50 to 100 miles, from a city, and having favorable shipping facilities, the cream trade offers exceptional advantages. The ice-cream trade in all cities demands a large quantity of good cream, and, as the season for ice cream lasts nearly the entire year in the South, the demand is a steady one.

The butter trade will offer inducements to some farmers, especially those who are so situated that they can not conveniently or economically market their product in the form of milk or cream. The demand for high-class butter is so steady that if a man is known to handle a good grade he has no trouble in disposing of his entire output to private customers at very remunerative prices. Either the butter or cream trade combines well with hog or poultry farming, thus utilizing to best advantage the skim milk and buttermilk from the dairy.

BEEF CATTLE PRODUCTION.

The production of beef cattle is a type of farming deserving of much attention in many portions of the South, and especially where good pastures can easily be had and an abundance of feed stuffs produced. The black prairie belt of Alabama and Mississippi, where

alfalfa, Johnson grass, and Bermuda grass grow to perfection, is exceptionally well adapted to the raising of beef cattle. One of the great advantages the South possesses over other sections of the country in the way of cattle raising is the almost continuous grazing season, making it necessary to feed but little during the winter in comparison with the quantity of feed required by the western stock grower.

The summer pasture is furnished by Bermuda grass, white clover, lespedeza, and native grasses, and winter pasturage may be had by sowing vetch, bur clover, and such winter cereals as oats, rye, wheat, and barley. For winter roughage an abundance of Johnson grass, alfalfa, sorghum, and cowpea hay can be produced. The mild winter climate, which makes the construction of expensive barns unnecessary, is also favorable to the development of this industry in the South.

The chief drawbacks to this industry are the presence of the cattle tick, or Texas-fever tick, and the consequent restrictions, during certain seasons, against cattle shipped from the South. It has been demonstrated, however, that the cattle tick can, in some localities, be effectually exterminated, and it may be only a question of time when this will be done generally and the restrictions removed. The only other serious difficulties are the character of the available labor and the lack of established local markets, both of which can and will be overcome in time.

SUMMARY.

It is apparent to all who are familiar with southern conditions that if the depletion and the washing away of the soil on southern farms is to be checked, a system of farming must be put into practice which will increase the organic content of the soil. As has been stated, this may be done either by a system of crop rotation involving the use of leguminous crops and green manures or by feeding a large portion of the crops on the farm and returning them to the soil in the form of animal manures. While it is true that there are many hindrances to a speedy change of system, such as character of labor, farmers trying to cultivate more land than they can properly manage, and lack of knowledge regarding the care and management of live stock, the future outlook for the agricultural South is, nevertheless, very promising. The great educational advance which has taken place in the South during recent years, the good work of the experiment stations, the teachings of the agricultural colleges, the demonstration work of the United States Department of Agriculture, and the far-reaching influence of the farmers' institutes, are all doing much to create an interest in the improvement of southern agriculture. The methods employed on successful farms and the demonstration work of the experiment stations and the Department of Agriculture are being studied

and put into practice. Thus each of these centers becomes a nucleus for the diffusion of information concerning a better type of farming, and there is reason to hope that the time is not far distant when diversified farming, in some of its various phases, will be general throughout the South.

III. LOUISIANA, ARKANSAS, AND NORTHEASTERN TEXAS.

By D. A. Brodie,

Assistant Agriculturist, Bureau of Plant Industry, in Charge of Diversification Farms in Louisiana, Arkansas, and Northeastern Texas.

CLASSES OF FARMERS IN LOUISIANA AND ARKANSAS.

In those sections of Louisiana and Arkansas in which cotton is grown we may divide the farmers into three classes:

First, there is the large planter, who owns extensive tracts of land, in most cases amounting to thousands of acres. Frequently he lives in town and rents his farm out in small tracts. It is not uncommon to find anywhere from 20 to 100 tenants with their families on one plantation. These are mostly negroes. The owner himself either engages in business in the city or more commonly personally directs the operations of his tenants.

Then, second, there is the small landowner, who owns and operates his own farm, either doing the work alone or with hired help.

The tenants constitute the third and most numerous class of farmers, the majority of them being negroes. Most of these are found on the large plantations, where each works 10 or 20 or more acres of land or as much as the owner of the land considers he can handle properly. The rent is either a cash consideration of $3 to $7 per acre, or it may be a share in the crop—one-third when the tenant furnishes his own equipment or one-half when this is furnished. In other respects the tenant is like the small landowner, either working the land alone or with hired help.

PRINCIPAL CROPS AND METHODS OF CULTURE.

Although the list of crops that can be and are successfully grown in Louisiana and Arkansas is as great as that of any other portion of the country, still it may be said that the agriculture of the cotton belt is based on two crops—cotton and corn. Cotton, being the most important crop, usually occupies several times the area that corn does and follows itself year after year on the same ground, except on such portions as are selected each year for corn.

The methods employed in the cultivation of these crops differ greatly in the various agricultural sections. The implements of tillage which have been commonly used in the South when work is done with one horse differ so much from those employed when two horses are used

that a description of them may be of interest. The description of these one-horse implements which follows not only indicates their character and uses, but gives an idea of the methods used by many farmers in the hill country.

In planting corn, the rows of the previous year are opened up the last of February or first of March with a 12-inch double-moldboard plow (Pl. IV, fig. 1, No. 1), popularly known as a "middle buster," which throws the soil into the "water furrows" between the old rows. This leaves the ground with the ridges where the furrows were before. If cotton seed is used as a fertilizer, it is drilled into the furrow made by the plow about March 1 and covered with a half-shovel[a] or small turning plow (Pl. IV, fig. 1, No. 2).

About March 10 to 15 this furrow is again opened with a 6 or 7 inch duck-bill plow (Pl. IV, fig. 1, No. 7), and the corn is planted either with a planter or by hand. When the planter is used, the seed is dropped every few inches in the row and covered at the same time. In hand planting, the seed is usually dropped in hills 3 or 4 feet apart and covered with a double or straddle stock. This is a modification of the Georgia stock, having two beams and two standards, each carrying a small shovel or "bull-tongue scooter," similar to the diamond scooter (Pl. IV, fig. 1, No. 6). These straddle the row, throwing enough soil between them to cover the corn. In case heavy rains follow before the corn comes up, an iron-toothed harrow is run over the row to loosen the surface (Pl. IV, fig. 1, No. 11).[b]

When the corn is "finger" high, it is "barred off;" that is, a furrow is run along each side of the row of corn with a one-horse turning plow or a diamond scooter, throwing a small furrow away from the corn. This leaves the corn on a narrow ridge. In a few days it is "four furrowed" by going around each row twice and throwing two furrows to each side of the row to cover any weeds that may have germinated. When the corn is knee-high it is "roached up;" that is, the loose soil is thrown around the corn with a 4-inch duck-bill plow with a 10-inch "heel-sweep" attached (Pl. IV, fig. 1, Nos. 5 and 9). Ten or twelve days later it is again four furrowed. This leaves a "balk" (a small ridge) between the rows, which is thrown out with a 12-inch "solid sweep" with a 20-inch heel-sweep attached (Pl. IV, fig. 1, Nos. 9 and 10). After this the corn is said to be "laid by," which means that it has received the last cultivation.

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[a] The half-shovel, bull-tongue, duck-bill, solid sweep, heel-sweep, scooter, etc., are attached to a Georgia stock when used. This consists of a pair of handles, a beam, and an upright standard. Where a shovel and a heel-sweep are used together, the sweep is bolted behind the standard with the same bolt that holds the shovel.

[b] On low lands the corn is planted on the ridge instead of in the water furrow; cotton, so far as the writer has observed, is always planted on the ridge.

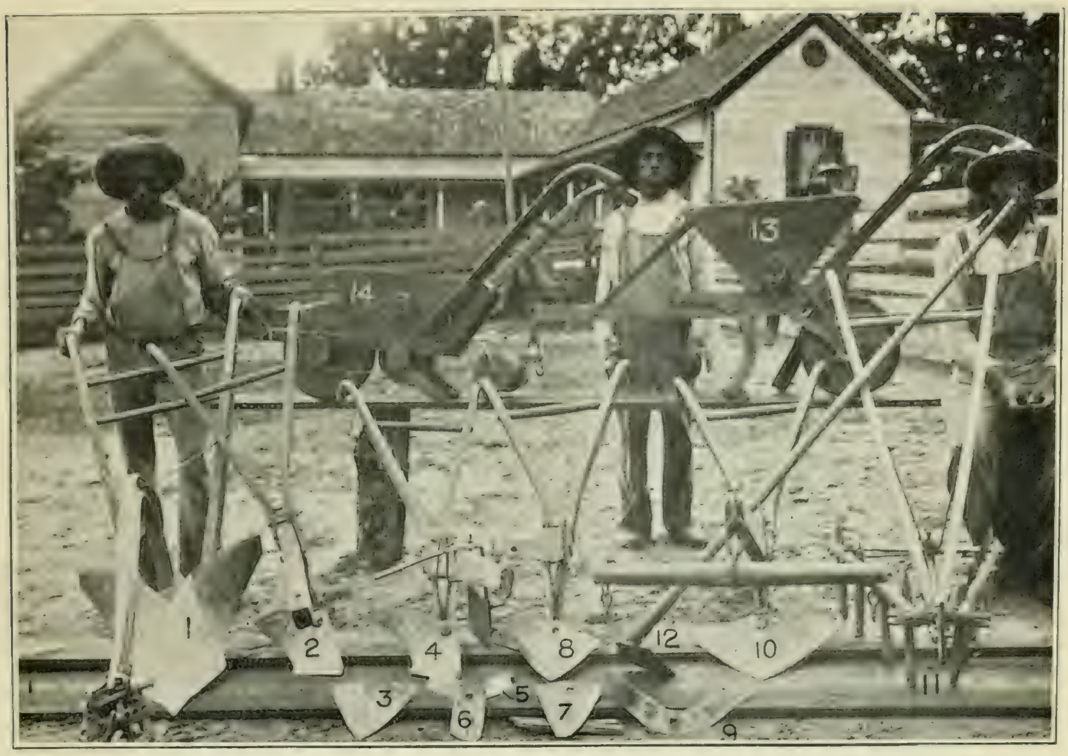

FIG. 1.—TOOLS USED IN THE CULTIVATION OF COTTON AND CORN.

[1, Middle buster or middle splitter; 2, stock with half shovel or turning plow; 3, small solid sweep; 4, Georgia stock with half shovel with fender attached to use in barring off; 5, 10-inch heel sweep; 6, diamond scooter; 7, duck-bill plow; 8, solid sweep with 18-inch heel sweep attached to Georgia stock; 9, 18-inch heel sweep; 10, 18-inch solid sweep attached to Georgia stock; 11, harrow; 12, hoe—typical form of those used in chopping cotton; 13, fertilizer distributer; 14, cotton planter.]

FIG. 2.—CHOPPING COTTON ON A LARGE PLANTATION NEAR ALEXANDRIA, LA.

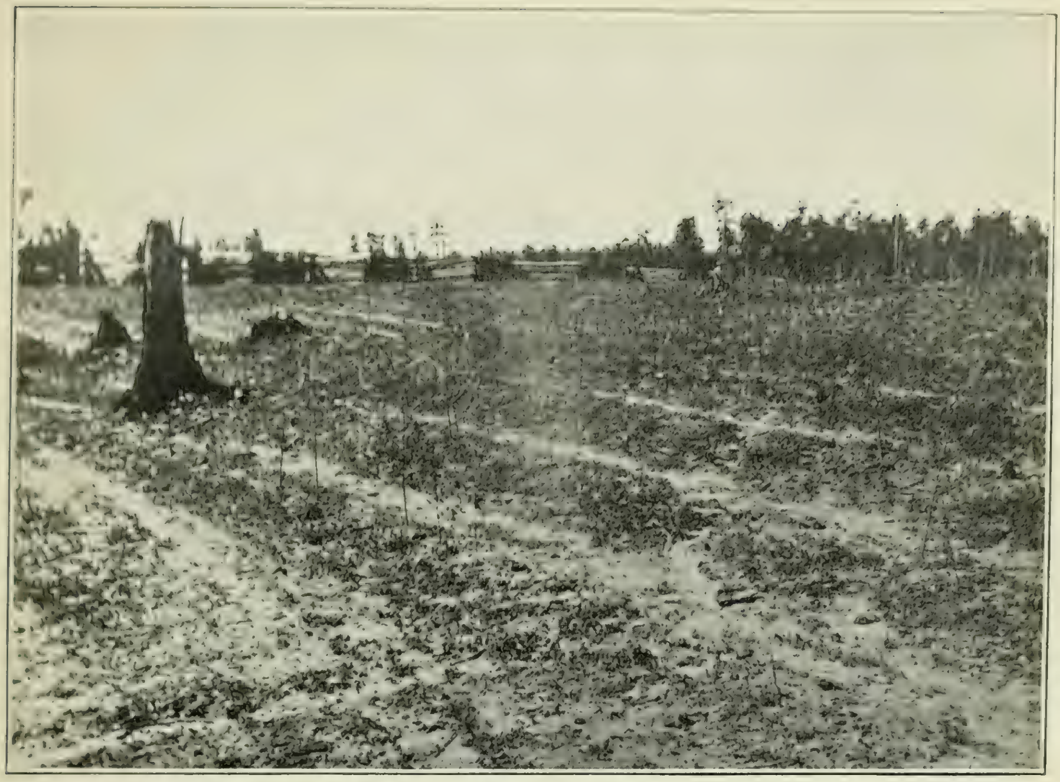

FIG. 1.—AN OLD COTTON FIELD JUST TURNED OUT.

FIG. 2.—A COTTON FIELD THREE OR FOUR YEARS AFTER BEING TURNED OUT, SHOWING HOW THE YOUNG PINE GROWTH TAKES POSSESSION.

FIG. 1.—A NEW FIELD READY TO BE PLANTED IN COTTON.

FIG. 2.—A TYPICAL COTTON FIELD OF THE BETTER SORT.

The cultivation of cotton is practically the same as that of corn, except that the cotton seed is drilled in with a cotton planter (Pl. IV, fig. 1, No. 14), and the rows are "barred off" when the cotton is 4 to 6 inches high. It is then "chopped out;" that is, the plants are thinned with hoes to about a foot or more apart in the row. (See Pl. IV, fig. 2.) Then, too, cotton is cultivated until quite late, or until all danger of weeds is past, while corn is laid by early in the season. A second hoeing is frequently given to remove "grass" (weeds) from the row.

It will readily be seen that where cotton and corn have been grown in this way on the same ground for long periods of time, the land has become so exhausted that it no longer yields profitable crops. In former times when the land became thus exhausted it was allowed to "lie out," that is, it was no longer cultivated, and soon became a thicket of trees and brush (Pl. V, figs. 1 and 2). The old cotton rows may yet be seen in the second-growth pine thickets marking many fields that have not been cultivated since the civil war. When a field was abandoned in this way it was necessary to clear a new piece of ground to take the place of the old one. This was done in some cases by cutting out the underbrush, "deadening" the larger trees by girdling, plowing the ground, and planting in cotton (Pl. VI, fig. 1). In other cases the land was cleared by deadening the timber and allowing it to stand two years, when it was set on fire and everything was allowed to burn.

To some extent these methods are still practiced in the hills and timbered sections, but the use of leguminous crops as soil renovators is rapidly replacing this practice. In the river valleys, where alfalfa grows luxuriantly, general use is made of it in building up the soil on the older plantations; and in the hills and other sections, where the adaptability of alfalfa has not yet been demonstrated, cowpeas are generally sown in the corn when it is laid by, and bur clover and vetches are sometimes used for winter pastures and turned under as green manure in the spring.

The adoption of leguminous crops for renovating the soil and maintaining its fertility has naturally resulted in the farmers raising more stock, and in quite a number of instances has led to the growing of a diversity of crops in which legumes hold a prominent part. Where this has been done the yield has been materially increased—in some cases as much as 100 to 200 per cent. (Pl. VI, fig. 2.)

The advance to more improved methods has been greatly hindered by what is known throughout the South as the credit system. By this system farmers are furnished with the supplies and tools necessary for conducting their farm operations until the crop is ready to sell. The amount furnished is based largely on the acreage of cotton to be

planted. In many cases the supplies consist of hay, grain, fertilizers, meat, and often fruit and vegetables. In order to meet the payments for all these supplies, as much cotton as possible is planted, it being the main money crop and the only one on which credit is offered in the strictly cotton-growing sections. In this way many farmers who are inclined to adopt a more diversified system of farming are prevented from doing so by being forced to pledge themselves to a certain area of cotton in order to get the necessary advance to raise their crops.

In some cases individual farmers have gradually freed themselves from this system by growing their own food and fodder, thereby saving the enormous bill that always accumulates when these things are bought. In such cases success has invariably followed. In fact, no portion of the country offers greater opportunities for making a farm self-sustaining than are offered here, where two or more crops can be grown during a single year.

In support of this statement may be cited instances of various types of farming that are successful in this part of the country, where certain farmers have broken away from the old-time methods and by so doing have opened a way to greater possibilities in agriculture in the South.

TYPES OF SUCCESSFUL FARMING.

While stock raising is not at the present time carried on to a large extent in the cotton-growing portions of Louisiana, Arkansas, and northeastern Texas, there are widely scattered instances of success in various phases of it.

Dairying has made gratifying progress in a good many places; for instance, Hammond, La., once a cotton-growing center, is now shipping 700 gallons of milk daily to New Orleans. At Marshall, Tex., one man has run a successful dairy for three years. In that time he has built up his herd to about 75 cows, pure-bred and high-grade Jerseys, the returns from which are over $500 a month. The gross receipts from each cow in a herd of 40 high-grade Jerseys at Lafayette, La., for the past year ranged from $180 to $222. The milk in this case is bottled and sold to local customers at 25 to 30 cents per gallon.

In the matter of beef production, the Louisiana Experiment Station has demonstrated that "market toppers" can be produced for the Chicago market. The Mississippi Experiment Station has produced high-grade two-year-old feeders at a cost not exceeding $12. These facts indicate that there are large possibilities in beef production in the South.

Many instances could be given of success with hogs, especially where alfalfa has become established and is used for pasture. In those sec-

tions where alfalfa has not yet passed the experimental stage other crops are used for hog pasture, and the industry is found to be highly profitable. In fact, there is no portion of the country where pork can be raised more cheaply.

In scattered instances horses and mules are raised for the market. At the present time good mule colts sell readily at 1 year old for $40 to $50, at 2 years old for $75 to $100, and at 3 years old for $150 to $200. There has never been a time in recent years when good mules did not bring good prices. Horses are not usually sold until broken, when they sell for $100 to $300.

Angora goats have been found highly profitable near the northern limit of the cotton area, and in rare cases are to be found farther south. These should find a place in the timbered sections, especially in the hill lands, where they would be valuable in clearing the land of brush and where the character of the soil is conducive to good health among them.

An example of successful general farming is found in the hills of Lincoln Parish, La., where a man on 125 acres of his 1,900-acre plantation has for ten years raised all the hay and grain not only for his own stock but for that of all his tenants. For the markets he produces horses and mules, milch cows and stockers, pure-bred Poland China pigs, and Plymouth Rock, Rhode Island Red, and Wyandotte chickens, besides cotton, corn, oats, peas, peanuts, sweet potatoes, hay, ribbon-cane sirup, and lard.

There is a strong, growing demand in the North for southern-grown vegetables and fruits. Many of these can be put on the markets at seasons when there is little or no competition and can be disposed of at paying prices. Successful fruit-growing and truck-growing associations exist in some portions of this territory, and the number is increasing each year.

DIFFICULTIES.

There is a strong desire on the part of a majority of the farmers to improve agricultural conditions generally. There are, however, some serious difficulties to be met with in changing to more diversified methods.

(1) It is claimed that, as a rule, the labor available knows very little of the cultivation of crops other than cotton and corn and is slow in adapting itself to any new system. White labor is very scarce and much of it is looked upon as inferior to the negro labor.

(2) The credit system has a retarding effect on the development of better systems of farming, for the reason that at the present time the farmer's credit is based on his acreage of cotton, which is often as much as he has means and equipment to work.

(3) The large plantation, with its 20 to 100 or more tenants, makes it difficult for the large planter to change, for he must educate his tenants in the new system. The small farmer who controls his own land is better able to make the change, and it seems that through him this change must come.

(4) The lack of knowledge of how to begin a better system keeps many from adopting new methods.

CONCLUSION.

In conclusion it may be said that the most important factor in successful farming—"Buy nothing that can be raised on the farm"—is being learned by a rapidly increasing number of farmers. This is due in a great measure to the influence of the farmers who have already succeeded in more diversified lines. While many of these have adopted modern methods and implements, eminent success has been attained by some who still adhere to the old methods. This goes to show that, while the latest labor-saving implements are desirable, they are not at all necessary in making the change.

The work of the experiment stations has been of inestimable value. These, in cooperation with the United States Department of Agriculture, are now instituting throughout the cotton belt diversification farms where scientific principles combined with good business methods are applied in a practical way to show that other types of farming can be made to pay as well as exclusive cotton culture.

There is every reason to believe that during the next few years great changes toward better methods of farming will occur throughout the South, and that these will eventually place it in the front rank as a general agricultural section.

IV. TEXAS.

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INTRODUCTION.

Texas, with its 265,000 square miles and its extreme range of 900 miles from north to south and the same from east to west, presents a wide variety of soil and climatic conditions, with a resultant wide diversity of crops. The subject of diversified agriculture in this State is so broad that recent developments and future possibilities can only be outlined here. For a better understanding of the matter it will be necessary to give a brief enumeration of the characteristics of the various agricultural sections into which the State is naturally divided,

together with a note as to the particular lines of farming for which each section is especially adapted. A large part of that portion of Texas lying west of the ninety-eighth meridian is yet virgin grass land, used as pasturage for cattle, and need not be considered in this classification.

THE NATURAL AGRICULTURAL DIVISIONS.

Lying along the Louisiana border is a strip 100 to 150 miles wide, locally known as east Texas. This section was originally heavily timbered with pine and various deciduous trees, and most of the farming is on the cut-over lands. Limited tracts in this section have been in cultivation for many years, but the lumbermen still add considerable acreages yearly to the tillable area. The soil for the most part is sandy, underlaid with red or yellow clay. River and creek bottoms often present considerable areas of black alluvial deposits.

Adjoining this section on the west, and extending south from the Red River Valley about 300 miles, with a width varying from 75 to 125 miles, is the black waxy belt. The western limit of this area is about the ninety-eighth meridian. The soil here is of limestone formation, a very rich, black loam usually underlaid with yellowish phosphatic clay. In various sections the limestone, or, as it is locally known, the "white rock," outcrops. The principal crops in this section are cotton, corn, wheat, and oats. Practically one-half the cotton crop of the State is produced here.

Lying west of the black waxy belt are two sections which in general may be grouped together and which are designated here as west Texas and the Plains region. In this discussion west Texas will be considered only so far as considerable areas of cultivated land extend, or to about the one hundredth meridian; in fact, a large part even of this area is in grazing land. This section is considerably broken, most of the cultivable land being in the valleys. A number of counties in this portion of the State, however, contain a high percentage of tillable land. The rainfall here is considerably less than in the sections just described. Stock raising and the growing of cotton are the principal industries. The Plains region will be considered here as including the entire Panhandle section and extending as far south as the thirty-third parallel. The elevation is considerable, ranging from 2,500 to 4,000 feet; the rainfall averages 16 to 18 inches; high winds are prevalent at certain seasons, and these tend to decrease the efficiency of the rainfall. Most of this section is grazing land; a large part of the area which is tilled is used for the production of forage for stock.

The east Texas country and the black waxy section may be considered as extending south to about the thirtieth parallel. In the region south of this line is the section locally known as south Texas,

including the Coastal Plain and extending west to about 97° 30′. The coast portion of this region is mostly in pasture or in some sections devoted to the culture of rice and sugar cane. Farther back from the coast cotton is the leading crop. West of this section and south of the thirtieth parallel, extending to the Rio Grande, lies southwest Texas. Like west Texas, the rainfall here is somewhat uncertain, the principal difference between these two sections being one of latitude. Of late years, however, artesian water has been found in various portions of southwest Texas and considerable diversified farming has sprung up in this belt and along the rivers where irrigation water can be secured. For the most part, cotton and cattle are the main articles of production.

In general, the various agricultural sections of the State fall into the foregoing divisions. Naturally, in a broad classification of this kind the lines of demarcation are rather indefinite, and within the various sections as outlined may be included smaller tracts of land varying greatly from the general type. A noteworthy example of this variation is the "Cross Timbers" country, lying along the Red River, in Grayson, Cooke, Montague, and Clay counties. In many respects this section resembles the east Texas country, and it is a considerable producer of fruits and vegetables.

THE EAST TEXAS COUNTRY.

The sandy and clay lands of east Texas are adapted to the growing of a wide range of truck and fruit crops. The principal orchard fruit now grown is the peach, the planting of which crop in the last few years has been enormous. Kieffer pears and Japan plums have also been quite extensively planted. Toward the northern end of this section there are soils which should yield good returns when planted to early apples; grapes also do well, but are now little grown. As yet strawberry growing is confined largely to a limited area around Tyler, but this industry should be profitable almost anywhere in east Texas. Blackberries and dewberries are grown in a limited way only; trade in the better shipping sorts is capable of considerable extension. Of the truck crops, potatoes and tomatoes furnish the great bulk of the shipments. The growing of early potatoes is general all over east Texas, and extends into other sections of the State as well. Tomato shipments are greatest from Jacksonville, but extend in a limited way throughout the section. Other crops which are shipped in smaller quantities are watermelons, cantaloupes, radishes, lettuce, and cabbage, though none of these vegetables are shipped from this section as largely as from other parts of the State, the Winnsboro cantaloupe shipment alone excepted. There is a field in east Texas for the growing of nearly all the garden vegetables for northern markets, as this section fills the gap between southwest Texas and the Arkansas trucking region.

Not all of east Texas, however, can be devoted to truck and fruit raising. Forage crops are necessary for the maintenance of work stock. Sorghum, cowpeas, and peanuts do well in nearly all locations here. Corn, with good cultivation and fertilization, seldom fails to produce a fair crop. Alfalfa does well in many places, especially on the river and creek bottoms. Good use can be made of oats, rye, and barley as winter-pasture and green-manuring crops. Hogs enough at least to supply home consumption should be raised. Dairying could well be introduced on many farms. An abundance of feed can be produced for winter; Bermuda grass and Japan clover furnish fine summer pasture; and the dairy herd would go a long way toward keeping up soil fertility if proper use were made of the manure. A small acreage of cotton well worked should be grown on nearly every farm.

THE BLACK WAXY SECTION.

Grain, hay, and live-stock farming, in addition to the growing of cotton, find a place in the black waxy belt. Except in limited areas, usually near the streams, this section is not well adapted to truck and fruit production for distant markets. Vegetables and fruits for home use may be grown on every farm, however. Of the grain crops, corn, wheat, oats, and barley all do well. Storage facilities should be provided on the farm, so that the farmers may hold at least as much of their crops as may be needed for winter feeding. Texas farmers can hardly afford to sell their corn in August for 30 cents a bushel, as many now do, and buy it back in January for 75 cents. Alfalfa can be grown almost anywhere in the black waxy section, and cowpeas, sorghum, and Johnson grass are reliable hay crops. Cotton should be grown as a cash crop with the grain and hay crops mentioned. Grown every third year on the land, with corn and cowpeas as the first year's crop and wheat followed by cowpeas for the second year, the fertility of the soil will be maintained and the production materially increased.

The highest development in farming in the black waxy belt is to be reached by a combination of live stock, grain, and cotton growing. With cotton and wheat as cash crops which may be sold off the farm, the corn, oats, and hay may be retained and fed to cattle, hogs, horses, and mules. There is nearly always a market at fair prices for good mules, and with Bermuda pasture, Johnson grass, alfalfa, and cowpea hay, and the various grains produced on the farm, mules of marketable age ought to return a good profit over the cost of production. The Texas hog can be produced very largely on forage crops, and only a small quantity of corn is needed to finish pork for market. With a demand close at hand which is not now nearly supplied, hog raising should be profitable. With Bermuda grass for summer and oats, wheat, or barley for winter pasturage, together with the various

hay and silage crops which may be grown, the dairy herd may be maintained with small outlay for grain or concentrated foods. There is need of a large number of creameries and well-maintained dairy herds in this populous section of Texas. At present the people of Texas probably pay out $10,000,000 annually for butter which could be produced at home. With the wide range of forage crops and the corn and cotton-seed products here, cattle feeding may prove profitable both to farmers and to mill owners.

WEST TEXAS AND THE PLAINS.

Cattle raising has long been the principal industry in west Texas and the Plains region, and it is only within recent years that any farming has been done. Even now most of the cultivated land is used in the production of forage crops for cattle, and it is probable that this will be the case for many years to come. Here Kafir corn and dwarf milo prove acceptable substitutes for corn in hog and cattle feeding, and from limited tests it seems probable that they will be found to be excellent grains for this purpose. In the way of forage this section produces sorghum, Kafir corn, and millet. Alfalfa can be grown in many localities, as widely scattered tests show. Johnson grass and cowpeas are heavy hay-producing crops, especially in the southern part of this region. Cotton is a reliable crop here, except in the northern end of the Panhandle. Wheat growing has long been important along the Red River and is now extending into the Panhandle section. The Red River country and various sections of west Texas have recently come into prominence as truck and fruit producing regions. Early apples do well and should be especially profitable. Most of the horticultural products of this section find a market in Colorado, though frequently some of them are shipped to southern and central Texas after the local crops there are exhausted. Mention should also be made of the irrigated valleys in the extreme western portion of the State, which produce alfalfa, grapes, and apples. While there is no great range of diversification here, there is little danger of depleting the soil in any section where alfalfa thrives.

SOUTH TEXAS.

South Texas is a large producer of rice and sugar cane. In addition to these staple crops, limited areas, notably in Brazoria and Galveston counties, are devoted to the production of strawberries and truck crops, especially potatoes, cucumbers, cabbage, and melons. The great melon-producing area of Waller County lies just at the northern edge of this section, about 100 miles from the coast. Not much attention is paid to forage crops, as the humidity of the air makes curing difficult, and the mild, open winters and abundant pasture leave small

need for the saving of winter feed. To provide for a dairy herd sorghum and cowpea silage may be used, thus overcoming any difficulty in curing hay from these crops. Back from the coast, in the northwest portion of this territory and the adjacent portion of southwest Texas, there are several creameries. Here also considerable corn and cotton is produced. There is less difficulty in curing hay than in the coast region, and sorghum, cowpeas, peanuts, and alfalfa are grown for winter feed. Hog raising may perhaps be attended with more difficulties than in the black waxy belt, but the home demand can at least be supplied. The production of poultry and eggs is an important industry in numerous counties of south and southwest Texas.

SOUTHWEST TEXAS.

The southwest Texas country has recently come into considerable prominence as a producer of early vegetables. Cabbage, melons, tomatoes, beans, peas, cucumbers, and a wide range of other truck crops are grown here, but the reputation of the section has been built largely on its Bermuda onions. The production of 1904 was 466 cars, and that of 1905 considerably in excess of that figure. These onions are shipped all over the United States, and probably receive a wider distribution than any other Texas horticultural product. Most of the truck crops in southwest Texas are produced by irrigation, but in the region around Corpus Christi little irrigating is done. There is opportunity in southwest Texas for increased production in nearly all lines of trucking, but especially in the small "bunch" vegetables—radishes, beets, and the like. Peppers, eggplant, cauliflower, and lettuce are vegetables which are now little grown, but which should find ready sale. Some of the hardier semitropical fruits can probably be produced here with profit. Strawberries and some varieties of grapes may also prove remunerative. In the fertile valleys north of San Antonio, pears and apples produce abundantly. In addition to the truck and fruit crops produced in southwest Texas, cotton, corn, sorghum, and cowpeas are also grown. Where irrigation water can be secured there are great possibilities in the production of rice and sugar cane and, in some cases, alfalfa. With these three crops the agriculture of southwest Texas is on a very stable basis.

SUGGESTIONS FOR THE FUTURE.

Having thus briefly reviewed the present status and suggested a few of the possibilities of diversified agriculture in Texas, it remains only to outline some of the methods by which future success may be achieved. In the truck and fruit producing industry there must be closer organization, insuring better distribution, uniform grading and packing,

and the marketing of first-class goods only. The growers must give more attention to the selection of varieties and to the cultivation and handling of crops. Canning and pickling factories must be built to provide home markets for surplus production. Live-stock men for the most part need to improve their herds and flocks and to provide adequate shelter and feed to insure against losses in winter. Grain and cotton growers must use improved varieties, rotate crops, give better cultivation, and use barnyard manure and renovating crops to conserve fertility. It is only by these methods that the greatest benefit may be secured from diversified farming in Texas.

DARK FIRE-CURED TOBACCO OF VIRGINIA AND THE POSSIBILITIES FOR ITS IMPROVEMENT.

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INTRODUCTION.

The original standard type of tobacco in Virginia is what is now termed the dark or fire-cured export type. For many years the laws regulating production—especially those passed by the colonial assembly of Virginia requiring that all the product that failed to come up to the legal exactions as to quality and soundness should be burnt—were rigidly executed. At that time all the tobacco was raised for export, Europe being the only market, and, the price being uniform whether for sale or as a circulating medium, it was necessary to institute an inspection to compel uniformity of grade.

Tobacco was first experimented with for export in 1612 by John Rolfe, and its culture gradually spread as the colonists built houses and cleared the land, in time absorbing almost their entire attention, and from that time to the present day tobacco has continued to dominate the agricultural interests of a considerable part of the State.

Tobacco was first grown in Virginia on the rich soils along the James River. As the industry grew and its cultivation extended back to the upland soils it was discovered that these uplands produced a much better quality of leaf than did the river lands. For many years tobacco growing has been abandoned in the tide-water sections of the State and its culture is now largely confined to what are known as the Piedmont and Southside Virginia districts. During the progress of the industry there has developed a marked differentiation in the varieties or types of tobacco grown and the use to which it is put. There are five distinct types of tobacco produced in Virginia, viz, dark shipping, red and colored shipping, sun and air-cured fillers, bright yellow wrappers, smokers, and fillers, and mahogany flue-cured manufacturing. These different types of tobacco are divided into various grades to meet the demands of the different European markets. They are severally characterized by peculiarities of color, quality, body, and flavor—the result of soil-influence and variety, modified by curing and management.

As this article deals solely with the dark tobacco of Virginia, it will not be necessary to discuss in detail the other types. The dark shipping tobacco is generally raised on rich lands and cured with open wood fires. England, France, Germany, Spain, Austria, and Italy take the bulk of this tobacco, although the higher grades are used at home for plug wrappers. This tobacco is produced to greater or less extent throughout the tobacco belt of Virginia, but the most of it is grown south of James River, in territory extending from Petersburg on the east across the Piedmont Plateau to the edge of the Blue Ridge, with Lynchburg and Petersburg as the most important market centers. Beginning on the Petersburg side, the soil is mostly a gray sandy loam, becoming more red and containing more clay as the Blue Ridge is approached. The more sandy soils produce generally a coarser and thinner leaf than the red clay. The leaf has a lighter brown or dappled color, and has considerable use in domestic manufacture, but is more important as supplying a part of the varied export demands. On the red clay soils the tobacco is normally darker in color, of finer texture and fiber, and of better body. Such tobacco is used to supply some particular export demands, as well as for domestic manufacturing purposes. It is largely from tobacco grown on this type of soil that the scanty supply of good dark leaf suited for plug wrappers is obtained.

This paper treats expressly of the conditions existing in this dark fire-cured tobacco district of Virginia. Tobacco is a highly specialized product, and the methods used in its cultivation vary with different conditions and types, so that recommendations which apply to the dark tobacco of Virginia may not be of any value in the case of another variety. Virginia is the oldest tobacco-growing State in the country, and the general methods of culture and handling are well understood by the farmers, yet in some very important respects they have not kept up with the agricultural progress of the last quarter of a century.

Notwithstanding the great strides made by modern agricultural science, the methods of cultivation, of fertilizing the soil, and of crop rotation are essentially the same as a century ago. Why do the strong clay soils of the Piedmont region rarely yield more than from 800 to 1,000 pounds of tobacco to the acre when the lighter soils of Pennsylvania and Connecticut are yielding easily from 1,500 to 2,000 pounds to the acre, and that, too, of a lighter-bodied leaf? The Bureau of Soils has given attention to this question for several years, and believes that there is a great opportunity for the farmers in this district of Virginia to improve their methods of culture so that larger profits may be secured.

In the year 1904 the Bureau of Soils began a series of experiments and investigations in Appomattox County, with the object of deter-

mining by practical commercial tests what is really possible to accomplish in these older tobacco-growing sections, where small yields and low prices, together with increasing cost of labor, have reduced a once profitable industry to one of hard work and very small profits.

SELECTION OF SOILS.

Appomattox County forms a part of the Piedmont Plateau and is situated 23 miles east of Lynchburg, in the heart of the open-fire cured dark tobacco belt of the State. The land selected for the experiment is the typical mellow red clay soil (Cecil clay) common to much of the Piedmont region. The selection of the proper soil is a very important matter. No single factor has so much to do with determining the quality of tobacco as the soil upon which it is grown. Hence great care should be exercised to select the right soil, else the best subsequent effort is under a serious handicap.

The soils in the district under consideration are very uneven in quality and crop-producing power. Only the best soils should be used for the culture of tobacco. A good soil should have depth and mellowness, the capacity to hold sufficient moisture for the needs of the growing crop, and the texture and composition suited to produce a fine quality of leaf. It should have the drainage requisite for quickly absorbing or carrying off excessive amounts of moisture, and under no circumstances should it be mucky or wet. There are in the county occasional areas of fine-textured gray soil, with red clay subsoil, that will produce a good quality of tobacco. Such soils have the advantage over the red or chocolate soils of being easier to cultivate. In general, however, it is believed that the deep, mellow red or chocolate soils of good drainage are the best for the production of a high grade of tobacco, especially if the aim is to produce a fine plug wrapper. Such desirable soils are often found in irregular areas along the numerous small water courses, but not exclusively in such positions.

THE TYPES OF LEAF.

The grower of tobacco should have clearly in his mind the type of leaf he is trying to produce. Most farmers of the dark-tobacco districts should probably aim to produce a leaf suitable either for plug wrappers or for the Austrian export trade, since such leaf generally brings the highest prices on the local markets.

The requirements for a good plug wrapper are a leaf of medium size, of good body, very oily and elastic, with fine veins and an absolutely solid, glossy, dark-brown color, entirely free from any trace of mottling or grayness. The width of the leaf should be maintained well out toward the tip, as such a leaf covers the plug more economically than does one with a long, tapering point. After the wrapper is placed on the plug it is subjected to an enormous pressure in hydraulic presses,

and it requires a very strong, elastic leaf to stand this pressure without breaking. It must also be fine of fiber, so that the veins will not show prominently, and of an oily, rich, solid color, so that the plug when finished will have a glossy, rich black appearance.

The Austrian requirements are for a broad leaf, about 24 inches long, with good width between the veins, of absolutely solid medium brown color, medium to good body, very elastic, and of good oil and luster. It should also have a sweet, aromatic odor. The best grade of this leaf is used in Austria for cigar wrappers, and it is the custom there to cut the wrappers from between the veins. It is for this reason that the leaf must be wide between the veins and must also be of good color and elastic, so that the wrappers will stretch well on the cigars and give the finished product a good appearance.

Thus, to meet the requirements of the Austrian market, the grower needs to produce a larger leaf than when trying to produce a plug wrapper. Besides, the leaf need not be so fine nor so heavy-bodied. Unless there is reason for believing that the land available has the quality suitable for the production of a wrapper leaf, it would probably be more profitable for the grower to aim at producing the Austrian type of leaf.

MAKING THE SEED BEDS.

The preparation of the seed bed is generally understood, and no special suggestions need be made. It should be remembered, however, that an advantage is to be gained by mulching. Before the plants come up the beds should be mulched lightly with a dressing of fine horse manure or hog manure kept free from weeds by feeding only clean forage while the manure is being collected. A light sprinkle of pine needles would have the same value as a mulch, but would have little value as a fertilizer. Beds mulched in this way will better retain the soil moisture, and besides will remain in a mellow and loose condition, which enables the plants to make a more rapid growth. It is also found beneficial to apply broadcast on the beds about 15 pounds of nitrate of soda to every 100 square yards of surface. This should be done a few days before the plants are expected to show above the surface. The addition of the nitrate causes the young plants to make a rapid growth, even during cold, unseasonable weather.

It is very desirable to provide for an abundance of plants. Nothing is more prejudicial to the prospect of a good crop than the arrival of the planting season without plenty of good, strong plants.

FERTILIZERS.

The fertilization of the soil is a subject deserving much attention by the farmers of the dark-tobacco districts of Virginia, because their main reliance for the production of paying crops is upon commercial fertilizers. These districts notoriously are not stock-raising districts,

and, while that industry should be encouraged as much as possible and every effort made to save and utilize barnyard waste to the fullest extent, the present conditions are such that the quantity of barnyard manure available is entirely inadequate for the farmers' needs, and even with the best efforts will continue so for many years.

There is nothing so essential to the farmer's success as the proper handling of the soil and maintenance of its fertility, and there is, therefore, no subject upon which the farmers in those districts where their main reliance must be upon commercial fertilizers should be so well informed as the proper use of the various fertilizer materials available in the markets of the world.

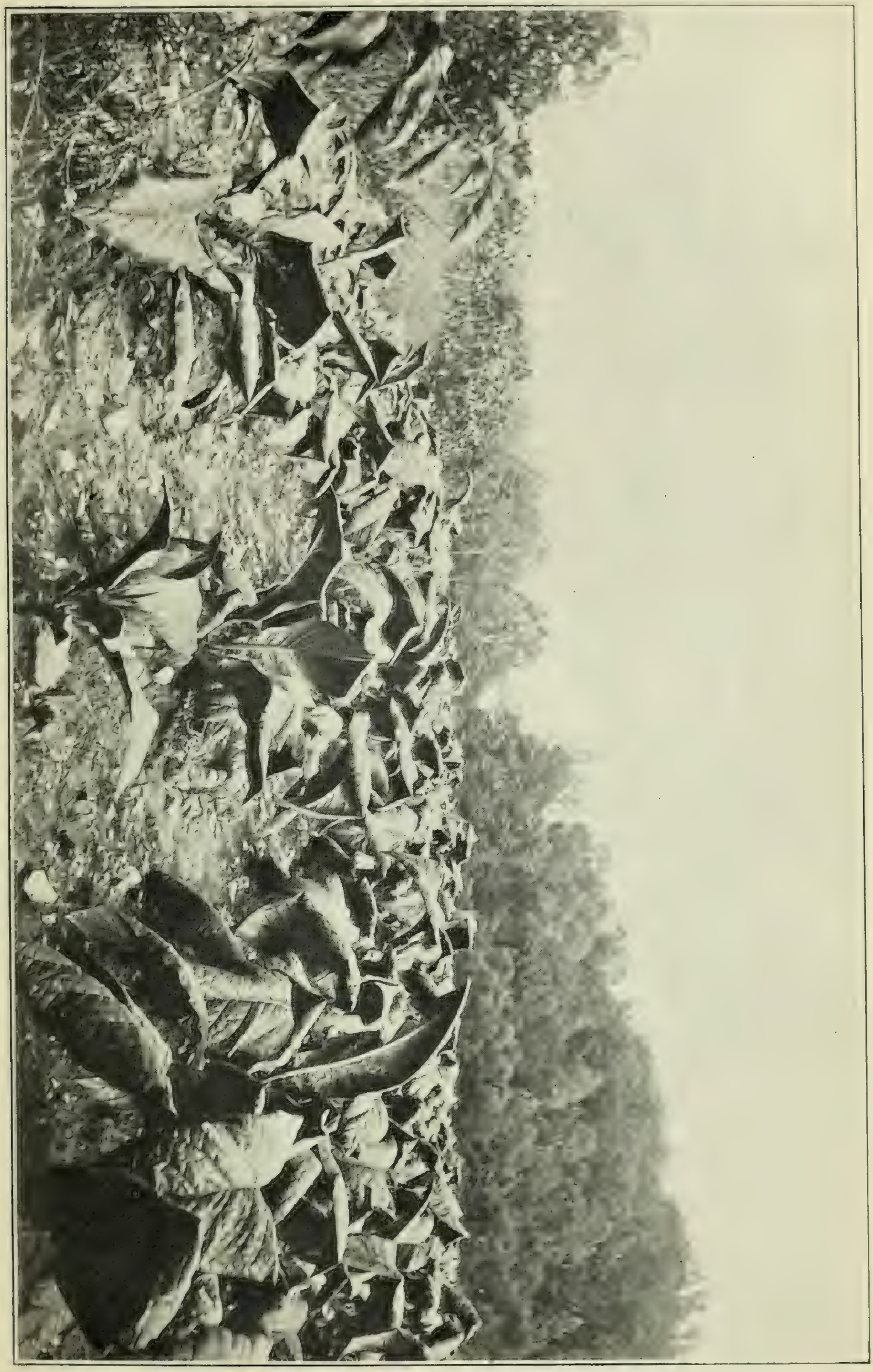
Tobacco is a crop which usually pays well for a large outlay in fertilizers, other conditions being favorable. Farmers not familiar with the methods practiced in the Connecticut Valley are greatly surprised when told that it is the custom with many of the best farmers in that locality to apply every year to the same field from $50 to $75 worth of fertilizer per acre. These growers expect and annually harvest in the neighborhood of a ton of barn-cured tobacco to the acre. Furthermore, the quality of the leaf produced is better now than it was twenty-five years ago, when much less intensive methods of culture and fertilization were used. The writers well understand that the export and plug-wrapper types of tobacco produced in Virginia are vastly different from the cigar-wrapper and binder types produced in the Connecticut Valley. They believe, however, that the efficiency of rich land is the same for both sections.

The average yield of tobacco in the dark districts of Virginia is about 800 pounds to the acre, usually selling at 5 or 6 cents a pound, thus yielding to the farmer from $40 to $50 gross returns per acre. As the result of experiments conducted by the Bureau of Soils during 1904, it has been shown that this yield can be increased to at least 1,400 pounds to the acre, and probably more, by the judicious use of fertilizers and by thorough methods of cultivation.

In Virginia the practice is to follow tobacco with wheat and the wheat with clover for two years and then back to tobacco. On the tobacco it is the custom to apply per acre 400 pounds of a fertilizer analyzing 3 per cent ammonia, 9 per cent phosphoric acid, and 3 per cent potash. This adds to the soil a total of 12 pounds of ammonia, 36 pounds of phosphoric acid, and 12 pounds of potash per acre. It is noticeable that the requirements of tobacco for phosphoric acid are very small, but as a matter of field practice it is found that the crop will show signs of suffering from lack of this substance unless the available supply is very much in excess of the amount actually taken up by the crop. Where wheat follows tobacco no additional fertilization is given, dependence being solely upon the natural resources of the soil and the remnant of the application given the tobacco. It is seldom that more than 10 or 15 bushels of wheat to the acre is harvested.

Tobacco is a crop that with an increase in yield usually gives a corresponding increase in quality, provided the soil conditions and management are right. It has often been found that it pays to apply very large amounts of fertilizer to a tobacco crop where it might not have proved profitable to do so with other and lower-priced farm crops. This was demonstrated in the Department's experiments at Appomattox, where an acre of land fertilized after the usual farmer's method (Pl. VII) with 400 pounds of fertilizer costing $5 an acre and furnishing 12 pounds of ammonia, 36 pounds of phosphoric acid, and 12 pounds of potash (formula No. 1), gave a yield of 673 pounds of tobacco, which sold for $45.50 gross, or an average of 6¾ cents a pound; while an acre (Pl. VIII) fertilized with 850 pounds of home-mixed fertilizer costing $16.44 an acre and furnishing 73½ pounds of ammonia, 57 pounds of phosphoric acid, and 75 pounds of potash (formula No. 2) yielded 883 pounds of tobacco, which sold for $81.09, or an average of 9¼ cents a pound, and another acre (Pl. IX), fertilized with 1,700 pounds of home-mixed fertilizer costing $32.30 per acre and furnishing 153 pounds of ammonia, 106 pounds of phosphoric acid, and 125 pounds of potash (formula No. 3) yielded 1,334 pounds of tobacco, which sold for $111.29, or 8⅜ cents a pound. From these tests it can be seen that the yield was increased by the extra application of fertilizers, and, as the prices obtained indicate, the quality of the tobacco was also improved. In order to keep the product of these plats uniform and to prevent the more highly fertilized plats from producing a coarse or overgrown leaf, the number of plants set to the acre was increased with the heavier application of fertilizer. The number of plants set on each acre was 4,200, 5,000, and 6,000, respectively. The net profit derived from these three separate acres was respectively $5, $21, $29. The amounts received from the more highly fertilized plats are above the average returns received by the Virginia farmers.

In common with most soils of the South, Virginia soils are generally deficient in vegetable matter, and the needs of the soil in this regard should not be lost sight of. Commercial fertilizers are necessary in the production of a highly specialized crop like tobacco, but it is only by the incorporation with the soil year after year of a considerable amount of vegetable matter that the proper physical condition of the soil can be maintained and improved. By the proper physical condition is meant good depth of soil, mellowness, and good water-holding capacity. In order to possess these a soil must contain a considerable quantity of decayed vegetable matter, and without these conditions it can not be expected that the full benefit possible from heavy applications of fertilizers can be realized. The stubble from good crops of grain, the grasses, and the leguminous crops—especially cowpeas and clover—may be relied upon for material improvement of the physical



DARK FIRE-CURED TOBACCO FERTILIZED WITH FORMULA No. 1.

DARK FIRE-CURED TOBACCO FERTILIZED WITH FORMULA NO. 2.

DARK FIRE-CURED TOBACCO FERTILIZED WITH FORMULA NO. 3.

FIG. 1.—CURING BARN FOR DARK FIRE-CURED TOBACCO.

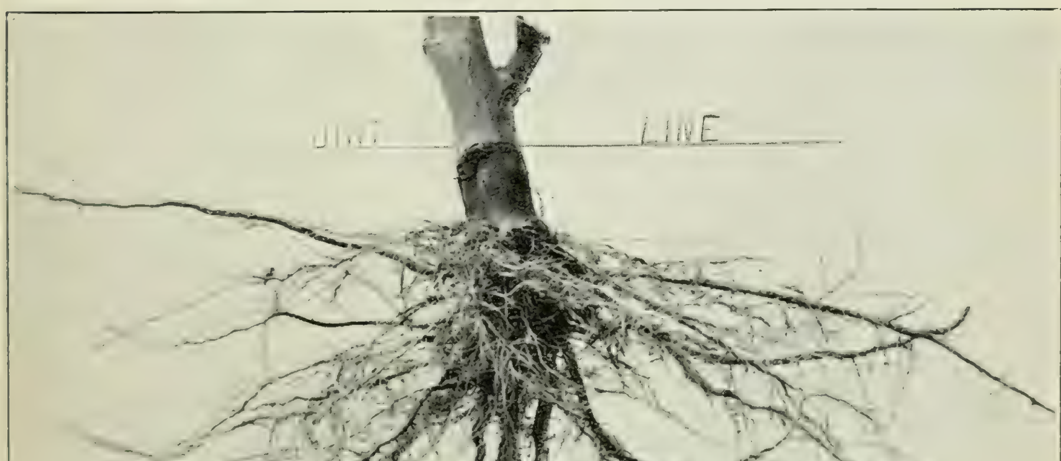


FIG. 2.—ROOT SYSTEM OF A TOBACCO PLANT.

condition of the soil. When practicable, preference should be given to legumes, as they have the power of adding considerably to the store of plant food in the soil. The bacteria in the nodules which form upon their roots have the power of abstracting considerable amounts of nitrogen from the air and rendering it available for the use of the plants. The plant, in turn, by its decay in the soil, makes a very material addition to the soil's supply of this constituent. The main reliance should be, however, upon some of the high-grade, readily-decaying organic fertilizers, such as dried blood, ground fish, and cotton-seed meal.

Tests that have been made of muriate of potash and other forms of potash fertilizers have not conclusively shown whether the large amounts of chlorine present in the muriate are detrimental to this type of tobacco or not. It is considered safer to use the sulphate of potash, for although the effect of the chlorine upon the burn is not considered important with the fire-cured tobacco, it is claimed by many of the best growers of Virginia that the muriate of potash tends to produce a coarse, heavy leaf.

The following table gives in detail the character of the fertilizers, the cost, and the quantities used in the Appomattox experiments. Formulas 2 and 3 were found best for the production of a high quality of leaf. Formula 1 (factory-mixed) is the mixture generally used by the farmers.

Composition and cost of the several fertilizers used in the experiments.

Material.	Formula No 1 (factory-mixed).	Formula No. 2.				
		Ground fish.	Nitrate soda.	Bone meal.	Sulphate potash.	Total.
Guaranteed analysis:						
Ammonia (NH_3) ....per cent..	3	10	19	4.5	....	....
Phosphoric acid (P_2O_5)..........do....	9	7	....	22	....	....
Potash (K_2O)....................do....	3	....	....	....	50	....
Quantity applied per acre....pounds..	400	500	100	100	150	850
Equivalent quantity per acre of—						
Ammonia (NH_3) ....pounds..	12	50	19	4.5	....	73.5
Phosphoric acid (P_2O_5) ....do....	36	35	....	22	....	57
Potash (K_2O)....................do....	12	....	....	....	75	75
Cost per ton delivered at Appomattox ....dollars..	25.00	34.50	50.50	30.00	50.50	....
Cost of quantities used in experiment, dollars..................................	5.00	8.62	2.53	1.50	3.79	16.44
Cost of fertilizer constituents per pound:						
Ammonia (NH_3)................cents..	21.66	14.45	13.30	13.80	....	....
Phosphoric acid (P_2O_5)..........do....	5.00	4.00	....	4.00	....	....
Potash (K_2O)....................do....	5.00	....	....	....	5.05	....
Cost of fertilizer constituents per acre:						
Ammonia (NH_3)..............dollars..	2.60	7.22	2.53	.62	....	10.37
Phosphoric acid (P_2O_5)..........do....	1.80	1.40	....	.88	....	2.28
Potash (K_2O)....................do....	.60	....	....	....	3.79	3.79

Composition and cost of the several fertilizers used in the experiments—Continued.

Material.	Formula No. 1 (factory-mixed).	Formula No. 3.				
		Ground fish.	Nitrate soda.	Bone meal.	Sulphate potash.	Total.
Guaranteed analysis:						
Ammonia (NH_3) ....per cent..	3	10	19	4.5	....	....
Phosphoric acid (P_2O_5) ....do....	9	7	....	22	....	....
Potash (K_2O) ....do....	3	....	....	....	50	....
Quantity applied per acre....pounds..	400	1,200	150	100	250	1,700
Equivalent quantity per acre of—						
Ammonia (NH_3) ....pounds..	12	120	28.5	4.5	....	153
Phosphoric acid (P_2O_5) ....do....	36	84	....	22	....	106
Potash (K_2O) ....do....	12	....	....	....	125	125
Cost per ton delivered at Appomattox..............................dollars..	25.00	34.50	50.50	30.00	50.50	....
Cost of quantities used in experiment, dollars....................................	5.00	20.70	3.79	1.50	6.31	32.30
Cost of fertilizer constituents per pound:						
Ammonia (NH_3) ....cents..	21.66	14.45	13.30	13.80	....	....
Phosphoric acid (P_2O_5) ....do....	5.00	4.00	....	4.00	....	....
Potash (K_2O) ....do....	5.00	....	....	....	5.05	....
Cost of fertilizer constituents per acre:						
Ammonia (NH_3)...............dollars..	2.60	17.34	3.79	.62	....	21.75
Phosphoric acid (P_2O_5)..........do....	1.80	3.36	....	.88	....	4.24
Potash (K_2O)...................do....	.60	....	....	....	6.31	6.31

In this table it will be seen that the actual fertilizer constituents in the factory-mixed brand of fertilizer are more expensive than in the home mixtures. The cost of the ammonia in the former is 21.66 cents per pound as against 14.45 cents and 13.8 cents for the ammonia supplied by the ground fish and bone meal and 13.3 cents per pound for that furnished by the nitrate of soda. This difference indicates the considerable saving in cost of the material used where the farmer mixes his own fertilizers. To offset this there is, of course, the cost of mixing, but this should not be more than 75 cents or $1 a ton.

It should be further noted that it would have taken 5,100 pounds of the factory-mixed fertilizer to furnish the 153 pounds of ammonia yielded by the 1,700 pounds of home mixture. The cost of the 5,100 pounds would have been $63.75, a sum so large as to prohibit profitable use, even ignoring the extra expense of handling such a large amount of material. On a basis of the 9 per cent guaranteed, the 5,100 pounds would have contained 459 pounds of available phosphoric acid, an amount entirely out of balance as compared with the amount of ammonia and potash furnished, and excessive in the extreme as compared with the needs of the crop. Moreover, had there been 5,100 pounds of this fertilizer, in which it may be assumed acid phosphate furnished the phosphoric acid, it is highly probable that the considerable quantity of acid always present in acid phosphate would have had a marked harmful effect on the roots of the plants, especially if

used in the drill. The acid would tend also to retard nitrification in the soil. This condition, of course, might be counteracted by the use of lime or other alkali, but only at a further needless expense. It is therefore apparent that increasing the applications of the fertilizer in common use in the county sufficiently to give the amount of ammonia and potash required for a 1,500-pound crop of tobacco would not be economical.

The use of large quantities of fertilizer in the growing of tobacco in this district of Virginia can probably be made to pay well, but the mixtures must be properly proportioned. It would lead to a much clearer understanding of the whole subject of fertilizers if the farmers would think, not of how many pounds of mixture they are applying to their fields, but rather of how many pounds of ammonia, phosphoric acid, and potash they are using. For example, if the tobacco grower who applies 400 pounds of the factory-mixed fertilizer to the acre would not think of the 400 pounds but of the fact that he is applying 12 pounds of ammonia, 36 pounds of phosphoric acid, and 12 pounds of potash to the acre, he would understand more clearly what it is reasonable to expect from the fertilizer he applies.

In this discussion the terms "ammonia" and "ammoniates" have been used in preference to "nitrogen" and "nitrates," as the former are the terms in common use in Virginia, as well as in most parts of the South, and are, therefore, more likely to be understood. For those accustomed to the use of the words "nitrogen" and "nitrates," it may be well to state briefly that of 17 parts of ammonia 14 are nitrogen.

CULTIVATION.

Great improvements can be made in the present methods of cultivation. The Virginia farmers generally cultivate their crops deeply, thus injuring the root system, which is spreading and near the surface (Pl. X, fig. 2). Their rule is to give the tobacco three cultivations, using a one-horse implement (the first two with a double-shovel plow and the last with a turning plow), and two hoeings by hand. Except in the case of low-lying fields, where there is danger from standing water, it is best to discard the turning plow entirely and use nothing but implements for shallow cultivation. This has been fully demonstrated in recent experiments, where the efficiency and profitableness of frequent and shallow cultivation of tobacco have been studied. The shovel plow may be used to advantage and is recommended for the first cultivation. At this time the roots of the plants have not spread into the row, and the soil is likely to be packed from heavy rains and from tramping it at the time of setting. Deep, thorough breaking out of the middles is to be advised at this time, and the double-shovel plow with narrow blades is about the best tool available.

As the plants grow and the roots begin to occupy the soil between the rows, deep cultivation should be stopped and frequent shallow cultivation substituted. For this purpose a five-toothed cultivator (fig. 60), with an 18-inch sweep and a depth-regulating attachment, is recommended. This will keep down the weeds and preserve an effectual soil mulch, which retards surface evaporation without doing injury to the roots. About six cultivations are necessary to keep the soil in good tilth, or an average of one a week between the setting and topping seasons, the soil being worked a little toward the plant at each cultivation. The low ridges thus formed will be effective in keeping surface water from standing around the plant in times of excessive rains, but will not be high enough to increase materially the surface of the soil exposed to evaporation.

CURING.

None of the operations conducted by the farmer is more important than the curing of the tobacco after it is grown and placed in the curing barn (Pl. X, fig. 1). Every year there are thousands of dollars lost to the farmers of Virginia through an imperfect understanding of the fundamental principles involved in the process of curing.

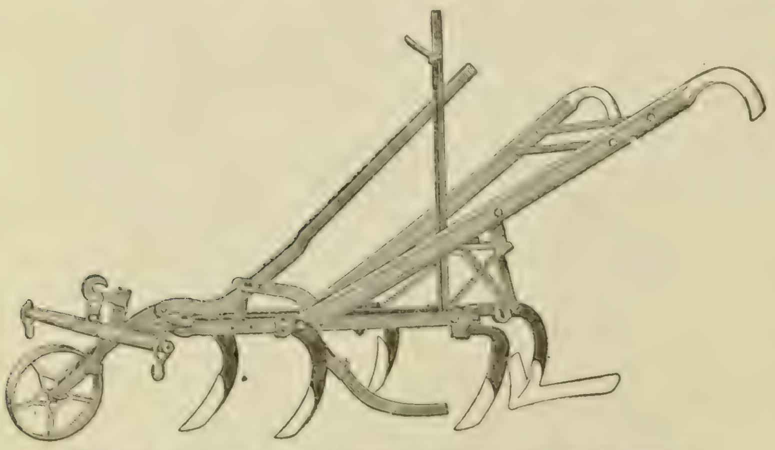


FIG. 60.—Cultivator used in the Appomattox experiments.

Weather and other conditions vary so greatly that rules can not be formulated to fit all cases, and the final dependence in every case must be reposed in the skill and experience of the individual farmer. It should always be kept clearly in mind, however, that the essential factor in securing a satisfactory cure is the maintenance in the barn of a proper degree of both heat and moisture. The grower's ingenuity and experience must be drawn upon to offset weather conditions when they are unfavorable. It must be remembered that curing tobacco and drying it are two different processes. After placing the tobacco in the barn it is first necessary to see that it yellows properly. When that is completed the final browning process follows.

The yellowing takes place during the first week after the ripe tobacco is cut, as an accompaniment of slow starvation and death of the leaf. This stage of the curing process proceeds best under moderate temper-

ature and moisture and in darkness. Therefore crowding the tobacco in the barn is to be recommended, especially if the weather should be dry. In cool weather material help may be given by building small fires in the barn and maintaining a temperature of from 85° to 90° F. A high temperature at this time would exhaust the moisture of the leaf before the color changes could take place. In this event the tobacco would dry out and not cure. While the process of yellowing is proceeding, the tobacco should be closely watched, and upon the slightest signs of house burn the ventilation should be regulated so as to allow a moderately free circulation of air. Fires should be started and a temperature of 95° to 100° F. maintained long enough to start the tips of the leaves to browning and drying. It should be borne in mind that in the browning as well as in the yellowing processes moisture as well as heat is essential to a good cure. The fires should be controlled so as to give heat and yet allow the leaf time enough to undergo the necessary color changes before the moisture is exhausted. It is advisable not to hasten the process of curing, especially at first, and after the fires have been burning long enough to start the tips of the leaves browning it is advisable to let the barn cool, which will allow the sap to become uniformly distributed throughout the leaf. This insures more solid and even color. After a few days the barn may be heated again for a short time, the temperature being allowed to rise a little higher than at the time of the first firing. The barn is then allowed to cool off again so that the sap may once more become equally distributed through the leaf. This process is continued until the leaf cures. As the cure proceeds, somewhat higher temperatures may be used if the moisture supply is sufficient. However, about 125° F. is as high as it is usually desirable to carry the temperature, even when the curing process is nearly completed and the danger from "setting" undesirable colors is minimized.

Advantage should be taken of damp, rainy weather, as at that time a higher temperature may be maintained without unduly exhausting the moisture supply. Under such favorable conditions the cure may be hastened. If it is desired to darken the tobacco materially, as is often the case in curing plug wrappers, the aim should be to secure rather high temperature and moisture content during the last part of the curing process, and to maintain these conditions for several hours. When there is danger from house burn or pole sweat, it is, of course, imperative to use sufficient heat to dry out the barn beyond the point of danger. It is usually in a barn of tobacco in which some house burn has developed that the undamaged tobacco is exceptionally well cured. This shows that the conditions of heat and moisture just below those which would cause damage are what the farmer should strive to secure.

MARKETING.

In marketing is found the final test which is to decide the result of the year's hard work. It is a lamentable fact that many of the farmers work extremely hard during the year in the effort to produce a fine crop of tobacco, and then, after reaching this stage, hurry the tobacco upon the market in a most indifferent manner, having little idea of the place in the trade that it is fitted to fill or the price which it is reasonable to expect for it. The growers should strive as hard to master the art of marketing their tobacco advantageously as to acquire the skill to grow and cure it. As previously stated, their first aim should be to produce a type of leaf suited to some specific market demand. They should study the market demands and at least keep up with a few of the standard trade requirements and current prices, and then try to assort their tobacco in such a way as to have each grade meet as far as possible some specific use in the trade.

The auction system of marketing, common throughout Virginia, is a very good one, but it does not assure the farmer that he will in every case get for his tobacco its true value. The absence of a buyer or a temporary market congestion may cause a sharp reduction in the price of certain grades on any particular day of sale. The farmer must look for protection to his own vigilance and knowledge of grades and prices, and in some instances it will pay him to pass the sale of his tobacco and offer it again on another day if he has reason to believe that the price bid is below the general market average.

EXTENSION OF THE RIVER AND FLOOD SERVICE OF THE WEATHER BUREAU.

By H. C. Frankenfield,
Professor of Meteorology, Weather Bureau.

EARLY ORGANIZATION OF THE SERVICE.

In an article on Floods and Flood Warnings, in the Yearbook for 1901, the writer, in a general description of the River and Flood Service of the Weather Bureau, stated that "efforts were being constantly made to still further improve this branch of the public service by more searching investigation and judicious expansion." At that time the organization consisted of 163 special river and 50 special rainfall stations, divided into 35 districts, each under the supervision of the official in charge of a regular Weather Bureau station, and daily river observations were also made at 42 regular stations. Since then many changes have been made. During the year 1902 the new districts of Boston, Mass., Knoxville, Tenn., and Sioux City, Iowa, were created and the district of Harrisburg, Pa., thoroughly reorganized; 31 special river and 14 special rainfall stations were established, and daily river readings were begun at 2 additional Weather Bureau stations; 3 special river and 5 special rainfall stations were discontinued during the year.

REORGANIZATION OF THE SERVICE.

During the year 1903 the district of Philadelphia, Pa., was created, with territory comprising the watersheds of New Jersey and the extreme eastern portion of Pennsylvania. Forty-one special river and 9 special rainfall stations were established, 1 special river station was discontinued, and 2 additional regular Weather Bureau stations began a daily record of river stages.

FIRST PERIOD OF IMPROVEMENT.

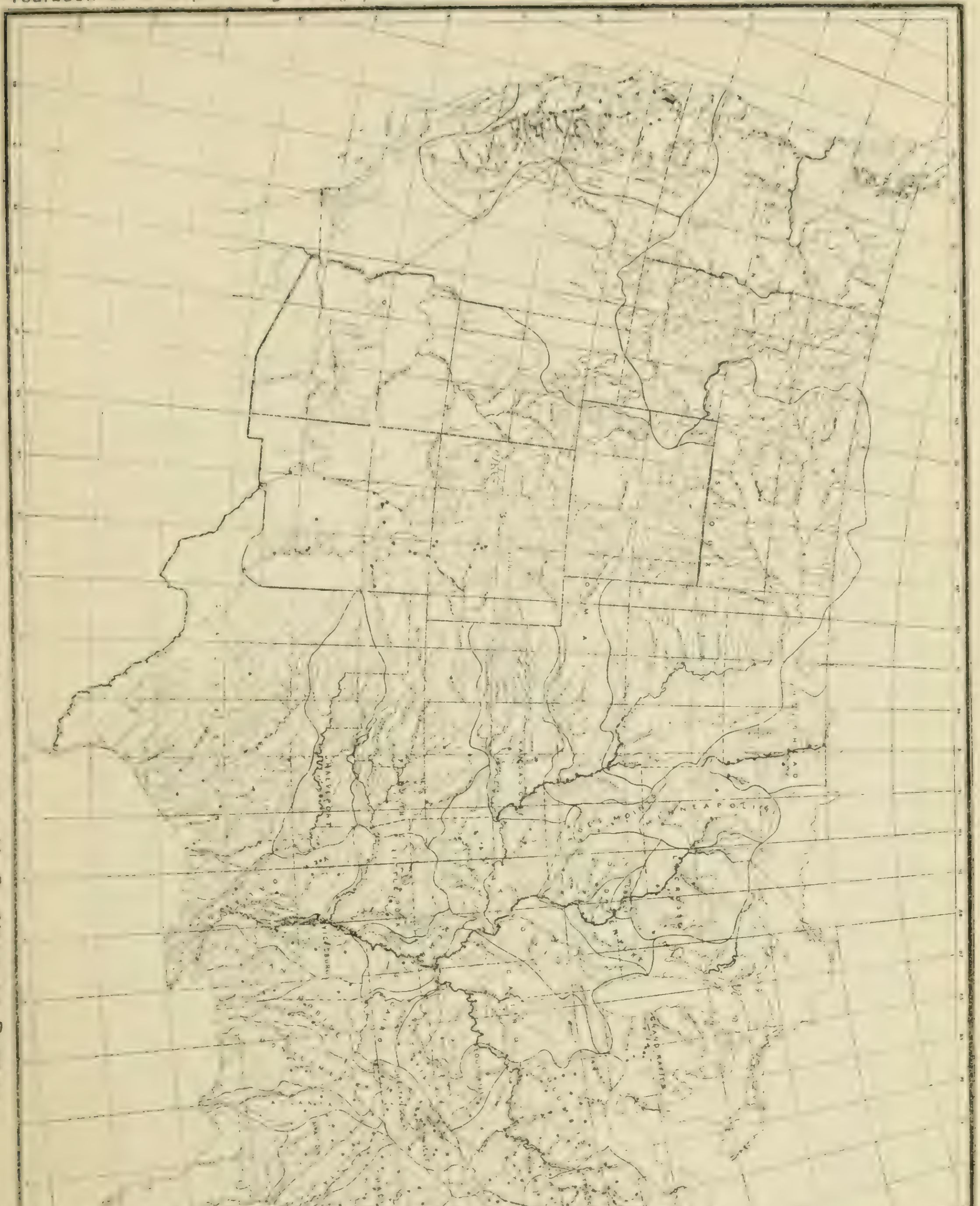
The year 1904 was a transition period. The first real transition period of the River and Flood Service began on July 1, 1893, when the work of river forecasting, which for twenty years had been done at the central office at Washington, was delegated to various station officials of the Weather Bureau, under the supervision of the central office, each with a certain specified territory in which was located a number of substations, both river and rainfall. At once the wisdom of the change became apparent. Each district was from that time on in charge of an official who kept in close touch with its remotest boundaries and who thoroughly understood its physical character as

affected and modified by the elements. The natural results were absolute localization, greater promptness of service, and vastly increased accuracy. At the same time the foundation was laid for more thorough investigation and study, with the almost assured certainty of greater efficiency in all branches of the work as a reward for the added labor.

SECOND PERIOD OF IMPROVEMENT.

The second transition period begins with the year 1904. The enormous magnitude and appalling destructiveness of the floods of the previous year, notwithstanding the good flood work of the Weather Bureau, had focused the attention of the country upon the subject. In districts provided with River and Flood Service, warnings were issued whenever necessary. The various communities affected had learned through previous experience to respect these warnings, and as a consequence all possible preparations were made and all due precautions were observed in the threatened districts, while throughout others not likely to be affected the fears of the people were allayed, and a great amount of unnecessary labor was saved. From Kansas and other districts, where River and Flood Service was not maintained, and where almost the extreme limit of disaster was reached, there came, even before the flood waters had subsided, an irresistible demand for a river service of the character and efficiency of that maintained in many other localities. There were also many requests, from districts already organized, for the establishment of new river and rainfall stations and a further extension of the work. Previous to this time it had been the policy of the Weather Bureau, with but very few exceptions, to maintain River and Flood Service on navigable rivers only, but from all sections there arose demands, after the great May and June floods of 1903, for flood warnings on the nonnavigable rivers. It was impossible to meet many of these demands on account of the character and environment of the streams involved. Some river channels were so short and precipitous that destructive floods could come and go before a warning could be distributed, while along others there were no means of rapid communication, such as the telegraph and telephone. It is manifestly useless to hope to aid those on the former class of rivers, but to those on the latter assistance can be given as soon as the respective communities increase sufficiently in size and importance to command the necessary facilities for electric communication. On other nonnavigable rivers it was found to be possible to establish services that promised to become efficient and valuable, and Congress was therefore asked to provide the funds necessary for their inauguration and maintenance.

The request was met in a liberal spirit on the part of Congress. Appropriations sufficient for a much enlarged and improved service were made, and on July 1, 1904, the work was begun. Some considerable extensions had already been made during the preceding six months



RIVER AND RAINFALL STATIONS OF THE U. S. WEATHER BUREAU.

THE NORRIS PETERS CO., WASHINGTON, D. C.

in the central and northern Pacific districts, but no attempts were made in new fields until fresh appropriations became available. The work was prosecuted vigorously, and by the end of the year 1904 four new districts had been created, as follows: Columbus, Ohio, for the watersheds of the interior rivers of the State of Ohio; Des Moines, Iowa, for the watershed of the upper Des Moines River; Grand Rapids, Mich., for the watersheds of lower Michigan, and particularly that of the Grand River, the scene of the devastating floods of the spring of 1904; and Meridian, Miss., for the watersheds of the Pearl and Pascagoula rivers.

During the year 1904 there were established 100 new special river and 30 special rainfall stations, and daily river observations were begun at 1 regular Weather Bureau station. Six special river and 6 special rainfall stations were discontinued.

PRESENT ORGANIZATION OF THE SERVICE.

During the year 1905 the district of Denver, Colo., was organized, its territory comprising the watersheds of Wyoming, Utah, Arizona, and New Mexico, and an adequate number of new stations were established therein. Attention was first directed to the Rocky Mountain district by the great floods of the autumn of 1904, which occurred after a long period of freedom from floods. These continued at intervals during the first half of the present year, and the new service, although only in a formative state, was able to do some very effective work by issuing general flood warnings that were instrumental in saving a large amount of property. Several other new stations were also established in various districts, and the district of Boston, Mass., was subdivided into three smaller ones, with headquarters at Portland, Me., Concord, N. H., and Hartford, Conn. To the Portland district were assigned the watersheds of the rivers of the State of Maine; to Concord that of the Merrimac River, and to Hartford those of the Connecticut and Housatonic rivers. By the end of the year the river and flood organization consisted as a whole of 546 stations (Pl. XI), classified as shown in the following table:

Number of stations now in operation in connection with the river and flood service.

District center station.	Special river.			Special rainfall.		
	Stations making regular reports.	Stations making occasional reports.	Cooperative stations.	Stations making regular reports.	Stations making occasional reports.	Cooperative stations.
Albany, N. Y.	18	0	0	0	0	0
Atlanta, Ga	8	1	0	4	0	0
Augusta, Ga	2	0	0	4	0	0
Cairo, Ill	10	4	0	0	2	0
Charleston, S. C	11	0	0	5	0	0
Chattanooga, Tenn	8	1	2	2	0	0
Cincinnati, Ohio	9	4	0	1	1	0

Number of stations now in operation in connection with the river and flood service—Cont'd.

District center station.	Special river.			Special rainfall.		
	Stations making regular reports.	Stations making occasional reports.	Cooperative stations.	Stations making regular reports.	Stations making occasional reports.	Cooperative stations.
Columbus, Ohio	2	12	1	3	3	0
Concord, N. H	3	0	0	1	0	0
Davenport, Iowa	3	0	0	0	0	0
Denver, Colo	0	16	0	0	12	0
Des Moines, Iowa	0	2	0	0	0	0
Dubuque, Iowa	0	0	0	0	0	0
Fort Smith, Ark	7	0	0	1	0	0
Galveston, Tex	17	2	6	0	0	0
Grand Rapids, Mich	5	0	0	0	1	0
Harrisburg, Pa	7	2	8	0	0	0
Hartford, Conn	5	0	0	3	0	0
Kansas City, Mo	8	0	0	0	0	0
Keokuk, Iowa	3	1	1	1	0	0
Knoxville, Tenn	6	0	0	4	0	0
La Crosse, Wis	5	2	0	2	0	0
Little Rock, Ark	7	0	0	1	3	0
Louisville, Ky	5	0	0	0	0	0
Macon, Ga	3	1	0	4	0	0
Memphis, Tenn	4	0	0	1	0	0
Meridian, Miss	6	0	0	0	0	0
Minneapolis, Minn	2	0	0	1	0	0
Mobile, Ala	4	1	0	1	0	0
Montgomery, Ala	6	0	2	1	0	7
Moorhead, Minn	0	0	0	0	8	0
Nashville, Tenn	4	0	0	1	2	0
New Orleans, La	10	0	0	0	3	0
Omaha, Nebr	2	0	0	0	0	0
Parkersburg, W. Va	2	1	0	1	0	0
Philadelphia, Pa	10	0	0	0	1	1
Pittsburg, Pa	17	3	4	0	4	0
Portland, Me	3	1	1	1	2	0
Portland, Oreg	10	8	2	0	0	0
Raleigh, N. C	7	0	0	7	0	0
Richmond, Va	2	0	0	0	7	0
St. Louis, Mo	7	0	0	3	0	0
San Francisco, Cal	0	12	0	0	8	0
Shreveport, La	5	0	1	0	0	0
Sioux City, Iowa	8	0	0	0	0	0
Vicksburg, Miss	4	1	0	1	0	0
Washington, D. C	3	0	0	1	0	0
Total	268	75	28	55	57	8
Regular Weather Bureau stations taking river observations	55					
Total	323	75	28	55	57	8

RECAPITULATION.

River stations making regular or occasional reports	398
Cooperative river stations	28
Total river stations making reports	426
Rainfall stations making regular or occasional reports	112
Cooperative rainfall stations	8
Total rainfall stations making reports	120
Grand total	546

OPPORTUNITIES FOR EXTENSION OF THE SERVICE.

As long as the present scheme of operation continues there will be no need of further broad extensions. There has been some demand for flood-warning service along the Rappahannock River and along the Colorado River of Arizona, and further telegraph service would be of benefit in other districts now in operation. New stations could be especially utilized with excellent effect in the following watersheds:

The Alabama and tributaries.

The Altamaha and its confluents, the Ocmulgee and Oconee.

The Canadian and its tributaries.

The Ohio and its tributaries.

The Potomac and its tributaries.

The Red.

The North Branch of the Susquehanna and its tributaries.

The Savannah.

The tributaries of the Mississippi between Lacrosse, Wis., and Davenport, Iowa.

An additional station or two in several other districts would also prove of assistance.

DEMANDS UPON THE SERVICE.

There are, of course, sufficient data available for the forecasting of river stages, both high and low, within the present narrow limits of accuracy (which are by no means doubtful), with hope of even greater exactness as the data multiply and as experience is gained. But the experiment of to-day becomes the immediate necessity of to-morrow. The history of weather forecasting affords a striking illustration of this characteristic tendency of the people. In the early days of weather forecasting only general forecasts were made, and for large areas of territory. Slowly but surely the areas covered by single forecasts were contracted, until finally many citizens seem to be of the opinion that they are entitled to forecasts that should at all times be applicable to their particular neighborhoods and for twice as long a period in advance as the forecasts that their predecessors enjoyed. The difficulties attendant upon the efforts of the forecaster to satisfy this demand have proved to be not the least annoying of the many unpleasant features connected with his arduous and often unappreciated labors. So it has become with the River and Flood Service. From the stereotyped phrases "The rivers will fall," "The Ohio River will rise," "The upper Mississippi will remain stationary," etc., have come by steady gradations the precise yet entirely comprehensive forecasts of the present time. It must not be inferred that any criticism of our predecessors is here intended. They were the pioneers in the work.

They blazed the trail, and did it well, when their sources of information are considered. They laid the foundation upon which has been reared the present structure. Sometimes the service has been urged; more often it has led the way; but there has always been a steady advance along all branches of the work. The result is that the River and Flood Service has now become of vital importance to many of the industries of the country. Every interested citizen expects, and usually receives, a river forecast applicable to his own particular locality—one that is very nearly, and frequently is absolutely, accurate as to the details of time, extent, and duration.

BENEFITS OF THE SERVICE.

Fair and pertinent inquiries that might be made at this time are: Have the large extensions of the River and Flood Service proved profitable to the country at large? Do the results obtained afford a sufficiently strong argument for the invasion of still greater fields? Is there reasonable ground for the hope of still higher efficiency in the future?

For those who have had an interest in the work, whether practical or sentimental, no answer to these questions is necessary. In reply to others we can refer to the records of the years 1903, 1904, and 1905. The work during the great Mississippi flood of 1897, magnificent as it was, was surpassed by that during the unprecedented floods of 1903, and also by that during the period of the great ice gorges in the Susquehanna and upper Ohio rivers in the early months of 1904. Mention should also be made of the work during the early summer floods of the present year in the watersheds of the Red River, the Rio Grande, and the Grand River of Michigan. The last two were new fields, yet the warnings of the floods were remarkable for their accuracy. They were the means of saving property to the value of many thousands of dollars, and were most highly commended by all.

INVESTIGATIONS NEEDED FOR THE PERFECTION OF THE SERVICE.

Although, as said before, the River and Flood Service needs but little in order to maintain, or even to elevate somewhat, its present standard of efficiency, and although the work can be successfully conducted along the present lines with the facilities at hand, there are opportunities for a still further broadening of our horizon that can be neither overlooked nor neglected, for a more elaborate refinement of method, with much greater precision of results, and for an extension of the work into fields of still greater usefulness, the consummation of the whole project constituting the third and greatest transition period of the service.

Of the several subjects for discussion that naturally suggest themselves in connection with the more detailed and elaborate exploration

of the field of river-stage forecasting, the following appear most prominent:

(1) Geology and topography of the watersheds.

(2) Snowfall, its distribution, character, and water equivalent, the last being of essential importance.

(3) Forest influences, their character and extent.

(4) Underflow or ground water, its character and extent.

(5) Evaporation, its amount, seasonal distribution, and modification by winds, weather, and temperature.

(6) Discharge volumes as affected by all the above conditions.

(7) Distribution of river forecasts and information.

GEOLOGY AND TOPOGRAPHY OF WATERSHEDS.

Of prime importance in connection with the régime of the different rivers is a more thorough investigation and intimate study of the geology and topography of their watersheds. For the intelligent preparation of a river forecast the forecaster should have at his command full and well-digested data relative to the geological formation of the watershed of his district. In one portion the river may flow rapidly over a hard rock bed, while in another it may gently find its way through soft bottom lands, the change from the former to the latter resulting in marked alteration in the volume and velocity of the stream flow. Not less important are topographical effects, particularly such as are caused by variations of weather and temperature and changes of surface made by the hand of man. It is true that studies of this character have been made in a very general way by the officials in charge of the various districts, but they have not been as complete as a proper understanding of the subject requires. Inability to spare the time from other important duties, the want of sufficient data, and the absence of facilities for obtaining them are mainly responsible for this condition of affairs. Lack of funds is also a very serious hindrance, one, by the way, that is equally applicable to all phases of the question.

SNOWFALL.

A factor to which entirely too little attention has been given in the past is the winter snowfall over the watersheds of the northern rivers. It is now known that while what was considered to be a proper allowance had been made for depth and distribution of the accumulated snow, there has been almost a total absence of precise knowledge of its exact water equivalent. It has not been known, even within very wide margins, whether the melting of 10 inches of snow would increase by 1 inch or by 5 inches the amount of water over the watershed that would be added to the warm rainfall of a heavy thaw. The addition or subtraction from a heavy rainfall of a single inch of water would in most cases determine whether there would be a flood or only a moderately

high stage of water, or whether there would be a dangerous flood or one but little over the danger lines. The average water equivalent of 10 inches of freshly fallen snow is 1 inch, and this value has usually been assumed as a basis of deduction without reference to the character of the snow, whether freshly fallen or accumulated, loose or compact. Careful measurements, however, have revealed the fact that the actual water equivalent of 10 inches of snow varies from less than 1 to more than 5 inches. It is needless to advance further argument as to the advantages of accurate information. Some attention has already been given to the subject by the Weather Bureau, and apparatus for measuring and melting the accumulated snowfall has been devised. Some few stations have been equipped with this apparatus, but the work should be extended to practically all the upper watersheds of the northern rivers.

FOREST INFLUENCES.

The effect of forest covering upon stream flow has been discussed exhaustively for many years, and the literature on the subject is varied and extensive. The subject is indeed a vital one, and a thorough acquaintance with it is absolutely essential if further real progress is to be made in the study of river variations. It is true that it is but one factor of many, but none is more important, both in a negative and in a positive sense. There is a present tendency to overestimate to some degree the effects of forests upon stream flow, and the proper weight to be assigned to the existing conditions can only be determined after careful investigation of every phase of the question. This tendency toward overestimation furnishes the text for the introductory paragraph of a paper by Mr. W. B. Greeley,[a] of the Forest Service, Department of Agriculture. Mr. Greeley says:

> In the current discussion of the relation of forests to stream flow there is a danger of overestimating the influence of forest cover upon the character of a stream to the exclusion of other factors of equal or greater importance. It is a mistake to assume that the wooded or denuded condition of a watershed is of necessity the controlling factor in determining the behavior of the stream; that a forested stream is necessarily regular in flow, and a deforested stream necessarily irregular. In any discussion of this subject, it must be recognized at the outset that forest cover is but one of a number of far-reaching factors whose combined influence produces a stream of a given character; and great care must be taken not to attribute to the presence or absence of forest cover upon drainage basin results which may be due primarily to other causes.

VARIATIONS IN THE AMOUNT OF GROUND WATER OR UNDERFLOW.

The variations in the amount of ground water or underflow do not constitute a very important factor, but have, nevertheless, some bearing upon the subject of low-water forecasting at times when the amount

[a] Forestry and Irrigation, June and July, 1905.

of run-off from the rainfall is only a small fraction of the volumes of water actually found in the rivers. During the low-water seasons of the late summer and the autumn, it is sometimes observed that after a time the rivers reach a level which, without any material increase in the amount of rainfall, is maintained for a considerable time. At other times the waters continue to fall even though the rainfall be more abundant than is usual for the season. It will usually be found that these phenomena have an intimate connection with the variations in the level of the underground waters. If the supply of ground water has been near or above the normal level, the streams will continue at normal low-water stages. If, on the other hand, the supply of ground water, as indicated by its height in wells, etc., has steadily decreased during the previous year or more, then the surface streams may be expected to fall below their usual low-water levels, notwithstanding the fact that an average amount of rain has fallen. If the ground-water level has been falling for several years on account of deficient rainfall, the surface streams will probably continue to fall, even though the rainfall be appreciably more than the average. The ground water must first find its normal level before the full effect of the rainfall can be felt. During the season of rising water in the rivers, or in times of flood, the influence of ground waters is of course negligible, owing to its exceedingly small quantity as compared with the volume of the stream flow.

EVAPORATION.

The loss of water by evaporation is another problem that the river forecaster must encounter. Any elaborate discussion of the subject has hitherto been found impossible, owing to lack of sufficient data of precise character. That the data are deficient is due to the fact that thus far there has not been devised a satisfactory form of apparatus for measuring the amount of evaporation under different natural physical conditions. However, for the purposes of the river forecaster it is not necessary that the data be determined with laboratory refinement and precision. His requirements will be fulfilled when he possesses a general knowledge of the amount and seasonal distribution of the evaporated water, with such modifications as are caused by variations in temperature, weather, and wind.

MEASUREMENT OF THE VOLUME OF WATER.

Whatever its source of supply, the water when actually within the banks of the river must be accurately measured. The present method of measurement by linear scale can not be improved upon when daily or hourly measurements are required for comparison among themselves, but there is often a difficulty in properly coordinating the relations existing between gages at different stations on the same river at different stages of water. Much of this difficulty could doubtless

be avoided by measuring the volume of the water at regular intervals, especially in times of floods. Data of this character afford a definite basis of comparison, and would be of vast assistance in the work of river forecasting. The U. S. Geological Survey has performed a very large amount of work of this character, but almost entirely upon the smaller streams, the waters of which are used, or are capable of being used, for power generation; but during recent years the work on the great navigable rivers has been almost entirely neglected. It would seem proper that this work should be done by the Weather Bureau, which is charged by law with the gaging and measurement of the rivers of the country.

THE FORECASTER AND THE DISTRIBUTION OF INFORMATION.

It is not sufficient that the information in possession of the responsible forecast officials be limited to their own immediate districts. In order to meet all requirements necessary for the greatest possible efficiency, it is essential that each official in charge of a river district should become familiar with the general character of the entire watershed of which his district is a part. He should have a thorough knowledge of its permanent characteristics, as well as of the changes introduced by engineering works, etc., and he should keep himself in close contact with the innumerable changes in weather conditions and other factors that so vitally affect stream flow.

There yet remains the subject of the distribution of river forecasts and general river information. After the data have been collected at the river district centers, and the forecasts, representing the application of the best knowledge, skill, and judgment in the possession of the forecaster, have been prepared, speedy and effective distribution is necessary in order to accomplish the proper completion of the work. The public press is, of course, the most effective, satisfactory, and economical vehicle for the distribution of information; but at times when hours, or even minutes, are valuable, the telegraph and telephone must be promptly brought into requisition. The annual expenditure for the use of the telegraph and telephone already amounts to a considerable sum, but is yet very far from being sufficient to really meet truly legitimate demands. All communities affected by river stages should have daily river forecasts, precisely as they now have daily weather forecasts, and these should be regularly printed, distributed, and bulletined for the benefit of all concerned.

Of course the service can not be extended and perfected as outlined in this paper without increased expense. The people, however, demand steady improvement in all branches of the service, while the individual citizen is properly insistent for a personal share of its benefits; and it is not unreasonable to ask and to expect that the money necessary to attain these ends be provided.

TABLE SIRUPS.

By H. W. Wiley,
Chief of the Bureau of Chemistry.

KINDS OF SIRUPS IN COMMON USE.

The American people, perhaps more than the people of any other country, use sirups of various kinds for foods. The use of hot cakes for breakfast is almost universal in the United States. They are found on the bills of fare of the hotels, restaurants, and dining cars, and are also very commonly used in private families. These cakes are served hot and eaten almost universally with a sirup of some kind.

SIRUPS FROM MAPLE SAP, SORGHUM JUICE, AND CANE JUICE.

There are several forms of table sirup in common use. First may be mentioned the maple sirup, which is the product obtained by evaporation of the sap from maple trees to the consistency of a sirup, containing from 70 to 80 per cent of solid matter. Maple sirup is highly appreciated, and commands the highest price in the market.

Another very abundant table sirup, and one which is in very common use, is made from sorghum by methods which are practically the same as those to be described in the manufacture of table sirup from sugar cane. The sorghum industry is very widespread in the United States, as there is scarcely any part thereof in which the sorghum plant will not mature and produce a cane rich in saccharine juices suitable for sirup making.

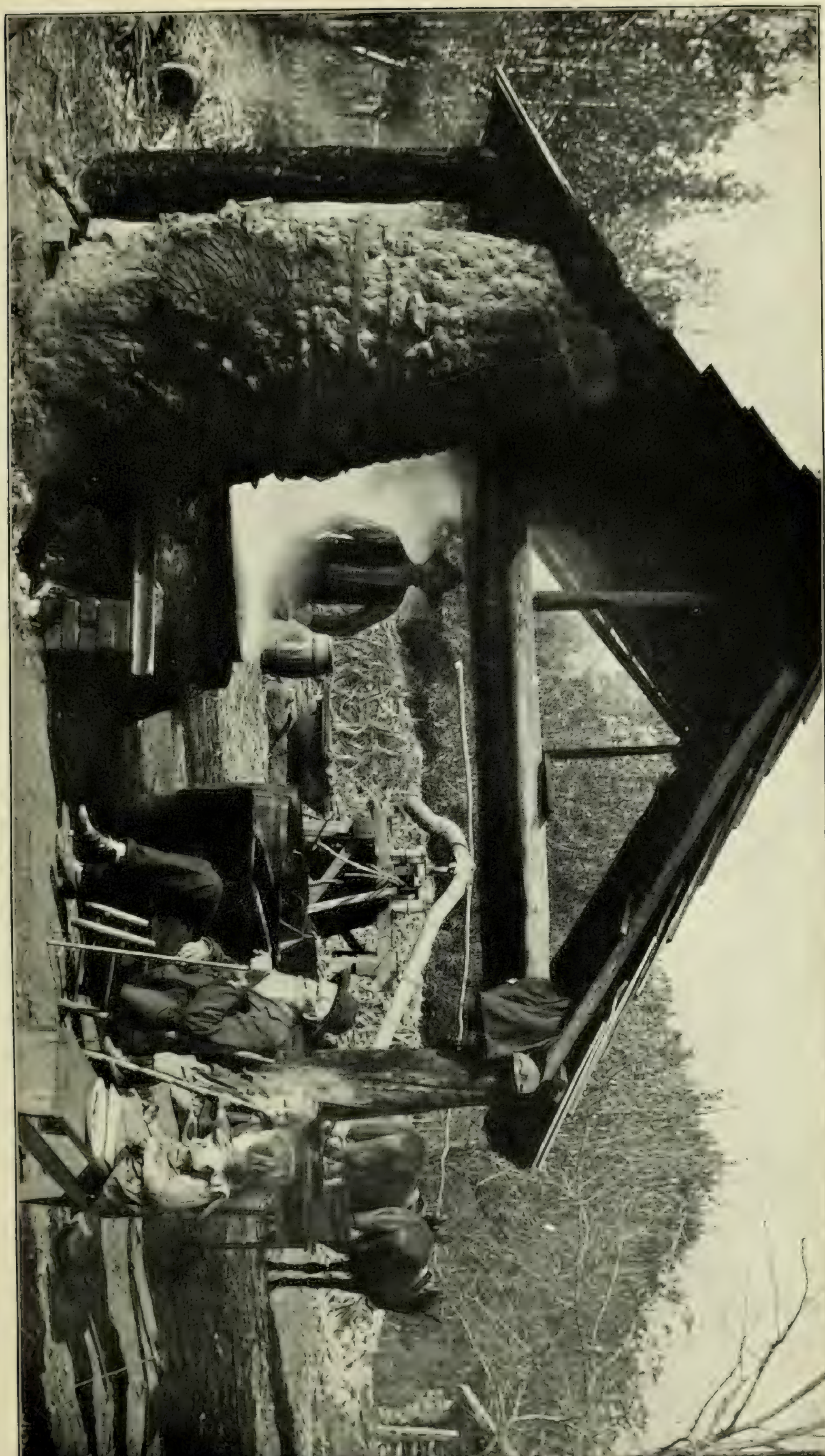
Another common source of sirup in this country is found in the molasses which is a by-product of the manufacture of sugar from sugar cane. In the methods of sugar making before the advent of the vacuum evaporator and strike pan, large quantities of sugar were inverted in the process of boiling in the open kettle. The moist sugars formed in this process after crystallization were placed in hogsheads with perforated bottoms, and the molasses was allowed to flow out by gravity. This kind of molasses is justly highly considered and formerly afforded a large percentage of the sweets used on the breakfast table. The modern processes of sugar making, however, have practically eliminated this open-kettle molasses from the market. To supply its place there has lately been a large extension in the Southern States, especially the South Atlantic and Gulf States, of the manufacture of sirup directly from the sugar cane and without the separation

of any of the sugar. This sirup forms a delicious, wholesome, and valuable condimental food substance, the use of which is rapidly extending; and, because of its merits, it appears destined to become a very important food.

MIXED SIRUPS.

There are also in use in this country quantities of table sirups which are simply mixtures made with or without the admixture of some of the sirups and molasses above mentioned. The chief ingredient of this mixed sirup is glucose, itself a sirup of fine body, but almost or quite colorless and not nearly so sweet as sirups containing common sugar as their sweetening agent. For some reason the consuming public has been led to judge a sirup largely by its coloration, a lighter-colored sirup bringing a higher price upon the market than one of a deeper tint. This is a very unfortunate circumstance, since it seems quite necessary in the proper manufacture of good sirup that some degree of color be produced. This arises from the fact that a sugar-cane sap depending largely upon common sugar for its sweetening content, if evaporated in a vacuum to the proper consistency, will crystallize on standing, thus spoiling its value for table use. The commonly accepted method of manufacturing this sirup is by evaporation in an open kettle, employing a high temperature and producing during evaporation a certain degree of inversion of the sugar, which prevents crystallization on standing. This high temperature necessarily produces some caramel or coloring matter from the sugar and gives it a reddish tint of greater or less intensity. The caramel is also condimental and imparts an additional agreeable flavor to the product. Instead of such a condition being considered by the consumer as detrimental, it should be an index that the sirup has been manufactured in the proper way. Glucose, as has been mentioned, is the chief ingredient of mixed sirups whose flavor and coloration are often derived from the molasses which is the final by-product of the sugar refinery. This molasses has a bright color, but contains so much soluble salts as to give it a distinct saline flavor. It also has more or less of the flavor derived from the repeated decolorizations by boneblack.

Many of these mixtures are placed upon the market under their true names, and in this condition are unobjectionable. Others are sold under the guise of the genuine sirup or molasses, and to this extent are fraudulent and adulterated. The object of the present article is not in any way to excite any prejudice in the mind of the consumers against the mixed sirups which are offered to them, but to call attention to the real character and quality of the genuine sirup and molasses. Thus, consumers who prefer a mixed article can have their taste gratified, while those who desire the unmixed article may be guided to some extent in securing what they want.



A PRIMITIVE TYPICAL SIRUP FACTORY, NEAR CAIRO, GA.

FIG. 1.—EXPERIMENTAL SIRUP FACTORY AT WAYCROSS, GA., SHOWING CANE SHED, HOIST, AND CARRIER.

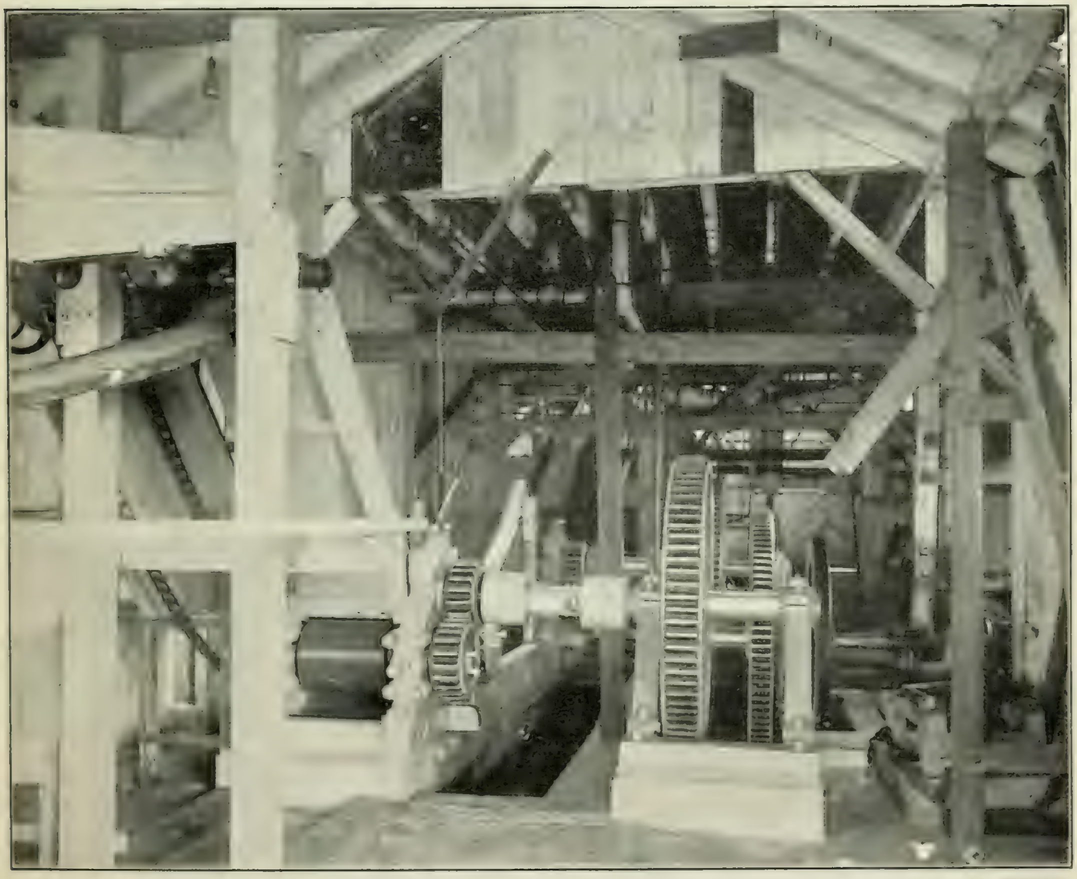


FIG. 2.—FRONT END OF SIRUP MILLS, SHOWING CANE CARRIER AND MILL GEARING.

APPARATUS FOR MANUFACTURING SUGAR-CANE SIRUP.

The manufacture of these table sirups at the present time is conducted in the simplest possible manner, largely by individual farmers who own small plants or by associations of farmers. It will be sufficient for the present purpose to describe only the process used with sugar cane. The environment of such a primitive sirup factory is attractive and interesting. It is usually located near the residence of the farmer and often in or near the pine forests. The fuel which is employed in the evaporation is usually derived from the pine tree. A primitive typical sirup plant of this kind is shown in Plate XII, reproduced from a photograph made near Cairo, Ga.

While the old-fashioned apparatus of this kind is the most interesting, it is by no means the most economical method of manufacture. But little more than half the saccharine matter in the canes is secured in the form of sirup by these old-fashioned processes.

The Department of Agriculture has lately conducted some experimental work in the manufacture of table sirup from sugar cane with a view to securing a larger yield at less cost. To this end an experimental factory has been built near Waycross, Ga., an external view of which is shown in Plate XIII, figure 1. The modern economical and efficient mill, which extracts from 70 to 80 per cent of the saccharine matter of the canes, as against 50 per cent in the primitive mill shown, is illustrated in Plate XIII, figure 2, from a photograph of the mill used by the Department of Agriculture in its experiments at Waycross.

GROWING THE SUGAR CANE FOR SIRUP MAKING.

The cultivation of sugar cane for sirup making is conducted in practically the same way as when it is to be used for sugar making. The canes themselves are planted in the spring, having been kept under a moist covering during the winter to prevent freezing, and the new canes grow from the eyes at the joints of the old cane.

AREA AND SOILS.

The growth of sugar cane for sirup making is possible over a wide area of the South Atlantic and Gulf States. Wherever sugar cane can be grown for sugar making, as in Florida, Louisiana, and Texas, it can also be grown for sirup making. There is a very considerable belt of territory north of this region, however, which produces excellent sugar cane for sirup making. It may be said that the southeastern quarter of Texas, two-thirds of the State of Louisiana, the southern third of Alabama, the southern quarter of Mississippi, the southern third of Georgia, and all of Florida, may be considered as having climatic conditions favorable to the production of sugar cane which can be

used profitably for sirup making. There are other localities also, even north of those mentioned, where usually excellent results could be obtained. It is a well-known fact that sugar cane when grown on poor, sandy soils produces a purer sap and one which makes a lighter-colored sirup than when grown on dark or very fertile soils. The light, sandy soils of the regions mentioned are peculiarly favorable, therefore, to the production of a sugar cane with a very pure sap. These soils, however, are very deficient in plant food, and if not fertilized do not produce a crop of sufficient magnitude to make the growth of sugar cane profitable. A rather liberal use of fertilizers is therefore necessary in almost all of these localities. With the proper use of fertilizing materials the production of a crop of 15 to 25 tons per acre is not difficult. In some cases larger crops are secured. A ton of good sugar cane with an average content of sugar should make from 18 to 24 gallons of sirup, according to the character of the technical processes used in the extraction and evaporation of the sap. Of course, when primitive methods of manufacture are employed the yield is not expected to be so great.

The total cost of producing a gallon of sirup (including price of cane, manufacture, and packing), if modern machinery such as was used at the Waycross factory be employed, varies from 20 to 25 cents. This product sells in the open market for about 35 cents per gallon in barrels, and up to 45 cents per gallon for smaller packages.

FOOD VALUE OF CANE SIRUP.

While it is true that sirups of this kind are used largely for their condimental character, it must not be forgotten that they have a high food value. It is a very common opinion now among physiological chemists that people take too much nitrogenous food, especially meats. The experiments which have been conducted in the Bureau of Chemistry indicate that when left to choice, and eating the usual diet, a young man weighing 150 pounds will consume from 15 to 17 grams of nitrogen per day. It is believed by many well-known experts that this quantity could be reduced to 12 grams daily, or even less, not only without injury, but with positive benefit. It is evident, therefore, that a more general use of table sirup as a food would tend to increase the proportion of nitrogen-free material in the diet, and if substituted for meat foods the sirup would diminish the quantity of nitrogen consumed. As is well known, table sirups have only a slight trace of nitrogen, while the sugars which they contain are highly useful as foods, furnishing heat and energy. In other words, a man engaged in heavy manual labor could eat a large quantity of table sirup with great economy as to the cost of food and at the same time secure a supply of those materials which are converted into heat and energy

during the digestive processes, thus furnishing in abundance the elements most needed.

There is a general opinion—and this is founded upon reliable observations—that the use of too much sugar in a food tends to cause deposition of fat. This is only true, however, when the proper exercise attending the use of such food is neglected. A person of sedentary habits might develop a tendency to obesity by eating large quantities of sugar without indulging in vigorous exercise. On the other hand, the man who lives much in the open, takes the proper amount of exercise, and indulges in a reasonable amount of manual labor would be able to eat large quantities of sugar without developing any such tendency. It is highly advisable that the tendency to become stout should be opposed as far as possible, but it appears that this can be secured in other ways more desirable than by depriving the individual of so valuable and palatable a food.

VALUE OF TABLE-SIRUP INDUSTRY TO AGRICULTURE.

One of the prominent points in connection with the development of the table-sirup industry is its value to agriculture. This industry is one which appeals strongly to the small rather than to the large farmer. It is especially an industry which utilizes profitably the efforts of those who till only a few acres. Therefore the fields of sugar cane which are grown for the manufacture of table sirup are mostly small, and they are correspondingly numerous. It is true that, for economical purposes, it is best that the factories where this sirup is made should be as large as convenient, and yet it must not be forgotten that the very best quality of this sirup is made by the most primitive methods described. This is chiefly due to the fact that the first pressings of the sap are always the purest, and therefore make a sirup of finer flavor and color. But by proper technical treatment mills which give heavy pressings and extract from two-thirds to three-fourths or more of the sap can be utilized in the manufacture of a product thoroughly satisfactory to the taste and eye.

Thus, it seems that an industry of this kind will appeal particularly to general agriculture over a wide area, affording a means not only of supplying the family with a wholesome and palatable product for home consumption, but also of producing a surplus which, when its qualities are fully recognized, will find a ready and profitable market in all parts of the country. The benefit which will come to the small farmer from the development of this industry is of no mean importance. The welfare of the agricultural class in general is not dependent upon a single industry alone, but upon the sum of all agricultural industries, many of which, considered individually, would be regarded as of very small importance.

DIFFICULTIES ATTENDING PRODUCTION OF TABLE SIRUPS.

The principal difficulty which heretofore has attended the marketing of the table sirups produced in the South has been found in the fact that during the hot weather succeeding the date of their manufacture they ferment or "sour," as commonly expressed. It is apparent that this fermentation can only take place by the introduction of yeasts of some kinds into the packages, and hence it is evident that when such an introduction is prevented there is no danger of fermentation.

A very common way of preventing the introduction of yeast in sirups is by the use of some antiseptic in connection with the manufacture and storage of the product. The one which has been commonly used is sulphurous acid, produced by burning sulphur in an appropriate stove. This gas has been extensively used in the manufacture of table sirup, principally because of its bleaching effect, and only incidentally by reason of its antiseptic qualities. But whether used for one purpose or the other, its presence in a product of this kind is objectionable. There is no doubt of the antiseptic properties of sulphurous acid, and there is also no doubt about its injurious character. Its use, therefore, is to be vigorously discouraged if not entirely forbidden. Very simple precautions will render the use of sulphur fumes needless as a preservative agent. If the sirups are immediately placed in the packages while hot, that is, as they come from kettles or pans, and if these packages have been previously thoroughly sterilized by conducting into them superheated steam for a sufficient length of time to enable the heat to penetrate the pores of the wood and kill the germs, and then after filling and before infection can take place the packages are stoppered with antiseptic covers, sealed so that no germs can enter, all danger of fermentation will have been prevented. It is not difficult to preserve the contents of large packages, even barrels, in this way. At the Department of Agriculture there are now stored two barrels of sirup three years old packed in the manner above described, in which not the slightest sign of fermentation has been developed.

Attention has been called to the use of sulphurous acid as a bleaching agent and also to the unreasonable prejudice of the consumer in regard to the color of the product. There is no doubt that the prejudice of the consumer should be considered as far as possible, but a prejudice should not be pandered to by the use of a hurtful reagent. If the consumer does not like a deeply tinted sirup he can simply refuse to buy it. He should not be induced to buy it by treating it with a bleaching agent which not only does not improve its quality, but positively destroys its flavor. Highly sulphured table sirups have a most pronounced and very objectionable flavor, although the color is light and attractive. It is evident, therefore, that the use of any such bleaching reagent in the manufacture of table sirup is highly reprehensible.

In the manufacture of sugar it is customary to add to the sap when preparing it for concentration a quantity of lime sufficient to neutralize its free acid. This is advisable in the case of sugar making by reason of the fact that during the process of evaporation, even in vacuo, highly acid juices suffer more or less conversion of the crystallizable sugar into the invert and noncrystallizable kind, thus diminishing the yield. In a table sirup, however, as has already been stated, such an inversion is highly desirable, as it prevents the second principal difficulty in the making of these table sirups, namely, their tendency to crystallize. In the experiments conducted by the Department of Agriculture, therefore, no neutralizing base has been employed. The addition of lime facilitates the clarification of the saps and the removal of the foreign matters, which are coagulated and precipitated under the joint action of lime and heat. This, of course, is a highly desirable end, but experience has shown that it is better to refuse the aid of such processes than to risk the danger of producing a table sirup which will solidify into a more or less solid mass of sugar crystals. Experience has shown that by continual skimming of the sap during the process of evaporation most of the foreign matter which is precipitated by the heat and by the thickening of the sirup can be removed mechanically. The thin sirup, or even the finished sirup, may also be filtered while still hot through sand or some other medium by means of which the minute solid bodies which are in suspension may be removed and a bright product secured.

SUPERIORITY OF NATURAL SIRUPS.

While the problems referred to have not been entirely solved, it is evident that the table sirup of the future may be made directly from the sap of the sugar cane without any further clarification than that which is produced by heat and by mechanical means. Sirup prepared in this way with its natural acidity is not only more palatable, but, as a rule, will have suffered a sufficient inversion of the sugar to prevent crystallization. Table sirups when thus made from the unadulterated saps of the maple, the sorghum plant, and the sugar cane, evaporated to the proper consistency without the use of objectionable bleaching or clarifying substances and properly preserved in sterilized packages, may be offered to the consumer with a full guaranty of high nutritive value and of purity, wholesomeness, and flavor.

SUPERIORITY OF SIRUPS FROM ORIGINAL SOURCE.

The sirup made directly from the sugar cane must of necessity commend itself to the consumer in comparison with the use of molasses arising as a by-product of sugar manufacture. In the production of sugar it is an economic necessity to make a white product, and this requires the use of bleaching agents of some description. Among

these sulphur is perhaps the most common. Also, in the washing of white sugar in the centrifugal, solutions of salts of tin or of indigo are often employed for giving an additional luster to the sugar. This bleaching agent must of necessity remain in the molasses, making it to this extent unsuitable for consumption. For these reasons it is evident that the production of a table sirup directly from the original source should be encouraged.

It appears from a general survey of the data which have been collected in these experiments that it is entirely possible to supply the demand for table sirup in the United States directly from the original sources, thus removing the danger of adulteration or contamination with substances injurious to health. The general consumption of a sirup of this kind would, it is true, interfere with the industry which is engaged at the present time in making a synthetic sirup for table use from doubtful sources, but which as a rule contains more or less molasses—the by-product of sugar manufacture—and contaminated more or less with substances injurious to health. The general welfare of the farmer and consumer would, therefore, be promoted by the general consumption of pure sirups of the kind which have been described.

INSECT ENEMIES OF FOREST REPRODUCTION.

By A. D. Hopkins,
In Charge of Forest Insect Investigations, Bureau of Entomology.

IMPORTANCE OF THE PROBLEM.

Investigations in this country have shown that the renewal of forests by self-sown seeds, by sprouts, and by artificial sowing and transplanting is more or less seriously affected by insects. The character of insect injuries to seeds, seedlings, and saplings is very much the same as that which claims the forester's attention in Europe and other temperate countries, and, in general, the damage is caused by the same class of insects. In other words, the species of insects in this country which are closely related to species in Europe cause the same or similar injury. It is found, however, that while an insect in this country may be almost identical in appearance and habits of attack with one in Europe, the more important facts in the life history of the two insects may be quite different. Thus, the remedies recommended for troubles caused by the more thoroughly studied insects of Europe can not be adopted for American species without amendments based on a knowledge of the difference in the life history, which shows the importance of detailed studies of this class of insects in their relation to the forests of the United States.

While the losses from insects injurious to forest reproduction are not nearly so great as those from injuries to matured forest trees and other major products, they are far greater than is generally recognized, and are of sufficient importance to require the attention of forest officials and others interested in the future timber supply of the country. It is the object of this article to give a brief review of this phase of the forest insect problem, and to call attention to the character of injuries caused by different species and classes of insects as necessary preliminary information for further observation and study.

With a few exceptions, very little is known of the life history and habits of this class of enemies of American forests as compared with what is known of similar insects in Europe. Heretofore we have not felt the need of such detailed knowledge. It is becoming evident, however, that the protection of our forests, and especially the young growth, is one of the most important duties we owe to succeeding generations. Those of the present generation who are most interested in

such work should have a sufficient general knowledge of the various enemies of reproduction, including insects, to enable them at least to recognize the evidences of a dangerous enemy and to collect the proper specimens to send to a specialist, thus contributing as well as receiving information.

GENERAL CHARACTER OF INSECT INJURY.

The injuries by insects which affect reproduction begin with the flower buds and are continued by varying classes and species of insects to the flowering, fruiting, germinating, seedling, and sapling periods in the life history of a tree.

INJURIES DURING THE FLOWERING PERIOD.

The flower buds of some kinds of trees are injured or destroyed by various kinds of insects. They are mined by the larvæ of beetles and moths, eaten by defoliating caterpillars, deformed by galls, and dwarfed and blighted by aphides and scale insects.

Among those insects which mine into the flower buds we have a striking example in a small black weevil which, according to Mr. E. C. Cotton, destroys the buds of black or yellow locust in Ohio and has caused almost a total failure of the seed crop in certain sections.

Complete or partial defoliation of seed trees by caterpillars, May beetles, and sawfly larvæ, at a time when the flower buds are opening, often prevents a seed crop.

The flowers also are injured, deformed, or eaten by various kinds of insects, but it is probable that exceptional injuries to buds and flowers are not continued in any locality for a sufficient number of years to materially affect natural reproduction. The greatest loss from this cause would naturally be to the collector of forest seeds for planting or sale.

INJURIES DURING THE FRUITING OR SEED PERIOD.

The fruiting or seed period is one in which the injury by insects is of considerable importance. It begins with the embryo fruit or seed and ends with the beginning of the germinating period. The fruits and seeds are mined by beetles, grubs, and caterpillars, deformed by galls, and blighted by aphides and scale insects.

The seed crop of conifers is often reduced or destroyed by caterpillars which mine in the nearly mature cones of pine and spruce and feed on the seeds, the caterpillars passing the winter in the pith of the cone, to emerge as moths the next summer and deposit eggs for the next generation.

The crop of seed of the Douglas spruce is sometimes entirely destroyed by a minute chalcis fly, which breeds in the seed. The seed is also deformed and prevented from falling from the cones by a small gall-making gnat. Cones and seeds of other conifers are injured to a

greater or less extent by insects of the same class. Chestnuts, acorns, hickory nuts, and seeds of other deciduous or hardwood trees are attacked by nut weevils, which sometimes destroy a large percentage of the crop. The pods, as well as the seeds, are mined by caterpillars and deformed by galls.

The principal—in fact, almost all—injuries to the fruit and seed begin before they fall from the tree; but in many cases the insects continue to feed, and do the greatest damage after the seeds have fallen or when they are stored.

INJURIES DURING THE GERMINATING PERIOD.

From the time the seed breaks open in the process of germinating until the young shoots appear above the ground they are subject to injury by different kinds of soil-inhabiting insects.

This class of injury has not been studied in this country; but according to German literature the principal injuries are by wireworms, white grubs, cutworms, mole crickets, meadow maggots, and thousand-leg worms. Injuries of this class are especially important in seed beds and nurseries, and are doubtless an important factor in preventing natural reproduction.

INJURIES DURING THE SEEDLING PERIOD.

From the time the sprouts appear above the ground until the young trees reach a height of 2 or 3 feet they are subject to injury by a far greater number of species than during any of the preceding periods, and many of these species continue their work on the small to large saplings and mature trees.

The roots of the young seedlings are gnawed and barked by mole crickets, larvæ of foliage-feeding snout-beetles, meadow maggots, and root-maggots. The tap and lateral roots are cut off or gnawed by white grubs and by the larvæ of ground beetles, and are mined by wireworms and injured by root aphides. The bark of the base of the roots of the older seedlings is mined by barkbeetles, and the young, tender stems are gnawed or cut off by cutworms. The large stems are gnawed by wasps, sawfly larvæ, and adults of snout-beetles, or are blighted by bark aphides, scale insects, and bark-bugs. The base of the larger stem is mined by barkbeetles, the larvæ of bark weevils, and other bark-boring larvæ. The wood of the stem of hardwood seedlings in this country is mined by an ambrosia beetle, which weakens or kills the plant, and is sometimes very destructive to the seedlings of many kinds of trees. The stems of both conifers and hardwood seedlings are sometimes deformed by bark-boring and bark-mining insects, as well as by insect galls, and the branches are deformed in a like manner.

The terminal, or leading shoot, is subject to attack by bark and pith mining grubs and caterpillars, which often results in the development of a deformed tree. The principal injury to terminal shoots of conifers, and especially pine, is caused by bark weevils, which more commonly affect the small to large saplings. The buds are subject to more or less serious injury by bud-miners, and the buds and leaves are sometimes entirely destroyed by caterpillars, sawfly larvæ, and leaf beetles. The foliage and twigs are also injured by scale insects, leaf-hoppers, and leaf-miners, which suck out the sap and cause a weakened condition.

INJURIES DURING THE SAPLING PERIOD.

The sapling period embraces young trees over 3 feet high and up to 4 inches in diameter breasthigh. Most of the insects which injure the large seedling continue their depredations on the small to large sapling, which often suffers severely from the work of some species. The pines, spruces, and firs are especially liable to serious injury from the work of bark weevils, barkbeetles, bud and twig miners, and foliage-feeding caterpillars.

FIG. 61.—The white-pine weevil (*Pissodes strobi*), natural size at right (original).

The bark weevils are worthy of special mention, on account of the great injury to the terminal shoots of pine and spruce.

THE WHITE-PINE WEEVIL (*Pissodes strobi* Peck, fig. 61).—This is perhaps the most important of the American bark weevils, since it seriously affects the normal development of one of the most valuable forest trees. The principal attack and primary injury is practically confined to the sapling period, but its effect is more or less prominent thereafter during the entire life of the tree. The beetle deposits its eggs in the bark of the 1-year-old terminal shoots of saplings from the time they are 3 or 4 feet high until they attain a height of 15 or 20 feet. The most vigorous shoots are usually selected for this purpose. The eggs hatch into small white grubs, which mine beneath and completely separate the bark (fig. 62), causing the death of the small terminal down to the upper whorl of branches. When the grubs complete their development they make chip cocoons in the pith and outer wood of the dead terminal, in which they transform to the adult beetle, and emerge during July and August of the same year.

This dying of the leading shoot throws the next year's growth into the upper laterals, which results in a forked and many-branched top. Each branch produces a vigorous terminal, and all compete for leader-

ship in forming the crown. In succeeding years the more vigorous terminals of the topmost branches are attacked and killed, causing more branches, and thus effectually preventing the development of the normal straight trunk and symmetrical crown necessary to a tree of commercial value. Wherever there is a dense growth of pine the trees affected by the weevil may in time develop into fairly good commercial trees; but if in the open woods or fields, a worthless, short trunk, with many large, forked branches, is the common result.

THE RIBBED PINE WEEVIL (*Pissodes costatus* Mann., fig. 63).—This is a widely distributed weevil in the Rocky Mountain and Pacific slope region which attacks the bark of the stems of small to large saplings, probably of several different species of pine, causing ugly rough scars on the sides of the stems (fig. 64), resulting in deformed growth, or, in some cases, the death of small to large saplings. Apparently this species does not normally attack the terminal shoot, but prefers to infest the main stem from near the ground to the upper branches. It is therefore an important enemy of western pine reproduction.

THE DOUGLAS-SPRUCE BARK WEEVIL (*Pissodes fasciatus* Lec., fig. 65).—According to original observations by Mr. H. E. Burke, field assistant in forest insect investigations of the Department, this species attacks medium to large saplings of Douglas spruce and kills them by boring beneath the bark toward the base and along the stem (fig. 66). This weevil is common in the Coast and Cascade Mountain sections of Oregon and Washington.

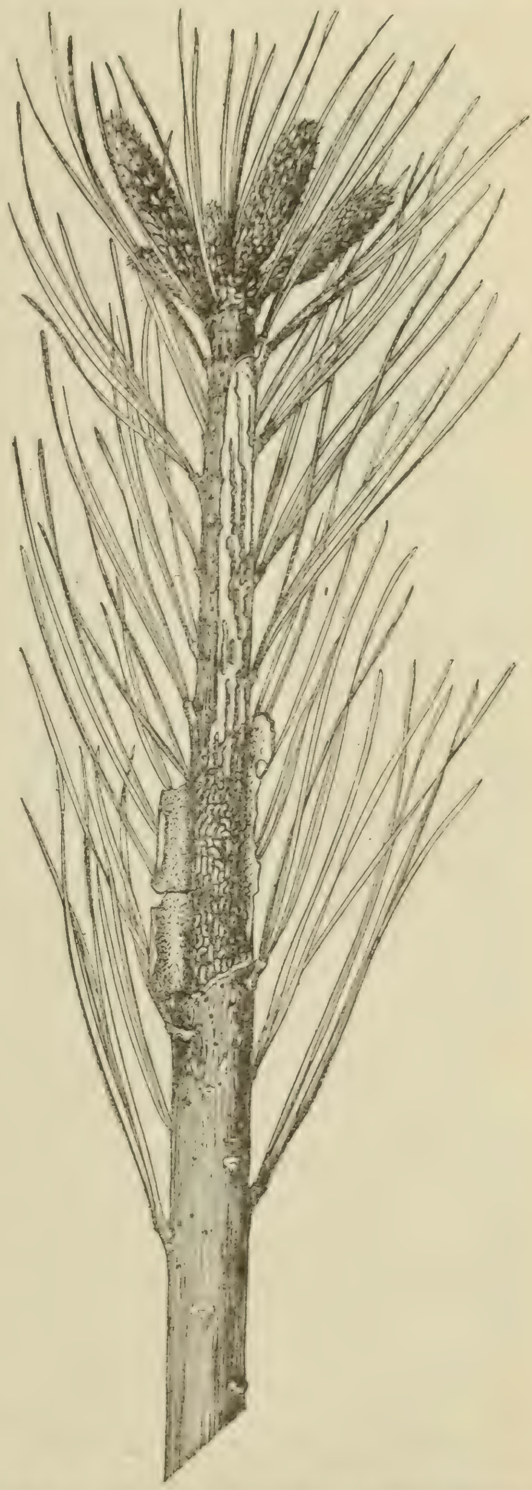


FIG. 62.—Work of the white-pine weevil (*Pissodes strobi*), much reduced (original).

THE BALSAM-FIR BARK WEEVIL (*Pissodes dubius* Rand., fig. 67).—According to the writer's observation, this eastern weevil appears to confine its attack to the balsam fir of the northern forests, and is probably more of a secondary enemy, living in the bark of the stem of large saplings or trees which have previously been otherwise injured.

FIG. 63.—The ribbed pine weevil (*Pissodes costatus*), natural size at right (original).

THE TWO-SPOTTED PINE WEEVIL (*Pissodes affinis* Rand., fig. 68).—This species, also of the northern forests, is in various collections, labeled "Minnesota" and "New Hampshire," and was found by Field Assistant W. F. Fiske in the bark of a white pine stump. Further observations on the habits of this species will probably show that it attacks weakened saplings and trees.

THE LAKE SUPERIOR BARK WEEVIL (*Pissodes rotundatus* Lec., fig. 69).—This species, described by Le Conte from a specimen labeled "Lake Superior," is represented in the National Museum by seven specimens, labeled "Marquette, Mich., June 27, 28, and July 4," and "White Fish Pond, Lake Superior." The food habits are not known, but it will probably be found in spruce or fir.

OTHER BARK WEEVILS.—There are some fourteen or fifteen other unnamed species of bark weevils in the collections of the Department and the National Museum, which have been taken from pine, spruce, and fir, from different sections of the country. Some of them are important enemies of reproduction.

FIG. 64.—Work of the ribbed pine weevil (*Pissodes costatus*), much reduced (original).

BUDMOTHS.—Small to large saplings of spruce and pine are often seriously damaged by the caterpillars of small moths working in the buds and terminal shoots, causing a dwarfed, bushy appearance of the young and old trees.

BARKBEETLES.—Reproduction pine in the Rocky Mountain region is sometimes killed in patches over areas of considerable extent by the Black Hills beetle and the Oregon Tomicus, which mine beneath the living bark of small to large healthy saplings.

ROOT-MINERS.—The young aspen over extensive areas of the Black Hills of South Dakota and other sections is sometimes killed by the poplar borer working in the base of the stems and roots.

THE SPRUCE GALL APHIS.—Cone-like galls are produced on the twigs of western and eastern spruce, which sometimes seriously affect the vitality of the trees during the sapling stage.

FIG. 65.—The Douglas-spruce bark weevil (*Pissodes fasciatus*), natural size at right (original).

DEFOLIATORS.—Saplings of various kinds of conifers and hardwoods are sometimes damaged and killed by insects, which, for two or three years in succession, feed on the leaves to such an extent as to cause complete or partial defoliation.

FIG. 66.—Work of the Douglas-spruce bark weevil (*Pissodes fasciatus*), much reduced (original).

INJURIES TO NATURAL REPRODUCTION FROM SPROUTS.

The renewal or extension of forests by sprouts from stumps and roots is affected much the same as are the large seedlings and small to large saplings from seed, except that the more vigorous young sprout can usually resist many of the insects which injure the slower growing trees from seed. There are a few exceptions, however, where the young trees from sprouts suffer more than those of the same species from seed. This is especially noticeable in the black or yellow locust reproduction, where the most vigorous shoots are attacked by the locust twig-borer, causing gall-like enlargements and stunted and deformed growths. Oak sprouts are also sometimes damaged by gall insects and certain stem-borers, more than are the seedlings; but, as a rule, sprout reproduction is less liable to serious injury during the sapling stage.

INJURIES TO ARTIFICIAL REPRODUCTION.

Artificial reproduction is injured by the same class of insects which affect natural reproduction, but the character of the injury may differ.

Seed beds and plantations in sod lands are especially liable to serious injury from white grubs, wireworms, and other insects which normally feed on the roots of grasses.

Transplanted trees, owing to their usually weakened condition, are often more liable to attack by barkbeetles and bark weevils than the same kinds of trees growing in the natural forest.

Nursery stock in the nursery row is subject to greater damage, as are also the seed and young seedlings in the seed beds.

METHODS OF COMBATING INSECT ENEMIES OF REPRODUCTION.

Much can be accomplished in the nursery and small plantation by the ordinary methods of combating farm and orchard insects, but in

FIG. 67.—The balsam-fir bark weevil (*Pissodes dubius*), natural size at right (original).

FIG. 68.—The two-spotted pine weevil (*Pissodes affinis*), natural size at right (original).

FIG. 69.—The Lake Superior bark weevil (*Pissodes rotundatus*), natural size at right (original).

the natural forest reliance must be placed on systems of forest management which will bring about unfavorable conditions for the work of injurious insects.

The best success with any method for the control of insect enemies of reproduction depends so much on a knowledge of the primary enemy, the more important facts in its life history and habits, and the local conditions, both as related to the insects and the practicability of a given method of control, that nothing should be attempted without some special information on the subject. This can be had by sending specimens of the insects or their work to the Bureau of Entomology of this Department, together with full notes on observations.

THE USE OF ILLUSTRATIVE MATERIAL IN TEACHING AGRICULTURE IN RURAL SCHOOLS.

By Dick J. Crosby,
Of the Office of Experiment Stations.

AGRICULTURE IN RURAL SCHOOLS.

The value of agriculture as a subject of study in the rural schools will be determined largely by the attitude of teachers toward it. In the high school and the consolidated rural school employing three or more teachers, the problem of teaching agriculture successfully is not a difficult one, for in such schools the facilities for illustrating the work are better than in the smaller schools, and there, too, a teacher having training in agriculture can be employed to teach agriculture and the other sciences. Even in the one-room rural school the difficulties, while they are more numerous, are far from being insurmountable. In such schools, it is true, teachers with a college education or with special training in agriculture are seldom found, and teachers having sufficient originality and energy to free themselves from a condition of absolute dependence upon the text-book soon command good salaries in other positions or take up some independent occupation. And yet these same rural schools, with their scanty equipment and poorly paid, poorly trained teachers, go on year after year turning out strong young men who, in spite of inefficient schooling, have acquired an education which enables them to forge to the front in the business or professional world, or to rise to high places in the councils of the Nation. Training for efficiency seems to be acquired in some way through mere contact with the environment of the rural school, or more likely through participation in the varied business operations and work of country life. How better to utilize these undefined and almost intangible educational forces is the question which prominent educators are now trying to solve by introducing nature study and elementary agriculture into the rural schools. The great danger is that agriculture, when it is introduced into these schools, will be treated merely as an additional burden to the teacher, as a text-book subject pure and simple; that the teacher will fail to see and appreciate the great wealth of illustrative material lying all around, which, if properly employed, would make the study of agriculture one of the most valuable subjects in the country school curriculum. The point of view for the teacher is quite clearly indicated in a recent

lecture by L. H. Bailey on "The School of the Future,"[a] in which he says:

In an agricultural community, for example, all the farms of the neighborhood will afford training in the elements of failure and success. There is no reason why the pupils should not know why and how a man succeeds with his orchard or dairy or factory, as well as to have the cyclopedia information about the names of capes and mountains, dates, and the like; and why should not every good farmer explain his operations to the pupils? Such work, if well done, would vitalize the school and lift it clean out of the ruts of tradition and custom. It would make a wholly new enterprise of the school, rendering it as broad and significant and native as the community itself, not a puny exotic effort for some reason dropped down in the neighborhood. When the public schools begin to touch experience and pursuits in a perfectly frank and natural way, we hope that persons who have money to give for education will bestow some of it on elementary and country schools, where it will reach the very springs of life.

There is no good reason why the teacher should not draw upon "all the farms of the neighborhood," all the highways, all the buildings, and many of the markets and business houses of the near-by towns for illustrative material to aid in teaching agriculture in the public school. The intrinsic value of this material is so great that few colleges would be able to purchase it, and yet it is available for the free use of the public schools. It is for the purpose of suggesting the nature of this material and how it may be used that this article is prepared. As a basis for further suggestions let us first see what use some schools are now making of relatively inexpensive illustrative materials in teaching agriculture, and how this teaching is made useful to the whole community.

AGRICULTURE AS TAUGHT IN SOME PUBLIC SCHOOLS.

A CONSOLIDATED SCHOOL.

In east Tennessee, near Concord, is a school which was organized by the consolidation of three school districts, and named the Farragut School in honor of the great naval hero, whose supposed birthplace is about half a mile away. One of the old schoolhouses was abandoned, one was moved to the site of the new school and remodeled for laboratory work in domestic science and manual training, and the other is still used for school purposes by the children of the primary grades in the village of Concord. The new school was opened in September, 1904, and is supported jointly by the Southern Education Board, which had contributed up to July 1, 1905, about $3,500; the State tax levy for the salaries of teachers, an local funds raised by means of subscriptions and entertainments. The funds thus raised, exclusive of teachers' wages, amounted, July 1, 1905, to about $8,000, of which $6,000 was expended for a seven-room school building and equipment, and $620 for 12½ acres of land. A small poultry house, with incuba-

[a] The Outlook to Nature. The Macmillan Company.

tor and brooder, a two-frame hotbed, and a shed for horses comprise the major portion of the farm equipment. Two other buildings are planned, a small barn and a dwelling house, which will enable the teacher of agriculture to live at the school. There are at present five teachers, including the superintendent and the teacher of agriculture, the latter an agricultural college graduate.

It is the plan to make this a model rural school in which agriculture, domestic science, and manual training shall be leading features, and in the single year of its operation much progress in this direction has been made, especially in the agricultural work. In the first place, a very creditable start has been made in assembling an agricultural

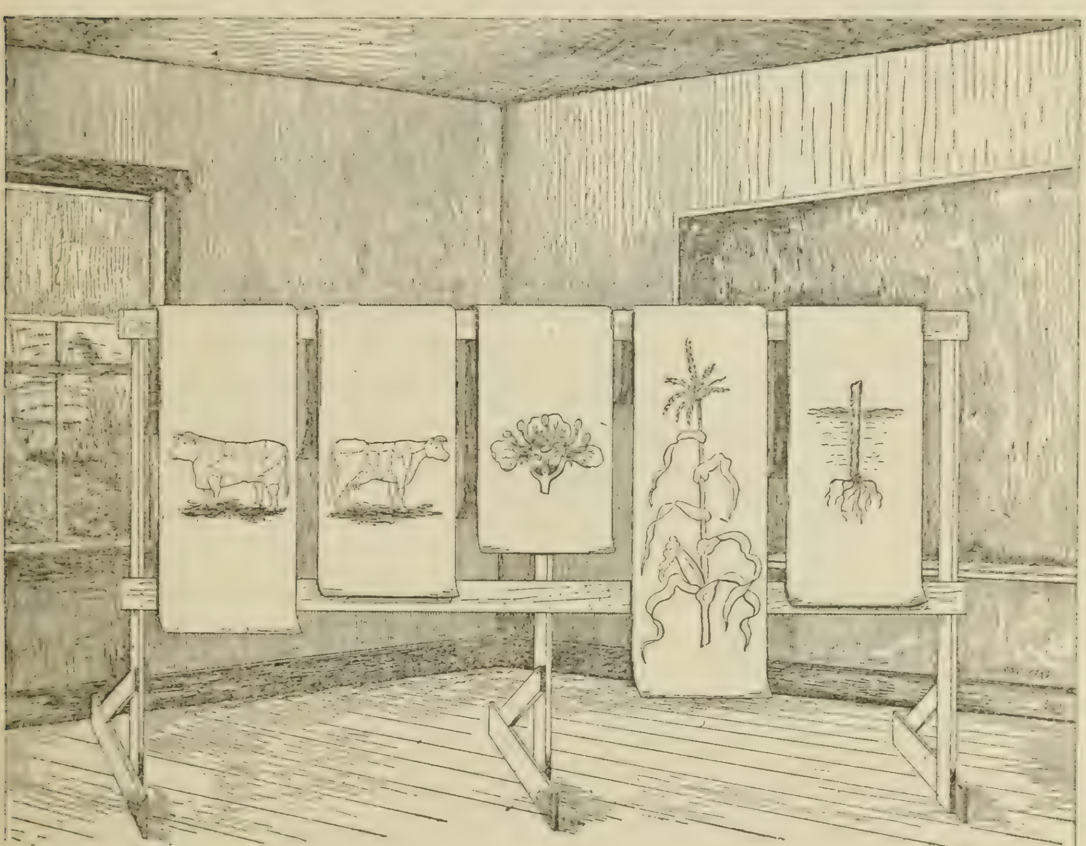


FIG. 70.—A frame for homemade manila charts used at the Farragut School, Concord, Tenn.

library. This consists of a number of elementary text-books of agriculture, which are used as reference works in connection with the regular text-book; a collection of bulletins from this Department and from State experiment stations; Yearbooks of this Department, and a large number of agricultural papers, about 40 of which are received regularly through the courtesy of the publishers. These books and other publications are kept in the agricultural class room, which also serves as a reading room and agricultural laboratory. Numerous homemade manila paper charts tacked to a rough frame, about 12 feet long and 5 feet high (fig. 70), are used in illustrating lectures on any

subject which can not be illustrated better in some other way. A large number of charts can be fastened to one frame, and those which are in front of the chart to be used can be turned over back.

Instruction in agriculture is given by means of text-books, lectures, a limited amount of laboratory work, and outdoor work. The last named is of most interest in this connection.

Of the land belonging to the Farragut School 6 acres is devoted to field crops, 3 acres to horticulture, and 3½ acres to campus and farmyard. The field-crop work has consisted largely of variety tests and demonstration work, and has been nearly self-sustaining. The teacher of agriculture writes that in a wheat experiment with three plats of about 1 acre each they succeeded in demonstrating the "value of seed selection, treatment for smut, balanced fertilization, and variety," besides learning something concerning the diseases and enemies of wheat, "and the yield paid for it all." Potatoes, onions, corn, and tomatoes were handled in the same way and quite as successfully. This work was of value not only to the pupils in the school, but also to the farmers of the whole community, who watched the experiments with a great deal of interest.

In connection with the field work the class in agriculture has recently taken up the study of farm drainage, hillside ditching, and contour work, and has taken sufficient interest in this work to raise the necessary funds for the purchase of a farm level (exercise 1). A milk tester has also been purchased and the pupils are testing milk from cows in different dairy herds, which are numerous in this beautiful east Tennessee valley.

A small plat of alfalfa grown on the school farm has aroused considerable interest among the farmers and led to the sowing of alfalfa in the neighborhood.

The hotbed furnishes material for instruction, is a source of income to the school, and a convenience to the farmers of the district. The students are taught how to make and manage hotbeds. All the early garden plants and flowers needed for transplanting last spring were raised in this one small hotbed, and $10 worth of tomato plants were sold to farmers who preferred paying a small price for such plants to undertaking the propagation of them in pans or boxes in the house.

The poultry work is also attracting attention. The poultry consists of two small flocks of pure-bred Brown Leghorns and Barred Plymouth Rocks, of which careful records as to feed, laying qualities, etc., are kept. Forty-five incubator chicks were sold as broilers, but all the choicer birds are disposed of for breeding purposes at $1 each, which the teacher of agriculture speaks of as "an unheard-of price heretofore."

Exercise 1.—*To make a farm-level.*

A cheap but serviceable farm-level can be made as shown in figure 71. It should be 4 or 5 feet high, with a crossbar about 3 feet long. Small glass tubes are tied to the ends of the crossbar and connected by a piece of rubber tubing 4 or 5 feet long. The tubing is filled with water (colored water is better) up to the line A B. When the instrument is set so that the line A B exactly corresponds with the upper edge of

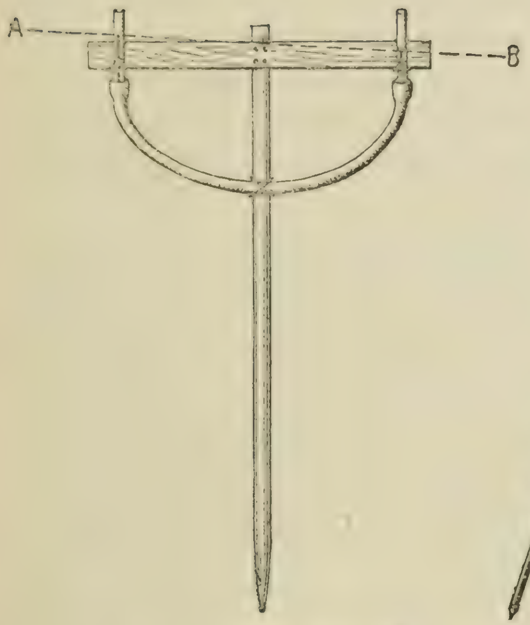


Fig. 71.—A homemade farm-level.

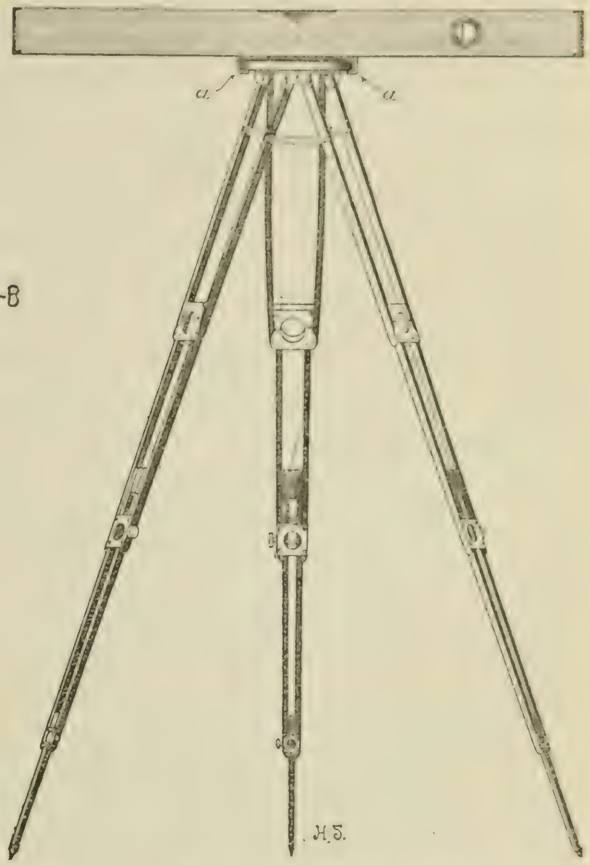


Fig. 72.—A farm-level made with tripod and carpenter's level.

the crossbar, the latter will be level. Such an instrument will cost not over 50 cents, and will be as accurate and nearly as convenient as a farm-level costing $15 to $25.

A more convenient farm-level can be made by fastening a 30-inch carpenter's level, costing about $1.25, to the head of an ordinary camera tripod. Make the fastening by means of two right-angled screw hooks, as shown at *a* in figure 72.

Here, then, is a rural school started as an experiment in adapting school work to country-life conditions. It has good equipment in buildings and land, rather expensive as country schools go, but not beyond the means of any consolidated district embracing within its territory from 20 to 30 square miles of well-improved farm land. It has had financial assistance from outside, but even that would have been unnecessary if the people of the three original school districts could have foreseen the possible advantages of a consolidated agricultural school in better courses of study, more efficient instruction, longer school year, and increased valuation of farm property. During the first year the attendance was considerably greater than the previous combined attendance in the three small schools. This is accounted

for by the fact that many boys attended the consolidated school who had outgrown the district school and gone to work and who either could not go to village or city high schools or were sensitive about going into classes with pupils much younger than themselves. These boys have given emphatic indorsement to the new order of things.

A VILLAGE HIGH SCHOOL.

In Erie County, Pa., surrounded by a good general farming and dairy country, is the village of Waterford, on the outskirts of which is the site of Fort Le Bœuf, of French and Indian war fame. At Waterford the first school in Erie County was established in 1800, and here in 1822 was erected a stone academy building, which is used to-day as the main part of the high-school building. The township of Waterford has a population of 1,460, and about half of these (770) reside in the borough of Waterford. The borough has its own elementary school, but the high school is supported and controlled jointly by the borough and township.

This high school, with its three teachers and three courses of study (language, scientific, and agricultural), has an enrollment of 80 pupils, and 35 of these are in the agricultural course. This course includes agriculture, five hours a week for four years. The work of the first year is devoted to a study of plant life—germination, plant growth, plant food, reproduction, propagation, transplanting, pruning, and uses of plants; the second year to a study of field, orchard, and garden crops; the third year to domestic animals, dairying, and soil physics, and the fourth year to the chemistry of soils and of plant and animal life. Text-books are used in the class room; a small library of agricultural reference books, reports and bulletins of this Department and experiment stations, and agricultural papers contributed by the publishers is in almost constant use, and lectures on agricultural subjects are given before the class and before the whole school by the instructor in agriculture, who is an agricultural college graduate. But the feature of instruction which chiefly distinguishes this agricultural course from the ordinary high-school course is the prominence given to the laboratory work and the outdoor practicum. For the laboratory work there is no elaborate apparatus. The pupils make much of their own apparatus, furnish their own reagent bottles, and, moreover, use them. In the plant-life course the pupils study not elaborate and carefully prepared drawings, but the plants themselves with reference to their life history and economic uses (Pl. XIV, fig. 1).

For the outdoor practicum the school is unfortunate in having neither land nor domestic animals or fowls, and yet it has a wealth of illustrative material all around it. Every good farm within a radius of 3 or 4 miles, nearly every barn and poultry yard in the village, the butcher shops, and the farm implement stores furnish costly

illustrative material and extend vastly the teaching force of the high school. The farmers and other owners of good live stock either bring their animals to the door of the school house to be studied by the class in agriculture (Pl. XIV, fig. 2), or allow the class to go to their barns and fields for this purpose (Pl. XV, fig. 1). It is said to be a rare thing for a good horse to come to the village and get away without being examined by the high-school class in animal husbandry.

The writer was fortunate in being the guest of the school one day last October and in having an opportunity to listen to some of the recitations in agriculture. A class of 14 boys and 6 girls was studying animal husbandry. It had been organized only three or four weeks, and yet the interest manifested and the readiness with which the boys and girls described the beef type, the dairy type, and various breeds of cattle, the mutton and wool types of sheep, the principal breeds of draft horses, and some of the standard-bred roadsters and trotters, were indeed surprising. At the close of the recitation the class was taken to a barn in the village, where several fine roadsters were owned. The owner was not at home, but the teacher had standing permission to take the horses from the barn in order that the class might examine them. A fine Hambletonian mare (Pl. XV, fig. 2) was led into the yard and examined critically by the pupils and criticised by them, the different points being brought out by skillful questioning on the part of the teacher.

From this place the class went to a livery barn where a splendid black Percheron stallion was stabled for the day. A member of the class had discovered the horse as he was being driven in from another town 14 miles away, and following the driver to the barn had got permission for the class to examine him. When the livery barn was reached the driver brought his stallion out into the street, put him through his paces, helped the teacher in calling attention to his good points and the contrasts between the draft type and the roadster type of horses, and allowed us to take several photographs. It was an instructive lesson not only for the members of the agricultural class, but for the score or more of farmers and townsmen who collected around the livery stable. In much the same way the local butcher is an instructor in the high school. The class studying the beef type of cattle, or the mutton sheep, or the different classes of swine is taken to the butcher shop and given a demonstration lesson on cuts and their relative values, which of the breeds are apt to produce the better cuts, which the better quality, and so on.

Thus this little village high school, though it pays only $2,230 a year in salaries and only $370 for other expenses, has a faculty made up of numerous specialists and an equipment in illustrative material such as few technical high schools could afford. And the pupils are being trained in the "elements of failure and success," not only on

"all the farms of the neighborhood," but in the village shops and markets. This is training for efficiency. It is training for culture, for breadth of view, and for sympathy with all that goes to make up the life of the community.

A COUNTY HIGH SCHOOL.

Kansas has local option in the establishment of county high schools. As a result several sparsely settled counties or counties in which there are few large towns are supporting such schools. Norton County, which a few years ago was dotted with sod school houses (Pl. XVI, fig. 1), and which still has many sod dwelling houses, now supports a good county high school in the village of Norton, a town of about 1,500 inhabitants, located near the geographical center of the county. The high-school building (Pl. XVI, fig. 2) is of brick, 2 stories high, over a well-lighted basement, and is located on the outskirts of the village, where land can be easily secured. The basement contains furnace and fuel rooms, lavatories, and a gymnasium. On the first floor is a physics and chemistry room, a natural history room, a music and art room, and the rooms of the business department. The second floor contains an assembly and study room and two recitation rooms. The apparatus and other equipment for the work in physics, chemistry, and natural history are exceptionally good for a small high school. There is also a good library and a reading room with current newspapers and magazines.

The expense of running the school in 1903-4 was $9,588, including $4,430 for teachers' salaries and $5,158 for buildings, grounds, and incidentals. This was a year when considerable sums were spent for furniture, apparatus, supplies, and additional land. The running expenses for the first six months in 1905 were $3,775. Heretofore five teachers have been employed, but this year there are six.

Previous to this year the Norton County High School has offered college preparatory, normal, business, and general science courses, but no courses related in any direct way to the leading industry of the county—farming. The county superintendent of schools said that his attention had been forcibly directed to this lack in the curriculum of the high school by the experience of a young man who came to the school from one of the many large farms in the vicinity, took the four-year business course, spent one year in a local bank at $30 a month, and then concluded that he would gain in both purse and pleasure by going back to the farm. Such a young man, and there are many like him in the Norton County High School, would have welcomed an agricultural course, and would have gone back to the farm much better prepared for the duties of life than he was with a business training. So the county superintendent of schools and the other members of the board of trustees decided that an agricultural course should take the place

FIG. 1.—PLANT-LIFE CLASS AT THE WATERFORD, PA., HIGH SCHOOL.

FIG. 2.—CLASS IN LIVE STOCK JUDGING DAIRY COWS AT THE WATERFORD, PA., HIGH SCHOOL.

FIG. 1.—CLASS IN LIVE STOCK STUDYING SHEEP ON A FARM NEAR WATERFORD, PA.

FIG. 2.—WATERFORD HIGH SCHOOL CLASS IN LIVE STOCK EXAMINING A HAMBLETONIAN MARE.

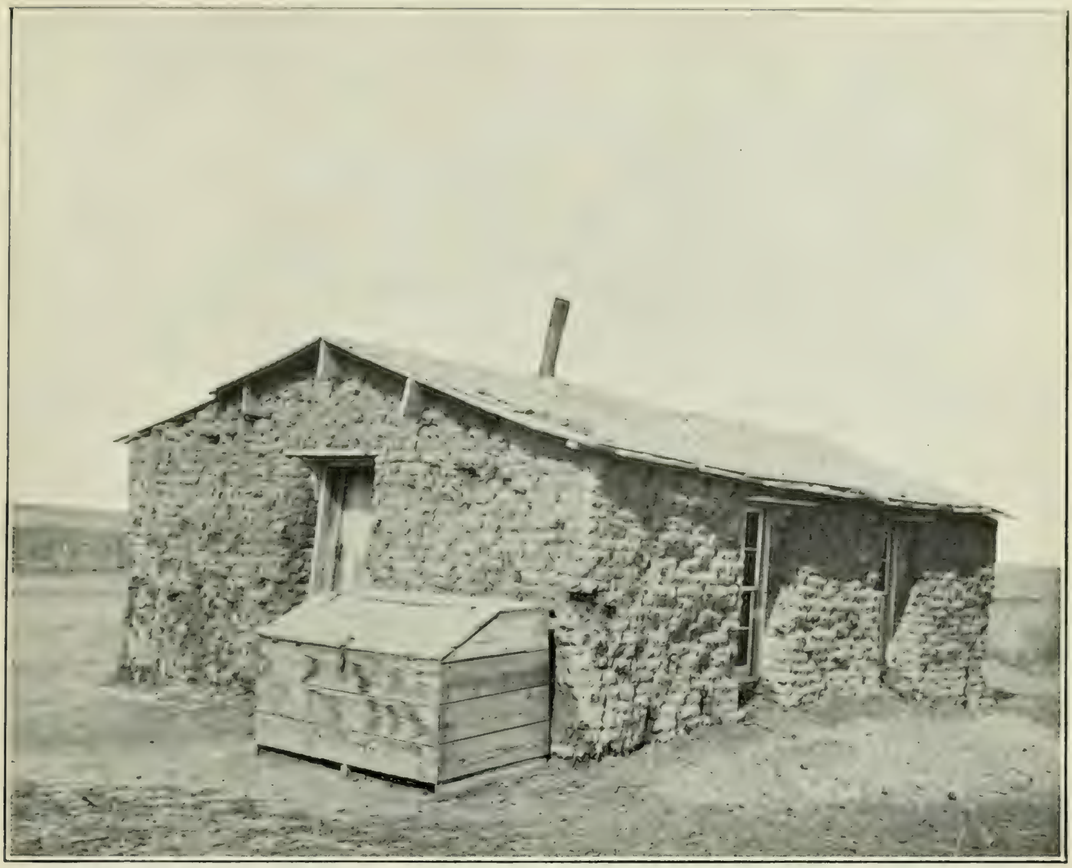


FIG. 1.—THE LAST SOD SCHOOL HOUSE IN NORTON COUNTY, KANS.

FIG. 2.—COUNTY HIGH SCHOOL BUILDING, NORTON, KANS.

of the general science course, and hired a graduate of the Kansas State Agricultural College to teach agriculture and other sciences in the high school. The Secretary of Agriculture, while making a trip through the "short-grass country," learned of the enterprise, became much interested in it, and in response to an appeal for aid sent a representative of the Office of Experiment Stations to Norton to help start it. The president of the Kansas State Agricultural College also responded to a call for assistance and made one of a party of four that toured the county for eight days in the interests of the new course of study. As a result, considerable interest was aroused in the proposed new work, a tentative agricultural course was outlined, and arrangements were made with the three farm implement dealers of the town to open their warehouses to the classes in agriculture and furnish experts to give instruction on the mechanics, care, and use of farm machinery.

The agricultural work of the course will include botany, with special reference to variation, development of species, hybridization, and the influence of light, heat, moisture, etc., on the plant; soils and tillage; plant physiology, farm crops, grain judging, and horticulture; farm accounts; farm management, including farm plans, methods of cropping, farm machinery and its care, and rural economics with special reference to the problems of a business nature that will be met on the farm; animal production and stock judging, and dairying. The teacher of agriculture reports that the implement dealers have given further evidence of their interest in the agricultural course by offering prizes aggregating $112 in value for a grain-judging contest, open to all young men in the county, and that these prizes have been supplemented by a $15 suit of clothes from a clothing dealer. Continuing, he says: "I am well pleased with the way the boys take hold of the work. Out of 70 boys we have 9 enrolled in the agricultural course, and I think most of the first-year boys will take it up when they get to it in the course. It is proving popular in the school and entirely free from the prejudice I had anticipated at the outset."

This is the nucleus of an important experiment in education. Norton is just in the edge of the great semiarid region of the Middle West. Agricultural practice in that region differs materially from that of the more humid regions on the one hand and from that of the irrigated districts on the other. The teacher of agriculture is thoroughly familiar with the agriculture of the region, and has but recently graduated from an agricultural college which is devoting much study to the problems of the hundredth meridian belt. The agriculture of this belt is extensive. Here one man works as much land as four or five men in the East; he cultivates three rows of corn at one crossing of the field, and does other things on an equally extensive scale. Improved farm machinery makes this method of farming possible. It

is therefore of the greatest importance that much attention to farm machinery be given in the agricultural course at the Norton County High School. The cereals (corn and wheat) are the leading field crops, hence the importance of grain-judging contests and other school work relating to these great staples.

The county superintendent of schools has expressed the hope that the school may also do much work that will be of immediate practical benefit to the agriculture of the county, such as testing seeds for viability, or germinating power (exercise 2), and milk and cream for butter fat; treating oats and wheat for smut and potatoes for scab; spraying trees and garden crops for insect pests and diseases, and making plans for farm buildings, roads, water systems, etc. Such work could be done largely by the pupils at school or on the different farms on Saturdays. It would be educational and at the same time would make the farmers feel that they were getting some immediate tangible return for the taxes paid in support of the school.

EXERCISE 2.—*Germination test of seeds.*

Count out 50 or 100 seeds of the kind to be tested[a] and place them in a plate between two folds of moistened canton flannel or thin blotting paper (fig. 73). On a slip of white paper record the variety, number of seeds, and the date, then place it on the edge of the plate. Cover the whole with another plate or a pane of glass to prevent too rapid evaporation of moisture. Set the plate in a warm room (68° to 86° F.) and examine the seeds every twenty-four hours for six or eight days.[b] If they get too dry add enough water to moisten, not saturate, the cloth or blotting paper. At the end of the test count the sprouted seeds and from them determine what percentage of the whole number of seeds are good. With large seeds no difficulty will be experienced in using the folds of canton flannel, but with small seeds the blotting paper is better.

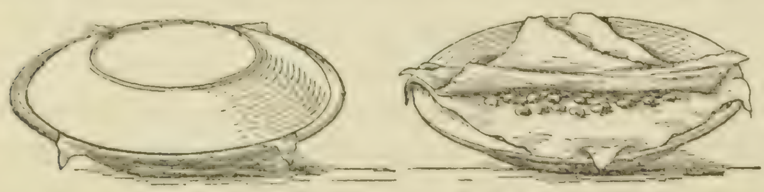


FIG. 73.—Seed-testing device.

Another seed tester (fig. 74) is made by inverting a small tin basin (*b*) in a larger basin (*a*) and covering the small basin with a piece of clean cloth large enough to dip into the water (*c*) at each end. Place seeds on the cloth and cover with another cloth as shown at *d*, *e*. How does moisture get to the seeds?

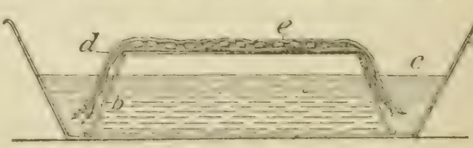


FIG. 74.—Another seed-testing device.

[a] In official germination tests 100 seeds are used of peas, beans, corn, and other seeds of similar size, and 200 seeds of clover, timothy, cabbage, wheat, and other small seeds.

[b] For most seeds six days are enough for the test, but beets, buckwheat, cotton, cowpeas, onions, redtop, tomatoes, and watermelons should be allowed to remain eight days; salsify and spinach ten days; carrots, celery, parsnips, and tobacco fourteen days, and bluegrass and parsley twenty-eight days.

LABORATORY EXERCISES.

The schools just described are utilizing illustrative material in the best possible way. They are making use of the actual experiences and business of the communities. There is no make-believe about it. Some of the principles of agriculture, however, do not lend themselves so readily to illustration in this manner. There is need of some laboratory work which can best be performed indoors with specially prepared apparatus. But much of the material for this apparatus is so inexpensive and many of the exercises are so simple that even the untrained teacher in the one-room rural school need have no hesitation in undertaking such work.

MATERIALS NEEDED.

Two dozen empty tomato cans, three or four lard pails, a few baking-powder cans and covers, a lot of empty bottles, a few small wooden boxes, a collection of typical soils (clay, sand, loam, and muck or peat), and a few seeds of garden and farm crops will enable the teacher and pupils to perform a variety of experiments illustrating important principles upon which the science and practice of agriculture are based, and will not cost a cent. If to this material the school board or the pupils will add by purchase an 8-ounce glass graduate (10 cents), 4 dairy thermometers (60 cents), 6 student-lamp chimneys (30 cents), 100 5-inch filter papers (15 cents), a pint glass funnel (10 cents), a 4-bottle Babcock milk tester with test bottles, pipette acid measure and acid ($5), an alcohol lamp (25 cents), a kitchen scale with dial which will weigh from 1 ounce to 24 pounds (90 cents), 12 ordinary glass tumblers (30 to 50 cents), a small quantity of litmus paper, and a few ordinary plates, pie tins, etc., the school will be provided with an excellent equipment for laboratory exercises, and all at a cost of less than $10.

PHYSICAL CHARACTERISTICS OF SOILS.

With this material in the hands of the pupils and a teacher willing to experiment and learn with the pupils the ordinary rural schoolroom becomes a laboratory in which it is possible to determine the comparative temperature, weight, acidity, porosity (exercise 3), capillarity (exercise 4), and fertility of different soils; to test their water-holding capacity and the readiness with which they may be drained, and to show the effects of cultivation, mulching, and puddling on the moisture content and physical condition of different soils. As far as the training of the pupils in mathematics will permit, the results obtained in the laboratory exercises should be translated to field conditions, and the importance of the principles involved should be brought out by questions concerning their application to the practical operations of farming.

EXERCISE 3.—*Porosity—the capacity of soils to take in rainfall.*

Break the bottoms off 5 long-necked bottles,[a] tie a small piece of cheese cloth or thin muslin over the mouth of each and arrange them in a rack with a glass tumbler under each, as shown in figure 75. Fill the bottles to about the same height with different kinds of soil—gravel in one, sand in another, etc., and firm the soils by lifting the rack and jarring it down moderately three or four times. Now, with watch or clock at hand, and with a glass of water held as near as possible to the soil, pour water into one of the bottles just rapidly enough to keep the surface of the soil covered and note how long before it begins dropping into the tumbler below. Make a record of the time. Do likewise with each of the other bottles and compare results. Which soil takes in water most rapidly? Which is the most porous? What happens to the less porous soils when a heavy shower of rain comes? How can a soil be made more porous? Repeat the experiment with one of the soils, packing the soil tightly in one bottle and leaving it loose in the other. What is the effect of packing? Does this have any bearing on farm practice?

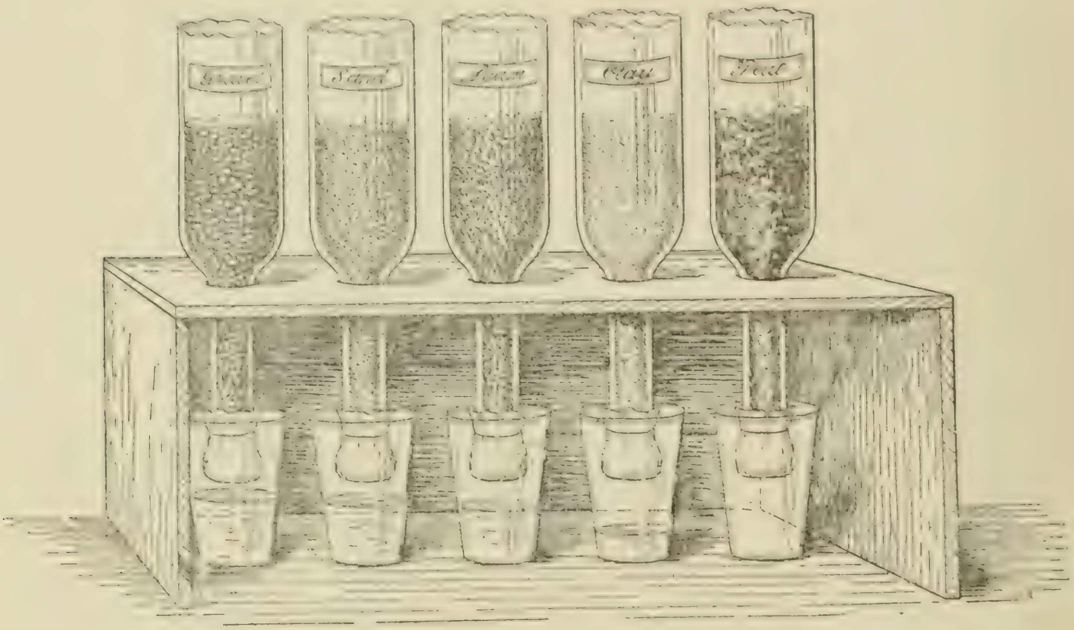


FIG. 75—Apparatus to test the capacity of soils to take in rainfall.

Which soil has the greatest capacity for water—that is, which could take in the heaviest shower? This can be determined from the above experiment by emptying and replacing each tumbler as soon as all free water has disappeared from the upper surface of the soil above it. After water has ceased dripping from all the bottles measure and compare the water in the different tumblers. Which soil continued dripping longest? Which would drain most readily?

Which soil would store up the greatest amount of moisture for the use of plants? This can be determined from the same experiment by weighing each bottle before and after filling it with dry soil, and again after water has entirely ceased dripping from it. The difference between the weight of the dry soil and that of the wet soil is the weight of water stored. During the time that the bottles are dripping, which may take several days, they should be covered to prevent evaporation of water from the surface of the soils.

Make other practical applications of the principles brought out in this exercise.

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[a] To break the bottom off a bottle file a groove in the bottle parallel with the bottom. Heat a poker red hot and lay it in the groove. As soon as a small crack starts from the groove draw the poker around the bottle and the crack will follow.

EXERCISE 4.—*Capillarity—the power of soils to take up moisture from below.*

Arrange 4 or 5 student-lamp chimneys, as shown in figure 76, and tie cheese cloth or thin muslin over their lower ends. Fill each with a different kind of dry soil, as in exercise 3. Pour water into the pan beneath until it stands about half an inch above the lower end of the chimneys, then observe the rise of water in the different soils. Make notes on the height to which the water rises, and on the time it takes. In which soil does the water rise most rapidly; in which to the greatest height? Which soil draws up the greatest amount of water? How can this be determined? This power of soils to raise water from below is called capillarity. It is an important function, for by it plants are able to get moisture and plant food from the subsoil in times of drought.

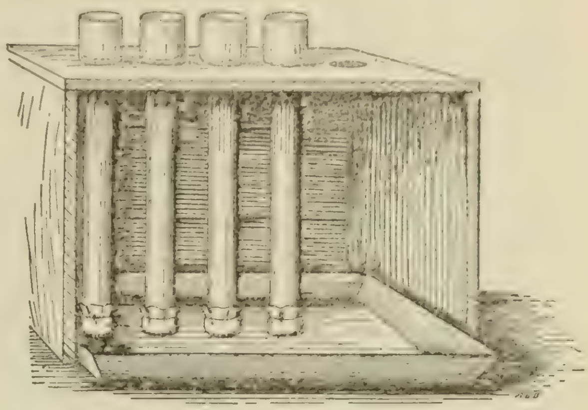

FIG. 76—Apparatus to test the power of soils to take up moisture from below.

If chimneys are not to be had, this experiment can be performed with the apparatus shown in figure 75 by substituting the pan for the tumblers; or the experiments performed with the bottles can be performed with the chimneys and tumblers.

If more accurate tests of capillarity are desired it will be necessary to procure a series of glass tubes at least 3 feet high, for in some soils water will rise to that height, or even higher.

RELATION OF SOILS TO PLANTS.

It will be perfectly feasible also to arrange exercises showing the relation of the physical characteristics of soils to plant growth—that plants need moisture in the soil; that they take up this moisture (exercise 5) and give off a part of it through their leaves (exercise 6); how much moisture is taken from the soil by a given plant; that too much moisture is injurious to plants; how the root hairs of plants absorb moisture; the best depth at which to plant different seeds in different soils (exercise 7); the effect of cultivation on plant growth, and a dozen other things important for the farmer to know and interesting as experiments for school children.

Seed testing has already been referred to. It is highly important that farmers should know that they plant good seed in order that all of the land they plow, plant, and cultivate may at least have a chance to make some return for the labor bestowed upon it. It is estimated that in the summer of 1905 the farmers of Iowa increased their corn crop several million bushels merely by giving better attention to the quality of seed planted. It would not be a difficult matter to teach every boy in school the process of testing seed, nor to impress upon him the practical importance of this work. Testing the viability of seeds would lead naturally to other studies in propagation, such as

making hard and soft cuttings, layering, grafting, and budding, all of which are clearly described in bulletins of this Department and in other publications which teachers can procure without cost.

EXERCISE 5.—*To show that plants absorb moisture from the soil.*

Thoroughly pulverize and sift enough good garden soil to fill two flower pots of the same size. To get the same amount of soil into each pot it should previously be weighed or carefully measured. Plant several kernels of corn in one pot, water both, and set them aside for the corn to grow. Whenever water is applied to the pot containing the corn an equal amount should be applied to the other pot, in order that both soils may be packed alike. When the corn is 2 or 3 inches high get two lard pails just large enough to take in the pots to their rims, as shown in figure 77. Mark on the outside of the pails the depth to which the pots will extend on the inside, and at a point 1 inch above each mark make a dent which can be distinctly seen on the inside of the pail. Now fill each pail with water up to the dent, water both pots thoroughly, and set them in the pails as shown in the figure. Set both pails and pots in a warm, light place so that the corn will continue to grow. The next day remove the pots, and you will probably find that the water is not up to the dents. What has become of it? From a previous experiment you will probably conclude that the soil has taken it up. From an 8-ounce graduate pour into one pail just enough water to bring it up to the dent again. Make a record of the amount necessary to do this. Fill the graduate and bring the water in the other pail up to the dent. Again record the amount of water used. Repeat these operations daily for two or three weeks. Find the total amount of water added to each pail. You will probably find that the pot containing the corn has taken up considerably more water than the other pot. Why? Was there any place for the water to escape except through the soil and the corn? How much water did the corn use? What became of this water? The next exercise will show what became of a part of it.

FIG. 77.—To show that plants absorb moisture from the soil.

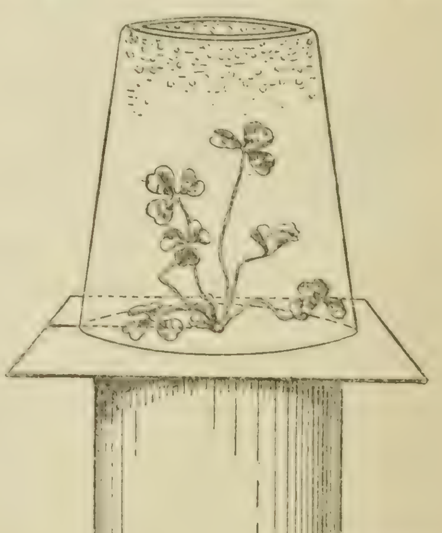

FIG. 78.—To show that plants give off a part of the moisture absorbed from the soil.

Exercise 6.—*To show that plants give off moisture.*

Take a plant that is well started in a tomato can or flower pot, a piece of cardboard, and a glass tumbler or jar large enough to cover the plant. Cut a slit in the cardboard and draw it around the plant as shown in figure 78. Seal the slit with pitch, wax, or tallow so that no moisture can come up through it from below; cover the plant with the glass and set it in a warm, sunny place. Moisture will condense on the inner surface of the glass. Where does it come from? Is all the moisture absorbed by the roots given off in this way? How can you find out? Why do plants need water?

Exercise 7.—*Depth of planting.*

To determine the best depth at which to plant corn take an olive bottle about 8 inches high, or other similar glass vessel. Fill it with garden soil to a height of 5 or 6 inches from the top, put in a kernel of corn flat against the side of the bottle, put in another inch of soil, then another kernel of corn, and so on until the bottle is full, arranging the kernels spirally as shown in figure 79. Moisten the soil, wrap the bottle up to the neck in black paper or cloth, and set it in a warm place. Prepare other bottles in the same way, but plant in them beans, peas, and some small seeds, such as those of radishes, onions, and lettuce. By taking off the wrappings and looking at the seeds daily you can not only determine the best depth at which to plant different seeds, but make many interesting observations regarding the rate of germination, how the little plants push out of the ground, whether they take the seeds up with them or leave them behind, etc. Take careful notes and try to determine whether large or small seeds should be planted deeper, whether the roots or the little plants are formed first, whether the plants ever start down or the roots up.

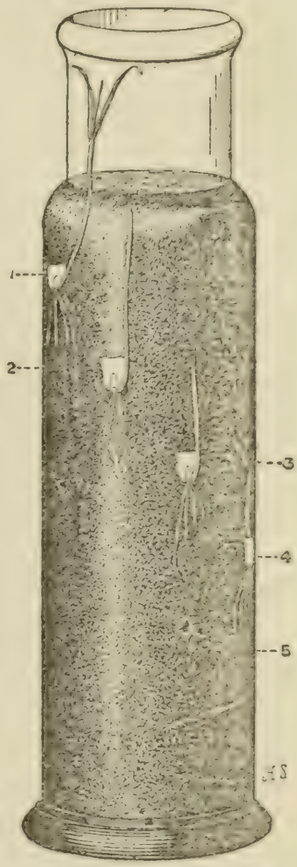

Fig. 79.—To show the best depth at which to plant corn.

STUDIES OF MILK.

The extent to which milk enters into the regular diet of a large percentage of the inhabitants of both urban and rural communities renders it almost imperative that some instruction concerning the importance of sanitary methods of handling milk be given in the public schools. In rural districts a number of inexpensive and simple experiments could be arranged to show the effect of different methods of milking, cooling, aerating, bottling, shipping, and other processes in the handling of milk upon its purity, flavor, odor, and keeping qualities (exercise 8). If the school is provided with a Babcock milk tester, the pupils could determine the relative value of different cows for the production of cream and butter, also the relative efficiency of different methods of separating cream from the rest of the milk.

EXERCISE 8.—*To show the effect of cleanliness on the keeping quality of milk.*

Provide one of the boys with two pint bottles which have been cleaned thoroughly, scalded, and plugged with clean cotton batting (absorbent cotton is better), and instruct him as follows: Take the bottles home and at milking time select a cow which has stood in the stable several hours and has not been cleaned. Milk a quart or two of milk into a pail in the usual way and set it aside. Then clean the sides and udder of the cow by first brushing and then wiping with a damp cloth. Wash the hands thoroughly, remove the cotton plug from one of the bottles, fill the bottle to the neck by milking directly into it, and immediately replace the cotton plug. Mark this bottle A. Now carry the milk in the pail to the milk room, strain it in the usual way, and from it fill the other bottle, removing and replacing the cotton plug as before. Mark this bottle B. Set both bottles over night in the room where the milk is usually kept, and the next morning bring them to school. Remove the plugs and note whether any bad odor has developed in either bottle. Pour a small quantity of milk out of each bottle and replace the plugs. Taste the samples. Is there any bad flavor? Test them with litmus paper to see if either is getting sour. Set the bottles in a moderately cool place, and examine them as above, morning and evening, for several days, making notes on any changes that take place in either. Does cleanliness have any effect on odor? On flavor? On acid formation?

Repeat this experiment, cooling bottle A immediately after filling and treating B as before. Does cooling affect the keeping quality of milk?

By keeping accurate temperature records and careful notes on changes occurring under different conditions, the above exercise may be made to yield quite accurate data regarding the proper methods of handling milk.

AGRICULTURE AN AID TO OTHER SCHOOL WORK.

Agriculture taught in this way, that is, supplemented and illustrated by numerous outdoor observations and laboratory exercises, will prove not only an interesting and instructive study in itself, but also an aid in teaching other subjects. What more efficient method of enforcing and fixing in the minds of the pupils the fundamental operations in arithmetic than by the frequent use of these operations in solving problems in their everyday life and work? The tables of weights and measures will be in constant use and the principles of percentage and proportion will enter into the solution of nearly every problem in soils. Composition will lose some of its bad flavor, and spelling be no longer distasteful when applied to the description of experiments in which the pupils are interested. Manual training will find its place in the making of boxes, labels, farm-levels, and other appliances used in the experiments. Some of the principles of botany, physics, and chemistry will be learned and applied in the experiments with soils, plants, and milk. And all of the work will leave a more lasting impression because concrete; more interesting because connected with the life and occupation of the pupils.

An educator who has had nearly five years' experience teaching in ungraded rural schools relates that as he now looks back upon that experience the nearest approach to satisfaction that he can feel is in

contemplation of a winter term's work in a country school having an enrollment of about 65 pupils, ranging in age from 5 to 20 years. He conducted between 25 and 30 recitations a day, played with the pupils during recess, drilled a company of boys in military tactics at noon, and yet found time nearly every day for a simple experiment or demonstration in physics or chemistry. Neither of these subjects was taught regularly in the school, but the exercises were introduced to illustrate the principles governing some of the common elements, such as oxygen, hydrogen, nitrogen, phosphorus, and potassium, in some of the combinations in which they are found in water, pure air and foul, plant and animal tissue, and other things affecting the everyday life and experience of the pupils. Teacher and pupils extinguished lighted candles by pouring carbon dioxid over them, made hydrogen guns, burned picture wire in oxygen, and performed other experiments which not only were interesting enough to make the teacher forget his troubles and the pupils their mischief-making, but made lasting impressions concerning the principles illustrated. The teacher was recently told by two of his former pupils that the one feature of school work that winter which they recalled clearly was the "experiments."

That was fourteen years ago, when educators in the North Central States were giving little heed to the needs of the rural schools. The teacher had spent two and a half years in an agricultural college, but had never heard or dreamed of such a thing as teaching agriculture in country schools. There were no elementary text-books of agriculture, no bulletins containing laboratory exercises carefully prepared for the use of country teachers, no normal schools where teachers could be trained in country-life subjects, no encouraging words from school superintendents, teachers' journals, or even the agricultural press.

Now a wonderful change has come over the aspect of country life and over the attitude of educators toward rural education. The State superintendents of schools consider it their highest duty to minister to the welfare and progress of the rural schools; State legislatures are providing special normal schools for country teachers; the older normal schools are offering courses in country-life subjects; the State agricultural colleges are aiding the normal schools by giving short courses for teachers, and their experts are preparing text-books, bulletins, and other reading matter on nature study and agriculture for the rural schools; teachers' associations and farmers' organizations are giving much discussion to these matters, and the school journals and agricultural papers are almost unanimous in their support of the movement for better rural schools and more instruction related to the environment of the pupils in these schools. With such encouragement and such assistance no teacher imbued with the spirit of progress, who is willing to do a little more than the contract calls for, and who is brave

enough to say to the pupils, "I don't know, but I'll work with you to find out," need have any hesitation about undertaking some features of the work alluded to in this article. Such teachers may feel assured that their efforts will not be passed over without recognition. There may be no immediate call to "come up higher," though intelligent and unselfish devotion to study is seldom without its pecuniary reward; but there will be a never-failing reward in feeling and knowing that better work has been done in preparing the children to meet the duties of life.

NEW FRUIT PRODUCTIONS OF THE DEPARTMENT OF AGRICULTURE.[a]

By Herbert J. Webber,

Physiologist in Charge of Plant Breeding Investigations, Bureau of Plant Industry.

Caution Necessary in Planting New Varieties.

The new fruits resulting from the Department's experiments possess interesting and apparently valuable characters, so far as can be judged by limited experimental tests. It is clearly impossible or at least impracticable for the Department to test these plants commercially under all conditions of soil and climate, and it is possible and indeed probable that some of the new plants may prove disappointing. Growers are therefore cautioned against planting new varieties extensively until they have been thoroughly tested and their full commercial value has been determined.

Every experienced horticulturist knows how difficult it is to predict what a new variety will do, and how frequently very promising sorts fail to fulfill the expectations concerning them in extensive commercial planting. The Drake Star orange forms a good illustration of this sort. This variety originated as an accidental seedling at Drakes Point, on the south shore of Lake Harris, near Yalaha, Fla. It was found to possess merit as a late orange, and was extensively budded on sour stocks at the place of its origin, many of the stocks, if the writer is correctly informed, being wild hammock orange trees. Yalaha is situated on very excellent hammock land, and there the Drake Star, budded on a fairly large scale, proved a very excellent late orange and at the same time prolific. It possessed a distinctive character of tree and fruit, differing markedly from other varieties, and this was much in its favor. The variety gradually grew into local prominence, and

[a] For the 1904 Yearbook the writer, in conjunction with Mr. Walter T. Swingle, prepared a paper on "New Citrus Creations of the Department of Agriculture," in which were described five new varieties or clons, namely, the Rusk and Willits citranges, the Sampson tangelo, and the Weshart and Trimble tangerines. Thanks are due Prof. P. H. Rolfs, Mr. H. C. Henricksen, and P. J. Wester, of the Department's subtropical garden at Miami, Fla., for valuable aid in the experiments; also to Mr. J. B. Norton and Mrs. L. H. Webber for assistance in testing the fruits and making the necessary notes.

was budded extensively, particularly in the high pine land regions of Lake County. Outside of its native hammock, however, it proved very disappointing, being an exceedingly shy bearer, and thousands of trees of this variety after eight or ten years' trial were budded over to other sorts. The Drake Star was mainly budded on sour orange and sweet orange stocks, and this may have been partially responsible for its failure. The writer has seen a few trees on rough lemon stock in high pine-land regions bearing heavily, and it is possible that if all of the trees had been budded on this stock the loss might have been prevented.

In the present paper there will be described one new citrange or hardy orange, two new limes, and five new pineapples.

THE MORTON CITRANGE.

[PLATES XVII AND XVIII.]

Name and origin.—In the last Yearbook of the Department an outline was given of the work which had been conducted up to that time in the production of hardy types of citrus fruits, and two new hardy sorts, the Rusk and Willits citranges, were described.[a] Since that time further hybrids have fruited, and one apparently very excellent sort has been secured. This new citrange has, with the consent of the Secretary, been named the *Morton*, in recognition of the valuable services to agriculture of the late Hon. J. Sterling Morton.

This very remarkable hybrid (No. 771), which in fruit characters closely resembles an ordinary orange, is nearly related to the Willits citrange (hybrid No. 777), having developed from another seed of the same hybrid fruit. The original fruit from which this hybrid developed was a cross of the trifoliate orange with pollen of the sweet orange, the pollination being made by Mr. Swingle in the grove of Col. G. H. Norton, at Eustis, Fla. This crossed fruit gave 40 seedlings, of which 11 exhibited clearly intermediate characters of foliage, showing that they were true hybrids, while the other 29 showed no indications of hybridization.

Description of fruit and tree.—Fruit slightly compressed, spherical or nearly so; large, from 3 to $3\frac{1}{2}$ inches in diameter and from $2\frac{7}{8}$ to $3\frac{1}{4}$ inches in height; color rather light orange yellow, similar to the Willits citrange; surface smooth or slightly roughened by small depressions over some of the large oil glands, this roughening being most pronounced at the base of the fruit, and with a few slight furrows running from base to apex, giving the fruit a slightly lobed appearance; weight medium, from 9 to 11 ounces, somewhat lighter than water; calyx persistent but inconspicuous, as in the case of the ordinary orange; rind medium thin, $\frac{1}{8}$ to $\frac{3}{16}$ inch in thickness, tender, not adhering so close to fruit as in the Rusk citrange, with some flavor

[a] New Citrus Creations of the Department of Agriculture, Yearbook, 1904, pp. 223–235.

THE MORTON CITRANGE. NATURAL SIZE.

(From a painting by Miss D. G. Passmore.)

THE MORTON CITRANGE. NATURAL SIZE.

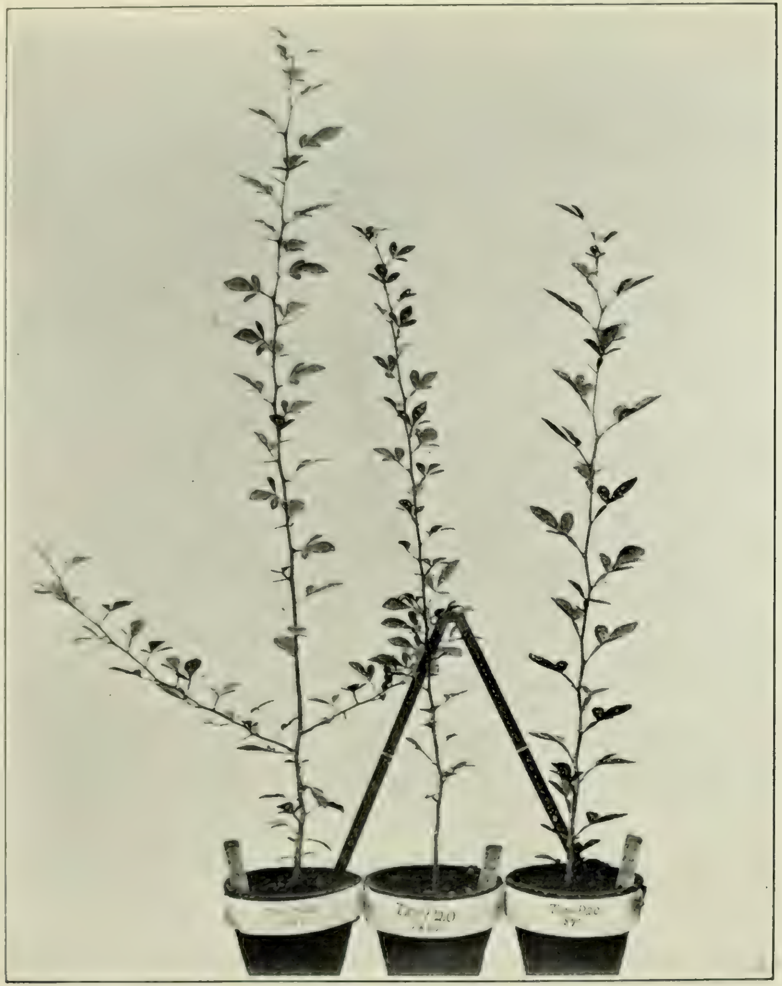

FIG. 1.—SEEDLING HYBRIDS OF TRIFOLIATE ORANGE CROSSED WITH POLLEN OF THE COMMON ORANGE.

[Seedling on the right, the Morton (No. 771). Seedling in the center, a false hybrid, thus a true trifoliate orange. Seedling on the left, a true hybrid (No. 783).]

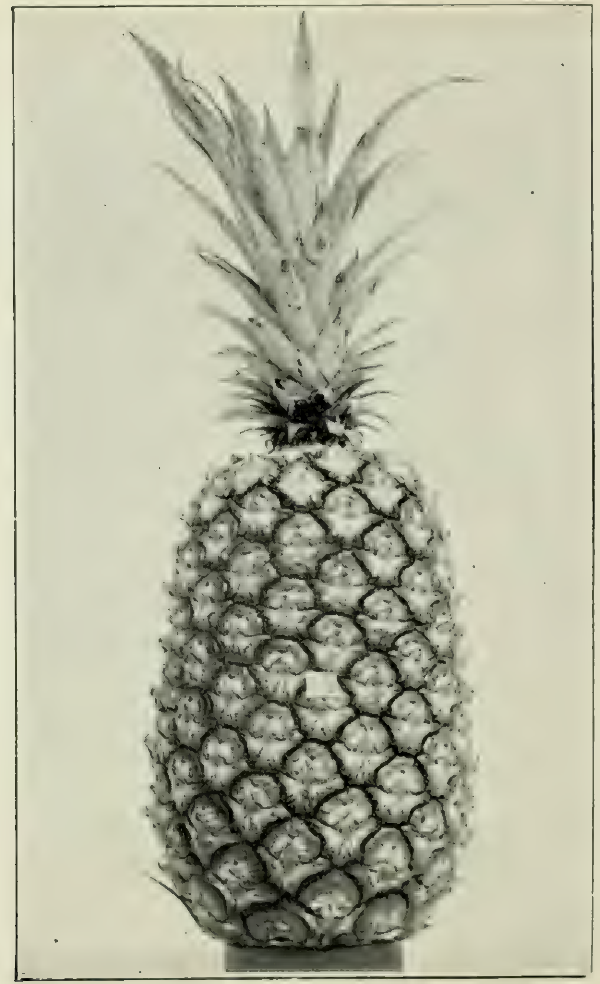

FIG. 2.—THE MIAMI PINEAPPLE. ONE-FOURTH NATURAL SIZE.

of orange and some of trifoliate, no more disagreeable to taste than skin of ordinary orange; oil glands similar in size to those of ordinary orange, mainly round (fig. 80*a*); pulp translucent, light orange yellow; pulp vesicles longer and smaller in diameter than in ordinary orange (fig. 80, *b* and *c*); tender; segments 9 to 10, separating membranes rather thicker and firmer than in ordinary orange, with very slight suggestion of the trifoliate orange bitterness; texture of fruit tender; axis small, ¼ to $\frac{5}{16}$ inch in diameter; flavor sprightly acid, with a peculiar but pleasant taste, sweeter than either the Rusk or Willits citrange and less bitter; seedless, or nearly so; aroma pleasant, but very light, suggesting both the common and trifoliate orange. Trees similar to trifoliate orange, vigorous and hardy, evergreen or semi-evergreen, medium height, shapely; leaves trifoliolate, but larger than those of ordinary trifoliate orange. Season of maturity medium early—from first of October to last of November.

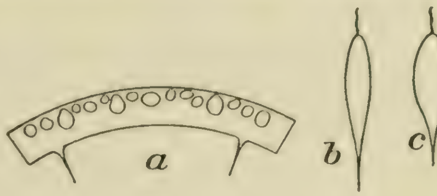

FIG. 80.—*a*, Section of the skin of Morton citrange, showing oil glands; *b*, pulp vesicles of Morton citrange; *c*, pulp vesicles of ordinary orange. (Natural size.)

The tree of the Morton citrange is a vigorous grower, of attractive appearance. The leaves are nearly twice as large as those of the trifoliate orange, as will be seen by an examination of Plate XIX, figure 1. Here the seedling on the right is the Morton citrange (No. 771), while that in the center (No. 780) is a false hybrid seedling of the same age, showing no influence of the hybridization, being thus a true trifoliate orange. The seedling on the left (No. 783) is another true hybrid similar to the Morton citrange. While No. 783 is almost exactly the same in all foliage and tree characters as No. 771 (the Morton), it produces an entirely different fruit, which, while differing greatly from the trifoliate orange fruit, is nevertheless small and of rather inferior quality in comparison to the Morton citrange.

While most of the fruits of the Morton citrange that have been produced up to the present time have been entirely seedless, a few seeds and rudiments occur in some fruits. It is probable that the variety, when extensively grown, will produce few seeds.

RESISTANCE TO COLD.—The hardiness or cold-resistant quality of the Morton citrange has not been thoroughly tested, but it is apparently about the same in this respect as the Rusk and Willits citranges. It has endured all of the winters at Glen St. Mary, Fla., since the spring of 1899 without losing its leaves. During this period severe freezes have occurred, which were very disastrous to the orange industry even much farther south. In January of 1900, when the buds were about eight months old, thus being young and tender, they endured a temperature between 15° and 18° F. without noticeable effect. Since this time these trees and others under test at the experiment station at Lake City, Fla., have frequently withstood temperatures which would have seriously injured the ordinary orange.

At the Georgia Experiment Station, located at Experiment, Ga., a set of the Department's hardy orange hybrids have been tested under

the direction of Director R. J. Redding and Prof. H. N. Starnes. Here the Morton citrange (No. 771) has withstood the winters, although the temperature fell in February, 1901, to 17° F. and in December, 1901, to 8° F. At the Alabama Experiment Station, where trees of this hybrid were also sent for testing, a temperature of about 9° F. was experienced in December, 1901. The trees of the Morton citrange at this station are reported dead, but it is not clear whether their death is to be attributed directly to the cold. At this station other intermediate hybrids of apparently similar hardiness have withstood all winters and are still alive. It is believed from the evidence accumulated that the Morton citrange can be grown safely without protection throughout the greater parts of Georgia, Alabama, Mississippi, Louisiana, Florida, California, and eastern and southern Texas. With some protection during severe cold spells, while the trees are small, it can probably be grown in South Carolina and in southern Tennessee and Arkansas. It can probably also be grown in regions of low altitude in Arizona and New Mexico and near the coast in Oregon and Washington. In any region which is only slightly too cold for the ordinary orange the Morton citrange can be expected to grow without danger of freezing.

Uses.—The fruit of the Morton citrange is so similar to an ordinary orange that the two would not be distinguished by an ordinary observer. The former differs from the latter only in being slightly lighter in color and having a slight indication of lobing. This does not detract from its appearance, which is equal to that of a good ordinary orange. The fruit has been tested by several different persons familiar with oranges and the orange industry, and all, without exception, considering its hardiness, pronounce it a very valuable and desirable fruit. It is more sour than the ordinary sweet orange, but some so-called sweet oranges are sold in the market which are as sour as the Morton citrange. It has a pleasant characteristic flavor, with very slight bitter taste, and served with sugar it will be found to be a good breakfast fruit. The rather firm membranes separating the segments allow the pulp to be easily extracted with a spoon. It makes an attractive citrangeade, similar to lemonade or limeade, but is probably no better for this purpose than the Rusk or Willits citranges.

It is believed that this fruit will prove of great value for cultivation in the sections previously mentioned, and that it will find a permanent place in the local southern markets and possibly also in northern markets. For eating purposes and as a dessert fruit it is much superior to the Rusk or the Willits citrange.

New Limes.

In the course of the Department's experiments the lime and lemon, which are supposed to be closely related, were several times crossed, with no definite aim in view other than to determine the nature of the product that might be expected from such crosses. For similar reasons the lime in one instance was crossed with the pomelo, the two parents here being quite widely distinct species.

A number of the hybrids resulting from such crosses have now fruited and are found to possess some interesting variations. Here, as in the case of certain other citrus crosses which have been described previously,[a] the effect of the hybridization is only shown in a comparatively small number of the resulting seedlings. In some crosses of the lime with pollen of the lemon, for instance, the great majority of the seedlings show nothing but pure lime characters. Out of 18 hybrids of West Indian lime with pollen of Sicily lemon 16 of the seedlings show only lime characters, while 2 show by their foliage a true effect of the hybridization. Neither of these true hybrids has fruited, but the majority of the 16 false hybrids which show no effect of the hybridization have fruited.

It is only within the last seven or eight years that the lime has become an important commercial fruit, and this has resulted from the use of limes at soda fountains, principally in making limeade. Previous to this time the lime was grown in all tropical and subtropical countries for home consumption, and was cultivated extensively in a few places for the manufacture of the commercial article known as "lime juice." No commercial culture existed, however, in the United States. Since limes have come to be used at the soda fountains there has grown up a considerable demand for these fruits, and this demand has been largely supplied from plantations in southern Florida. The trees cultivated are mainly seedlings and of unknown qualities. Some give large fruits, some small fruits; some are very seedy and others are nearly seedless; some are early and others late in season. Some markets have come to demand small fruits, and in other cases large fruits are more in demand. Very few varieties have been introduced and named, and there is thus little selection of varieties possible at the present time. Under these conditions it seems desirable to have good fruits of known qualities named, so that growers may know what they are planting. Some of the hybrids between the West Indian lime and Sicily lemon, which are true limes in all characters, are excellent fruits, and, while other seedling limes can doubtless be found among the plantations in southern Florida which are just as good as these, it

[a] Webber, H. J., and Swingle, W. T., Yearbook of the Department of Agriculture, 1904, pp. 226–227.

is thought desirable to name two of them which are believed to possess characters of merit.

One of the hybrids selected gives uniformly a small fruit, while the other has a rather large fruit for a lime, approaching the size of an ordinary lemon.

THE PALMETTO LIME.

[PLATE XX, FIGURE 1.]

NAME AND ORIGIN.—The smaller of the two limes referred to has been named the *Palmetto*, and is a hybrid of West Indian lime with pollen of the Sicily lemon. The original seedling has been grown, fruited, and tested in the Subtropical Garden at Miami, Fla. The original hybridized lime fruit from which the seedling developed produced only three seedlings (Nos. 931–933), one of which was small and ultimately died; both of the others have fruited and are very similar to each other, the two being the smallest fruited limes which have thus far been produced in the Department's experiments. No. 931 had fruits in 1905 which had an average weight of 1.21 ounces, with an average water displacement per fruit of 36.2 c. c. The fruits of No. 933, the Palmetto, in the same season had an average weight of 1.16 ounces and an average water displacement per fruit of 33.2 c. c., being somewhat smaller than No. 931.

DESCRIPTION OF FRUIT AND TREE.—Fruit elliptical or nearly round, with small apical nipple, having the form and appearance of an ordinary lime; size small, from $1\frac{3}{8}$ to $1\frac{1}{2}$ inches in diameter and from $1\frac{3}{8}$ to $1\frac{11}{16}$ inches in height; average weight per fruit about 1.16 ounces; average water displacement per fruit 33.2 c. c.; color light yellow, like ordinary lime; surface smooth and attractive; rind very thin, less than $\frac{1}{16}$ of an inch; segments from 8 to 10; membranes tender; axis small, $\frac{3}{16}$ to $\frac{1}{4}$ inch in diameter; pulp tender, very juicy, light greenish color, like ordinary lime; seeds few, from 3 to 6; quality and texture excellent; flavor a sprightly acid of excellent bouquet; tree of spreading bushy habit, vigorous and prolific, bearing the greater part of the fruit near the exterior; foliage, branching, and shape of tree like that of ordinary lime; season of maturing, early.

The fruits of the Palmetto lime are of particularly fine appearance, running very uniformly of about the same size. This variety will prove especially desirable for those markets that demand a small fruit.

THE EVERGLADE LIME.

[PLATE XX, FIGURE 2.]

NAME AND ORIGIN.—The larger of the two limes mentioned in the general discussion has been named the *Everglade*. The original fruit producing the seeds, one of which gave the Everglade lime, was a hybrid of West Indian lime with pollen of the pomelo, or grapefruit. Of the four hybrids (Nos. 732, 733, 734, and 735) that were grown from seeds of this fruit none showed any visible effect of the pomelo

FIG. 1.—THE PALMETTO LIME.
NATURAL SIZE.

FIG. 2.—THE EVERGLADE LIME.
NATURAL SIZE.

parent; all were true limes in every visible character and were doubtless false hybrids developed from adventive embryos. Of these four the Everglade (No. 735) produces the largest and best fruit, and it also produces the largest fruits of any lime which has been tested in the course of the experiments.

Description of fruit and tree.—Fruit elliptical, with rather large apical nipple, having shape and appearance of ordinary lime; size from $1\frac{1}{2}$ to 2 inches in diameter and from $1\frac{3}{4}$ to $2\frac{1}{4}$ inches in height; average weight per fruit 1.6 ounces; average water displacement per fruit 44.4 c.c.; color light yellow, like ordinary lime; surface medium smooth with slight depression over largest oil glands, rougher than the Palmetto; rind thin, about $\frac{1}{16}$ inch; segments 8 to 11; membranes tender; axis small, about $\frac{1}{4}$ inch in diameter; pulp tender, very juicy, light greenish in color; seeds few, from 2 to 10, averaging usually about 5; quality and texture excellent; flavor a clear sprightly acid of good bouquet; tree vigorous and productive, of spreading and bushy habit, bearing fruits mainly near exterior, thus easy to pick; foliage like ordinary lime; season of maturing, early.

The fruits of the Everglade lime run very uniform in size and are of excellent appearance. If a large-sized lime is desired the Everglade will be found an excellent variety.

Pineapple Hybrids.

When the writer, jointly with Mr. W. T. Swingle, took up work in pineapple breeding no literature bearing on the methods by which existing varieties had been produced could be found. The pineapple as ordinarily cultivated is almost seedless, seeds being so rarely produced that the great majority of growers had never seen a seed and believed the fruit to be wholly sterile. To test the possibilities of obtaining seeds, the writer in 1895 crossed 10 flowers on a fruit of Mauritius with pollen of the Red Spanish variety. This fruit produced about 35 seeds, from which 15 seedlings were grown. These were grown and tested by Mr. G. C. Matthams, at West Palm Beach, Fla., but none of them gave desirable varieties and all were finally discarded. In March, 1897, Mr. Swingle made a large number of crosses between as many varieties as could be obtained, and in March, 1898, the writer made a considerable number of crosses between various desirable varieties.

When the Department's pineapple breeding experiments were started the question of what varieties to cultivate was giving growers considerable trouble. Many growers insisted that the Red Spanish was by far the best variety, basing their conclusion on the fact of its adaptability to open field culture, freedom from disease, and good shipping qualities. Other growers contended that as varieties existed that were of far better quality and flavor, the market should be educated to demand these better so-called "fancy fruits." Among the fancy varieties that were at this time most generally cultivated, the

Smooth Cayenne, Abachi, Enville, Porto Rico, Green Ripley, and Pernambuco may be mentioned. The fancy sorts were grown mainly under sheds and required more careful culture than ordinary varieties to give satisfactory results. Several other varieties, such as the Sugar Loaf and Egyptian Queen, were considered as semi-fancy and were grown to some extent both in field culture and under sheds.

Practically all of these varieties had some fault or faults which rendered them more or less unsatisfactory. The Red Spanish, while productive and hardy, bore rather too small fruits and was of poor quality. The Smooth Cayenne, while producing a large fruit of the highest quality on a smooth-leafed plant—a very desirable character—was very subject to disease, gave almost no slips and few suckers, and did not carry well in shipment. The Abachi, while producing an excellent fruit of good size, did not ship very well, and the slips were borne so close to the fruit that it was often injured and disfigured in cutting or breaking it from the plant. The Porto Rico gave a large fruit and was found to be a fairly good shipper, but the quality was little, if in any measure, superior to the Red Spanish, and it was late in ripening. The Enville produced a poorly shaped fruit of excellent quality, but was a poor shipper, and was disfigured by its multiple crown. The Mauritius produced no slips. The Egyptian Queen was very susceptible to disease. In the Ripley the crown would drop out, and the variety was unproductive and possessed other undesirable characters.

It seemed that by carefully planned experiments in crossing different varieties new sorts could be obtained, remedying some of these defects. It was primarily desirable (1) that more smooth or entire leafed varieties be produced, as this is an important character, and only one variety with entire margined leaves was known to the growers; (2) that more hardy, disease-resistant varieties be obtained; (3) that the general quality of the fruit be improved; and (4) that better shipping varieties be produced. General purpose fruits, possessing all of these four desirable qualities in improved degree, were greatly demanded, and the mating of the different varieties was planned to secure some or all of these improved qualities, if possible.

In the pineapple a number of flowers are borne together in a compact, solid head, and the cohesion of the fleshy ovaries and perianths forms the fruit. Each flower normally bears both stamens and pistils. In the writer's experiments flower heads of a certain variety were selected on which a number of flowers were found to be open. All of the flowers on the head do not open at the same time, and usually only from six to eight flowers can be found open at once on a single flower head. The pollen to be used in the crossing was obtained by cutting off the flowers close to the fruit with small scissors. These clipped flowers were put in small vials, labeled, and carried in the pocket until

desired for use. A fresh supply of pollen was collected each day as desired.

The process of crossing used by the writer was very simple. No attempt was made to emasculate the flowers in the bud, as this would probably disfigure or injure the development of the fruit, and it is so seldom that any seeds set under normal conditions that it was considered that they must ordinarily be self-sterile. It was found on examination that the flowers of the varieties worked with are normally dusted with their own pollen, and yet no seeds set except very rarely. While self-fertilization thus might in very rare instances lead to the setting of seed, it was clear that ordinarily there was no result. For the same reason, the flowers or flower heads were not inclosed or bagged, as is usually done in hybridization experiments.

In the process of crossing, the flowers, which scarcely open normally, were forced open slightly, in order to give easy access to the pistil. Pollination was then effected by rubbing open anthers of the desired variety over the pistil, from one to three anthers being used on each stigma, depending on the abundance of the pollen present.

The flowers of different varieties were found to differ considerably in their characters. In Smooth Cayenne, the anthers are large and the pollen abundant. The pistil is long, bringing the stigma considerably above the anthers. In this variety, furthermore, the flowers protrude conspicuously from the general surface of the flower head and it is thus easy to manipulate in crossing. In the Abachi, the flowers protrude well and the pistil is long, as in the Smooth Cayenne, but the pollen is not very abundant. In the Porto Rico, the anthers are large and pollen fairly abundant; the pistil, however, is short, so that the stigma is deeply seated among the stamens within the flower, and is difficult to reach without mutilating the flowers. In the Pernambuco, the anthers are small and the pollen scarce. The flowers protrude well in this variety and have long pistils which are easy to pollinate. In the Enville, the pistil is so short as to render pollination difficult. In White Antigua, the petals remain tightly rolled, not opening, and the nectar is so abundant that the pollen and the stigma are usually considerably wetted.

The fact that only a few flowers are open at the same time in a single flower head renders it necessary that several visits on different days be made to the same plant if it is desired to cross a very large number of flowers in the same head. As a plant bears only one fruit and as the fruits are valuable and are spoiled for the market by crossing, it is desirable usually to cross a considerable number of flowers on the same fruit rather than make the same number of crosses on several fruits. It is, of course, important to use only one kind of pollen on a single fruit, as it would be difficult, though probably not impossible, to trace

each seed as coming from a certain flower. By placing only one kind of pollen on the same fruit, the individual flowers need not be marked and no care need be exercised in cutting the fruits, as all seeds set will be of a certain cross.

In the experiments conducted by Mr. Swingle and the writer it was found that different varieties crossed together apparently gave different degrees of fertility. As illustrations of nearly sterile combinations, the following may be mentioned: Of Pernambuco, 72 flowers on 6 different fruits crossed with pollen of Porto Rico gave no seeds, while the reciprocal cross, 39 flowers of Porto Rico on 6 different fruits crossed with pollen of Pernambuco, gave only one seed, which did not germinate; 50 flowers of Smooth Cayenne crossed with pollen of Porto Rico gave only 2 seeds, while the reciprocal cross, 134 flowers on 9 fruits of Porto Rico crossed with Smooth Cayenne, gave 212 seeds, all but 2 being borne in the same fruit. As illustrations of the most fertile crosses, the following may be cited: Of Green Ripley, 98 flowers on 3 fruits crossed with Smooth Cayenne pollen gave 515 seeds, and 26 flowers of Enville on 3 fruits crossed with Smooth Cayenne pollen gave 512 seeds.

The variability in the results obtained by crossing is shown by the following instances: In 1897 Mr. Swingle crossed 85 flowers on 4 fruits of Porto Rico with pollen of Smooth Cayenne and secured 212 seeds. In 1898 the writer crossed 49 flowers of Porto Rico with pollen of Smooth Cayenne and got no seeds. In crosses of Abachi with pollen of Smooth Cayenne in 1897, Mr. Swingle crossed 23 flowers on 2 fruits and no seeds were produced. In 1898 the writer crossed 57 flowers of the same combination on 5 fruits without result, but in the same year 40 other crossed flowers on 3 fruits gave 56 seeds.

To determine whether seeds would be set by self-fertilization, the following experiments were made:

Pernambuco self-pollinated by pollen from same flower:
- 8 flowers on one fruit gave 0 seeds.
- 10 flowers on one fruit gave 0 seeds.
- 10 flowers on one fruit gave 0 seeds.
- 10 flowers on one fruit gave 1 seed.
- 6 flowers on one fruit gave 3 good seeds.

Porto Rico self-pollinated by pollen from same flower:
- 8 flowers on one fruit gave 0 seeds.

Abachi self-pollinated by pollen from same flower:
- 17 flowers on one fruit gave 0 seeds.

These experiments indicate that while ordinarily the fruits are sterile when self-pollinated, occasionally seeds may set by self-pollination if the pollen is carefully applied at the right time. From an examination of the flowers of various varieties the writer concluded that the stigma almost invariably became self-pollinated to a greater or less extent, at least when the flowers began to wither. The pollen, however, may normally reach the stigma too late to insure any action.

THE MIAMI PINEAPPLE.

(EYES NATURAL SIZE, SECTION OF FRUIT ONE-HALF NATURAL SIZE.)

The experiments were not sufficiently extensive to determine the degree of self-sterility. It will be noticed that the crosses of Pernambuco with Porto Rico previously mentioned gave no seeds in 72 crossed flowers, while 44 self-fertilized Pernambuco flowers gave 4 seeds.

The hybrid seed obtained in the course of the crossing experiments was planted in a greenhouse at Washington, D. C., and the young hybrid plants were grown until they reached the size of 6 or 8 inches in height, when they were shipped to Miami, Fla., and planted in the Department's Subtropical Garden at that place, where they have been grown and fruited. The first seeds were planted in the summer of 1897, and the seedlings grown from these seeds gave their first fruits in 1901. A considerable number of them fruited that year, which shows that only four years are required ordinarily for seedling plants to reach the fruiting stage. The writer has seen it stated that eight years are required, but this is certainly erroneous when plants are properly handled.

A noteworthy character of these hybrids is their exceptionally good quality. Among those who have been testing the fruits regularly, this uniformity in fine flavor has become proverbial. Many times the best varieties and best fruits to be found on the Washington markets have been tested in comparison with various hybrids, and in every case some of the hybrids were far superior to the other pineapples in flavor. This very general good flavor and quality of the hybrids would suggest that the pineapple varieties now grown have been propagated by slips and suckers so long without the intervention of seed propagation that they have deteriorated to some extent. It may be that a return to seed propagation is occasionally necessary to maintain the highest quality.

The different hybrids under test by the Department have all fruited at least once, and three clonal generations of fruit have been grown from some of them. Many have been discarded as worthless, and others require to be further tested. A few have been selected as worthy of propagation, and five of these are described in this paper.

THE MIAMI PINEAPPLE.

[PLATE XIX, FIGURE 2, AND PLATE XXI.]

One of the most promising fruits secured in the course of the Department's experiments is No. 16, which is a hybrid of Enville with pollen of Smooth Cayenne. This fruit has been named the *Miami*. In general appearance the fruit somewhat resembles the Smooth Cayenne, but differs in color, shape, and flavor. The leaves are smooth or entire margined, like that variety. No influence of the female parent can be detected, unless it be in the flavor, which is believed to be superior to that of the Smooth Cayenne. The first fruit of this

variety was produced in 1901. The next fruits were produced in 1904, and in 1905 a considerable number were secured. The cross was made in the spring of 1897 by Mr. Swingle. Following is a technical description of this variety:

Description of plant and fruit.—Plant of medium to large size, spreading; leaves mainly broad, recurved, rigid, with spineless straight margins; color of leaves green or light green, usually with a distinct purplish-red central stripe from ¾ inch to 1¼ inches wide; crown of medium or small size, 3 to 8 inches high, with spread of from 4 to 7 inches, mainly single, sometimes multiple; appearance excellent; fruit medium size, weighing usually from 3 to 4 pounds, oblong or slightly ovate; height 5 to 7 inches; diameter usually 4 to 5 inches; color reddish orange, by Ridgway's standards between orange-rufous and rufous, some fruits being cadmium orange; surface fairly smooth and attractive; eyes flat, rather large, 1 to 1¼ inches wide by ¾ to 1 inch high, with markedly rugose surface; eye bracts comparatively small, not conspicuous, with smooth or somewhat serrate margins; eye pits moderately shallow; flesh juicy, medium solid, yellow, attractive in appearance; flavor subacid, rich; texture tender, somewhat stringy; axis ½ to ⅝ inch in diameter, mainly rather tough and woody, but little flavor. Productive, giving from 4 to 6 or more slips and 1 or 2 suckers. Apparently fairly resistant to disease and a good shipper. Time of ripening midseason, mainly from about June 10 to July 10.

The Miami is a beautiful, highly colored fruit, of excellent proportions and shape. The crown is usually of small size and single, but occasionally a multiple crown is produced. The eyes are flat and very little protruded, but the ribbed, rugose character of the eyes, which is quite marked in some specimens, may give the fruit a somewhat roughened appearance. This, however, in no way detracts from the good appearance of the fruit, but rather serves to distinguish it from other varieties. The flesh is somewhat open, very juicy and tender, and of a good, rich yellow color. In flavor it is a rich subacid, rather sweet, but not flat. The fruits which have been shipped from Miami to Washington for testing have almost invariably been received in good condition, showing almost no rotting; thus they apparently carry well in shipment. The variety is believed to possess special merit for general culture.

THE SEMINOLE PINEAPPLE.

[PLATE XXII, FIGURE 1.]

One of the best pineapples in size, shape, quality, and general appearance which have appeared in the course of the Department's experiments is hybrid No. 33, a cross of Green Ripley with pollen of Smooth Cayenne. For this variety the writer proposes the name *Seminole*. In general, the fruit of the Seminole resembles the Green Ripley more closely than the Smooth Cayenne, but differs considerably from either of these varieties. The leaves are entire-margined, like the Smooth Cayenne, or at most have but a few small serrations at the apex. The cross which resulted in the Seminole was made by Mr. Swingle in the spring of 1897, and the first fruit was produced in

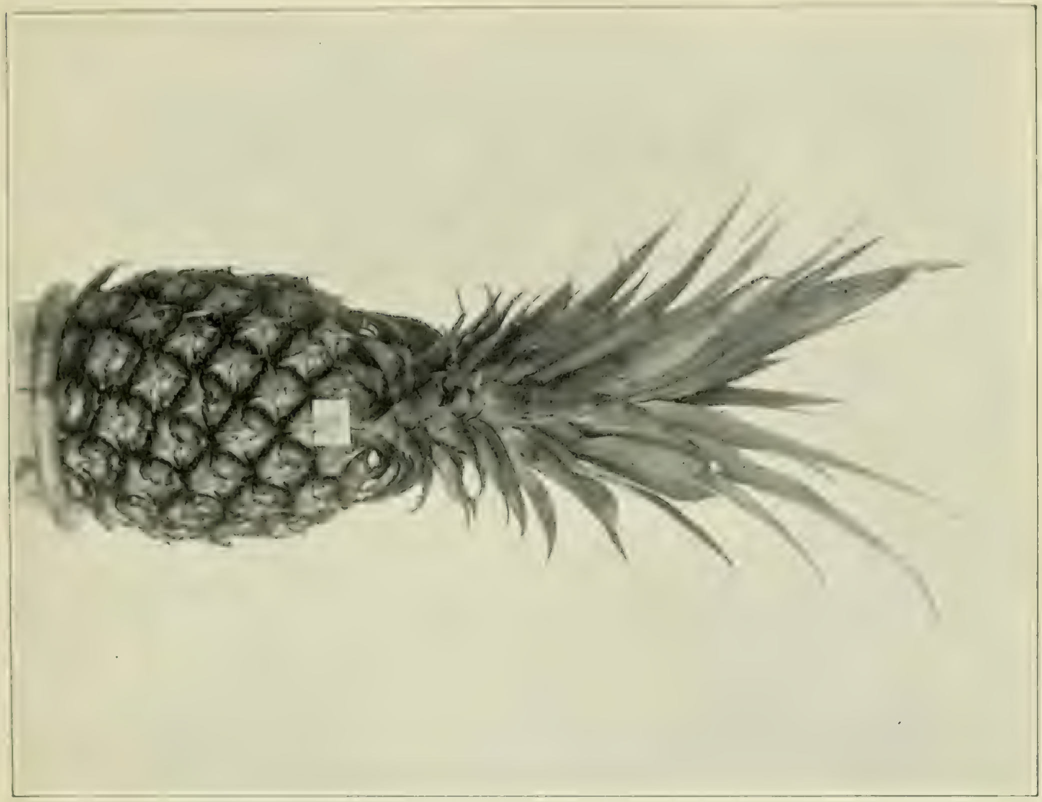

FIG. 1.—THE SEMINOLE PINEAPPLE. ONE-FOURTH NATURAL SIZE.

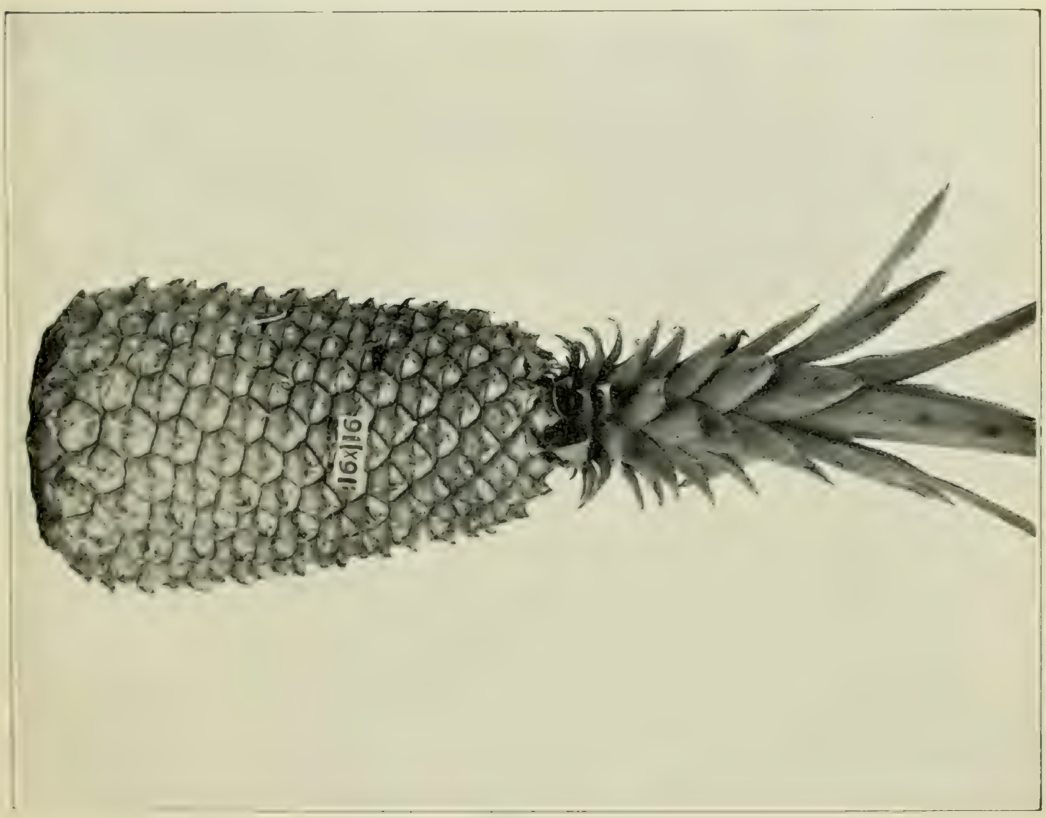

FIG. 2.—THE EDEN PINEAPPLE. ONE-FOURTH NATURAL SIZE.

1901. In 1902 one fruit matured, and in succeeding years a considerable number of fruits were produced and tested. Following is a technical description of the variety:

Description of plant and fruit.—Plant medium to large in size, spreading; leaves dark green, in general comparatively narrow, recurved, rigid, entire-margined or with few spines at apex, usually with an indistinct purplish central band about 1 to $1\frac{1}{4}$ inches wide; margin somewhat undulate or nearly straight; fruit of excellent appearance, medium size, weighing ordinarily from $2\frac{1}{2}$ to $3\frac{3}{4}$ pounds, oblong elliptical, height from $5\frac{1}{2}$ to 7 inches, diameter from $4\frac{1}{2}$ to $4\frac{3}{4}$ inches; color, in general, bright orange yellow; by Ridgway's standards the eyes are ochraceous to orange-ochraceous, and the bases of the eye bracts show a flush of rufous; surface smooth; eyes of medium size, not very much protruded; eye bracts medium to large in size, mainly with slightly serrate margins; aroma rather light, but pleasant; flesh yellow, attractive, solid; eye pits shallow; texture crisp and tender, in some fruits slightly stringy; quality excellent; flavor a rich sweet subacid, very attractive; axis of medium size, $\frac{1}{2}$ to $\frac{7}{8}$ inch in diameter, rather tough, but edible in some fruits; crown single, of good appearance, medium size, about 7 to 8 inches high, with a spread of from 6 to 7 inches; slips from 2 to 8; suckers 1 or 2. Season mainly June and July.

The Seminole pineapple is particularly noteworthy for its good quality. Practically all of those who have tested the fruit have pronounced it of excellent quality. It has a distinctive flavor which is very attractive. It is of good shape, full at the apex and base, ripens evenly, and has a good attractive color and surface. In season of maturing it has thus far been quite variable, many of the fruits ripening in the autumn—in October and November. The general good qualities of the Seminole, coupled with its smooth leaves, make it a desirable new sort.

THE EDEN PINEAPPLE.

[PLATE XXII, FIGURE 2.]

In the general discussion of pineapple hybrids the high quality of the hybrid fruits in general was mentioned. Hybrid No. 91, which has been named the *Eden*, is believed to be superior in flavor to any pineapple on the market.

The Eden is a hybrid of Enville with pollen of Porto Rico. In the series of 34 hybrids of this combination, which resulted from a cross made by Mr. Swingle in the spring of 1901, the great majority resemble the Enville in their principal characters. The majority are conical in shape, have small, protruding eyes, and are white-fleshed. All of them are also exceptionally good in flavor, resembling the Enville, though very variable in this regard and in size of fruit, crown, length of eye bracts, etc. Three or four fruits have large eyes, like the Porto Rico, but none of these has thus far exhibited promising characters. No. 90 of this series has been pronounced by all who have tasted it as the highest and best flavored pineapple they have ever eaten. The fruit of this number, however, seldom weighs more than from 1 to 2 pounds, and the crown is exceptionally large, reaching a height of 18

to 20 inches, thus rendering the fruit unsalable. No. 91, the Eden, has almost the same high flavor as No. 90, and has a larger, better shaped fruit, with smaller crown, and is apparently a better keeper. The Eden has many objectionable characters, and it is only its exceptionally high quality that justifies its being named and distributed. It is believed, however, that many growers will desire to cultivate a few plants for their home use, and possibly for a special trade, even if the variety should prove unsatisfactory for general commercial cultivation. Following is a technical description of the Eden pineapple:

DESCRIPTION OF PLANT AND FRUIT.—Plant medium to large, mainly spreading; leaves broad, recurved, rigid, dark green in color, and usually with a distinct central purplish stripe about $1\frac{1}{4}$ inches in width; margin serrate or spiny, straight or somewhat undulate; crown of medium to large size, mainly single, but sometimes compound; average crown about 8 inches high, with a spread of from 5 to 8 inches, appearance in general symmetrical in relation with fruit; leaves of crown serrate, from 6 to 9 inches in length and from $\frac{3}{4}$ inch to $1\frac{1}{4}$ inches in width; fruit of medium size, usually weighing from 3 to $4\frac{1}{2}$ pounds, conical to oblong in shape, height from 5 to 10 inches, diameter from $3\frac{1}{2}$ to $5\frac{1}{4}$ inches; color of fruit rather light lemon yellow; by Ridgway's standards fruits have been found to vary from deep chrome to Indian yellow and gallstone yellow, the base of the eye bracts frequently having a tinge of coral red; surface of fruits rough; aroma usually light, but in some fruits rich and strong; eyes small, similar to Enville in shape, and considerably protruded; eye bracts of medium or small size, with serrate margins; general quality of fruit excellent; texture very tender and brittle; flavor a rich, sweet subacid, very attractive; flesh white, rather open; eye pits of medium depth; axis large, from $\frac{5}{8}$ inch to $1\frac{1}{4}$ inches in diameter, comparatively tender and brittle, in most fruits being of fair flavor and edible; slips numerous, usually from 4 to 10; suckers 1 or 2. Shipping quality good; season of ripening mainly from June 15 to July 15.

The Eden is similar in shape to the Enville and derives most of its characters from that parent. It resembles the Enville in shape, form, and size of eyes and color of flesh; but differs from it in having a single crown and being of superior flavor and possibly better shipping quality. Judging from the handling of the experimental fruits, it would seem to be a fair shipper, but this character requires further testing. The conical shape of this fruit is not desirable from the grower's standpoint, as it is frequently too long to pack well. The crown in some fruits is small and in others it is too large. To reduce the crown to the right size, slips and suckers for reproduction should be taken only from those plants having good crowns. The protruding eyes give the fruit a rather too rough surface, but in the protruding eye the eye pits do not extend so deep into the edible flesh, and there is less waste in peeling, so that this character should thus not be considered as wholly detrimental. The slips are frequently borne rather too close to the fruit, so that the fruit is injured in removing it from the plant.

With all its bad qualities the flavor of the fruit is so superior that it is believed to be worthy of cultivation.

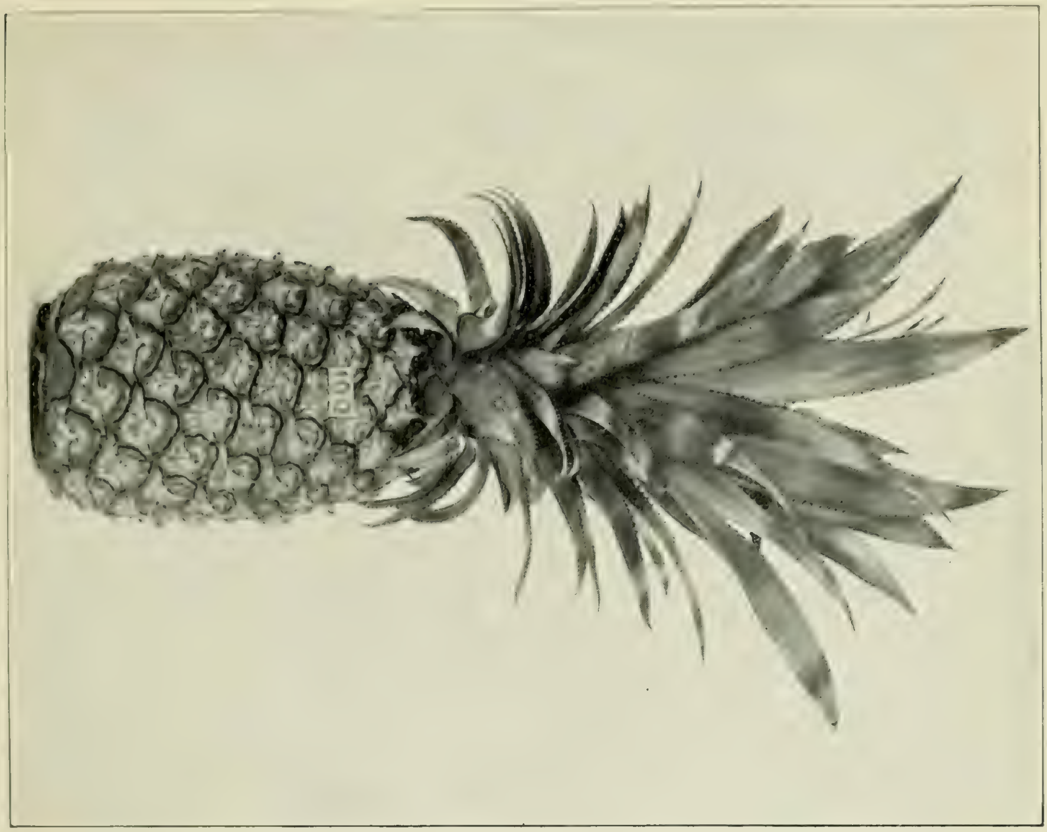

FIG. 1.—THE MATTHAMS PINEAPPLE. ONE-FOURTH NATURAL SIZE.

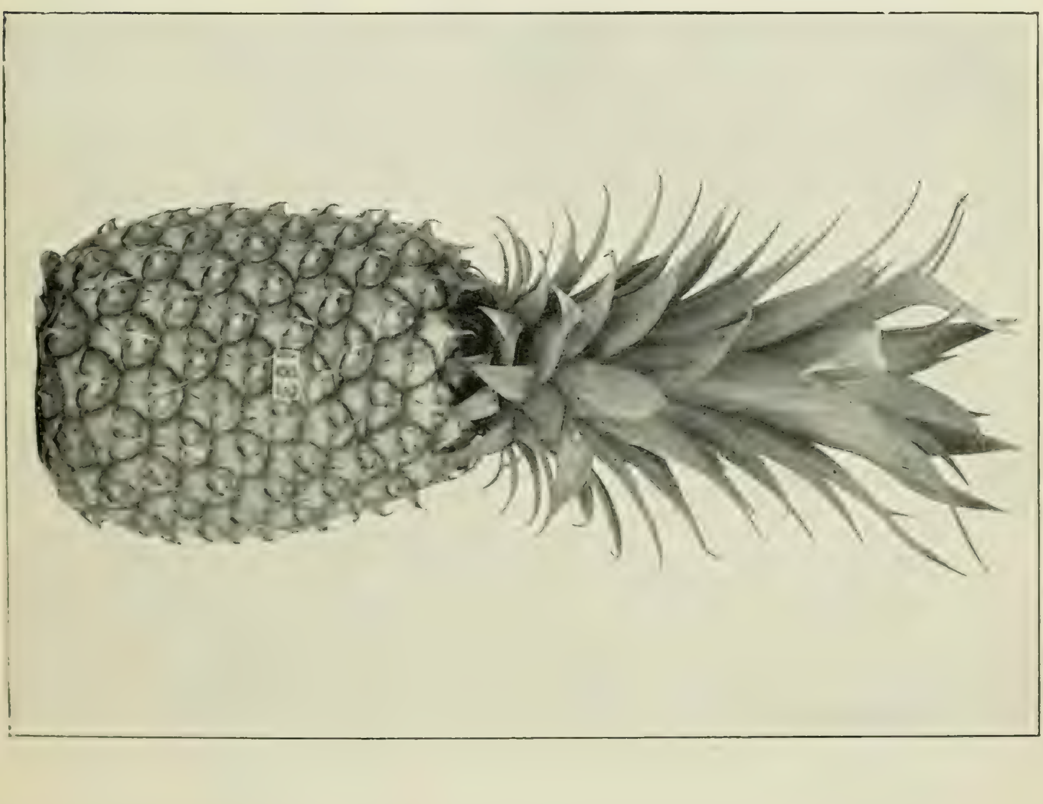

FIG. 2.—THE GALE PINEAPPLE. ONE-FOURTH NATURAL SIZE.

THE MATTHAMS PINEAPPLE.

[PLATE XXIII, FIGURE 1.]

This fruit, hybrid No. 100 (Green Ripley, female, crossed with Smooth Cayenne, male parent), developed from a cross made in the pinery of Mr. G. C. Matthams, of West Palm Beach, Fla. Mr. Matthams has been very active in pushing the development of the pineapple industry and has been of great service in connection with the pineapple experiments of the Department. The writer, with the approval of the Secretary, has given the name *Matthams* to this variety. In shape, size, appearance, and adaptability to general culture the Matthams is one of the best hybrids that has been produced in the course of the Department's experiments. The cross was made by Mr. Swingle in 1897, and the first fruit was produced in 1902. The variety is very prolific, and a number of fruits have been produced in each succeeding year. Following is a technical description of the variety:

Description of plant and fruit.—Plant of medium size, spreading or somewhat compact, dark green; leaves rather broad, recurved, rigid, with indistinct central purplish band above, about $1\frac{1}{4}$ inches wide and cross-banded below with alternate light and dark green stripes; margin straight or somewhat undulate, serrate, with rather distant reddish-tipped spines; crown mainly single, of medium size and excellent appearance, 4 to 9 inches high, with spread of from 3 to 8 inches, width of crown leaves from $\frac{3}{4}$ to $1\frac{1}{4}$ inches; fruit of excellent appearance and medium size, weighing usually from 2 to 5 pounds, oblong, 5 to 8 inches in height and from $3\frac{3}{4}$ to 5 inches in diameter; color, in general, orange yellow, by Ridgway's standards orange-ochraceous to cadmium yellow; surface smooth, even, and attractive in appearance; aroma light in some fruits, in others very rich and attractive; eyes medium in size, $\frac{7}{8}$ to 1 inch by $\frac{3}{4}$ to 1 inch, flat or but very slightly protruded; eye bracts of medium size with serrate margins; general quality of fruit excellent, very juicy; texture tender and brittle, very slightly stringy in some fruits; flavor a sweet subacid, very pleasant; flesh orange yellow, attractive in appearance, solid; eye pits of medium depth; axis $\frac{1}{2}$ to 1 inch in diameter, rather tough and with little flavor; slips from 2 to 6, suckers from 1 to 4. Season, June and July.

The Matthams, taken in all characters, is an excellent fruit. It is usually well proportioned, having a good crown to fit the fruit, and in general is about the size most preferred by growers. The surface is very smooth, and yet the eye pits are fairly shallow. In eating this fruit out of hand one uses the flesh well up to the rind, and the fruit peels economically. The flesh is solid, and this, with the shallow eye pits, would indicate that the fruit should be a good canning variety. It is ordinarily sweet enough, so that, it is believed, little or no sugar would be necessary in canning it.

In some cases the surface is somewhat cracked, but this has never been so serious as to disfigure the fruit. In flavor this fruit is excellent, being very rich and sweet. It may possibly be too sweet for some. The tender, brittle flesh renders it very attractive as an eating fruit. In some fruits the axis or core is tender and edible; in others it is rather too tough to be eaten. It would seem to be a good

shipper, as it has almost invariably stood the shipment from Florida to Washington without injury; and several times a fruit has been retained in a warm room for more than two weeks after its receipt without suffering serious damage. It is believed that this variety will prove satisfactory for general commercial culture.

THE GALE PINEAPPLE.

[PLATE XXIII, FIGURE 2.]

This pineapple, hybrid No. 183 (Green Ripley crossed with pollen of Smooth Cayenne), is named the *Gale* in honor of Prof. Elbridge Gale, of Mangonia, Fla., formerly professor of horticulture in the Kansas Agricultural College. Professor Gale has for many years been actively identified with the development of tropical fruit interests in southern Florida, and has been of great service to the Department of Agriculture and the fruit growers of Florida by his preservation and distribution, without special pecuniary gain to himself, of the Mulgoba mango, introduced by the Department.

The seedling of the Gale pineapple fruited first in 1902, and in the season of 1905 gave several very fine specimens. In appearance the fruit is one of the finest which the writer has ever examined. A technical description follows:

Description of plant and fruit.—Plant medium to large, spreading; leaves broad, erect, or somewhat recurved, rigid; color light green, with indistinct purplish central band from 1 to 1¼ inches in width; margins more or less undulate, smooth, or with very few small spines at apex; crown of medium size, 6 to 10 inches in height, and with spread of from 5 to 8 inches, of excellent shape and appearance, largest crown leaves from 6 to 10 inches in length and from ¾ to 1 inch wide, with smooth margins; fruit of excellent appearance, medium size, weighing from 2¾ to 3 pounds, oblong elliptical, 4 to 4⅜ inches in diameter and 5 to 6½ inches in height; color of fruit light orange, with flush of red on base of eye bracts. The color of the eyes of various fruits is recorded, using Ridgway's standards, as orange-ochraceous, deep chrome, and cadmium yellow, while the color of the eye bracts is recorded as coral red and cadmium orange. Eyes of medium size, ¾ by ⅝ inch, flat, giving smooth surface; eye bracts of medium to small size, with smooth margins, usually of reddish color; flesh solid, juicy, of yellowish color; texture tender, somewhat fibrous; flavor a rich, sprightly acid; core small, ⅜ to ½ inch in diameter, tough, and with little flavor; eye pits moderately shallow; aroma light but pleasant; general appearance and quality excellent; slips from 2 to 3, suckers from 1 to 2. Season, June and July.

The Gale pineapple produces a very handsome, highly colored fruit, with smooth surface and well-proportioned crown. The light-orange color of the eyes, combined with the reddish color of the eye bracts, makes it one of the most attractive appearing varieties known. Its rather fibrous flesh and tough core are against it, but these poor characters are overbalanced by its good qualities. It is apparently a good shipper, and ripens evenly from bottom to top. In flavor the fruits tested have all been very excellent, rich, and sweet, and not lacking in characteristic bouquet. It is believed to be one of the most promising fruits yet tested.

THE BUSINESS OF SEED AND PLANT INTRODUCTION AND DISTRIBUTION.

By A. J. Pieters,

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INTRODUCTION.

In 1839 Congress appropriated $1,000 to be used by the Commissioner of Patents in collecting agricultural statistics and for the purchase of seeds of new and rare varieties of plants. This was the first appropriation providing for a work which during the fiscal year 1906 requires an appropriation of $290,000. But before such specific help as that referred to was granted to this work the distribution of seeds had been considered of great importance. In a letter dated January 22, 1839, the Commissioner of Patents referred to the introduction of Baden corn as having increased the Mississippi corn crop by 50 per cent, and also stated that varieties of wheat were distributed and tested in 1838. During the early days of the settlement of this country there was of course much miscellaneous private introduction, but in 1770 Benjamin Franklin, as the agent of Pennsylvania, sent home for distribution seeds and mulberry cuttings, and during the administration of John Quincy Adams consuls of the United States were instructed to forward rare plants and seeds to the Department of State for distribution. The amounts annually appropriated since 1839 have varied widely; and, so far as can be learned, in but few instances has the whole appropriation been expended.

Between the years 1839 and 1880 a number of important new crops were introduced—sorghum, Kafir corn, wheats, and sugar canes; but meanwhile the distribution of vegetable and flower seeds became a more prominent feature, and by 1890 nearly all the seeds distributed were of this class.

With the increase in the number of packages annually assigned to Senators, Representatives, and Delegates in Congress, it became increasingly difficult to obtain seeds of new varieties in sufficient quantities, and to a greater and greater extent those of standard varieties were substituted. The introduction of new and improved varieties as an important feature of the distribution work was never wholly lost sight of, however, and in 1898 received distinct recognition in that

Congress set aside the sum of $20,000 to be used for securing from abroad varieties that might be adapted to our conditions. This action brought the work back to the original purpose, namely, the introduction and testing of new things to be afterwards more widely distributed if found valuable.

For a few years the two branches of this service worked under separate administrations, but in 1902, the Bureau of Plant Industry having been formed, the writer was placed in charge of both branches and he has since carried on the work under the direction of the Chief of the Bureau.

SEED AND PLANT INTRODUCTION.

The work of seed and plant introduction, begun before there was a Department of Agriculture and carried on now for sixty-five years, has to its credit the introduction of some of our most important crops, the annual value of which it would be difficult to estimate.

OBJECTS OF THE WORK.

The question we are often asked and which we shall try to answer here is, "What is the object of this business?"

The object of this branch of the Department is to find new crops and to introduce them to the notice of the American farmer, business man, and consumer. There is always room for something better, and in many sections there is a crying need for anything that will grow and out of which the cultivator can make money. There are plenty of good things known in one section of the country that ought to be known in others, and even in the older sections of our country changed conditions call for new crops—crops that will fit into the rotation and keep the ground occupied, crops that will come on at a time when there is no other work, or crops that will make heavy expenditures for nitrogenous fertilizers unnecessary. The object of this business, therefore, is to help the agriculture and horticulture of the country wherever a need is felt for new crops or for new varieties of old crops. Moreover, an important feature of the work is to learn which crops already standard in this country may be extended to parts of the United States where their value is not at present appreciated. Such work is being done in the extension of alfalfa culture in the eastern United States. Explorers are also sent to every part of the habitable globe to bring home the best seeds and plants.

In all parts of the country there is need of something. On the Atlantic seaboard the abandoned rice fields are waiting to have their fertility utilized by some crop that will pay; in the fruit-growing sections north, south, east, and west, the growers want the ideal cover crop; tobacco growers everywhere need a soil improver that can follow tobacco the same season and will cover the ground during the winter; the home makers in the Northeast and in the Northwest want

better trees, especially evergreens for wind-breaks and ornament; the florist desires a healthy Easter lily; the southern farmer is in need of better cottons, disease-resistant cottons, and better corn; Florida wants new fancy fruits that will bring high prices to pay for the high cost of production, besides crops that can be grown cheaply and will pay for the trouble; the Northwest needs, among other things, hardy alfalfa and grains to resist drought and rust; the Southwest wants crops that will resist drought and alkali; everywhere, indeed, there is need of some crop adapted to special conditions of soil, of climate, or of market.

The object of this business is to fill these various needs by introducing new and improved crops to the American cultivator.

DOES IT PAY?

The old records of seed distribution are not as complete as might be desired, but a study of some of the important crops introduced since the first appropriation in 1839 and a conservative estimate of the present annual value of some of them have given the following interesting results. The estimates are little more than guesses, and probably much below the actual annual value of the crops.

Sorghum.—Introduced from China and France, 1864(?). Cost of introduction, about $2,000. At present grown throughout the United States. The annual value of the crop is at least $40,000,000.

Kafir corn.—Introduced at a cost of probably not more than $5,000. The annual value of this crop, which is largely grown in the semiarid Southwest, exceeds $15,000,000.

Durum wheat.—Cost of introduction, not more than $10,000. At present durum wheat is the chief dependence for a crop on more than 500,000 acres of land too dry to grow other wheats. The cultivation of this wheat is extending every year. The present value of the crop is about $10,000,000 annually.

Japanese Kiushu rice.—Cost of introduction, about $18,000. The introduction of this variety has resulted in a large increase in the rice crop and has been an important factor in the phenomenal growth of the rice industry in Texas and Louisiana. Since the introduction of Japanese rice the area devoted to this crop has increased from 210,396 acres in 1899 to a total of 610,700 acres in 1904, raising the value of the land in the coast sections of Louisiana and Texas from between $1 and $2.50 per acre to from $35 to $50 per acre, and the output of cleaned rice has been increased from 179,919,293 pounds in 1899 to 548,880,600 pounds in 1904. If one-half of this increase has been due to the above introduction the annual value of this is nearly $3,000,000.

SWEDISH SELECT OATS.—Cost of introduction, about $5,000. The annual value of the increased crops produced by this variety in Wisconsin alone has been estimated at $1,000,000.

EXCELSIOR WHITE SCHONEN OATS.—Introduced in 1868. The cost of this introduction is not ascertainable, but it was probably not in excess of $1,000 for the variety. Hon. William G. Le Duc, then Commissioner of Agriculture, writing in 1879, says:

> The increased production per acre by the Excelsior White Schonen oats some years since was 2.5 bushels per acre, and a like increase is reported from a distribution of the Board-of-Trade oats in the northern and the Rustproof in the southern part of the country during the past two years. But the average increased yield fairly attributable in like period to improved varieties of seed would amount to 40,000,000 bushels, now worth $15,000,000.

CHEVALIER BARLEY.—Distributed by the Department about 1871. Cost of introduction not ascertainable, but probably about $1,000. At present this is one of the standard varieties in the United States, the crop being worth many millions of dollars. This barley has also been extremely useful as one of the parents of some hybrids at present more valuable than the parent variety.

FULTZ WHEAT.—Introduced by the Department in 1871. Cost of introduction not ascertainable, but probably small. This is still one of the standard varieties in the East, and the value of the crop, at a low estimate, amounts to millions of dollars annually.

WASHINGTON NAVEL ORANGE.—The original cost of this introduction was probably insignificant, but the value of the California crop alone for the past year was $8,000,000, f. o. b. cars in California.

The cost of all seed and plant introduction and distribution work from 1852 to 1905, inclusive, has been $4,477,402. The estimated *annual* value to-day of a few of the varieties introduced by the Department is certainly far in excess of $100,000,000.

But the justification for this work may be found not alone in what has been done, but in the prospective value of crops and varieties, if we can find and introduce the kinds that are clearly needed. The crop of flaxseed in North Dakota alone is worth nearly $17,000,000 annually, and the presence of wilt disease is a serious menace to this crop. If seed of a wilt-resistant variety can be secured and distributed, flax may again be grown on thousands of acres now said to be "flax sick." This will mean that the tow mills which have been recently established in North Dakota for handling fiber from the general seed crop, but which have been forced to close because the haul became too long to make their business profitable, may again open.

The loss of cotton in a few counties in the South from wilt disease alone amounts to half a million dollars annually, all of which may be prevented by the introduction of a wilt-resistant variety.

The tobacco growers of Connecticut expend large sums for nitrogenous fertilizers. If they can use a vetch that will leave nitrogen in the soil, it will easily save them $10 per acre on 30,000 acres, or a total of $300,000 annually.

This country imports dates to the value of $600,000 annually. Why should we not establish the industry in our own hot deserts and keep the money at home? Japanese straw matting can be woven by power looms, but the raw material is not at present produced here. The annual value of this crop to the farmer will be, if established, at least $2,000,000. In every portion of the United States there is need of some profitable crop to add to those already grown. It is the business of the Office of Seed and Plant Introduction and Distribution to fill these needs, and the filling of them seems well worth while.

WHAT IS BEING DONE, AND HOW.

The Office of Seed and Plant Introduction and Distribution is endeavoring to assist in the upbuilding of new plant industries wherever opportunities offer. Many of the best of these opportunities are opened up by discoveries made by experts employed by the Department of Agriculture, and one important line of the work consists in cooperating with the other offices of the Department.

This Office stands distinctly for cooperation, because it is believed the work can best be done in that way. There are more than fifty men in the Bureau of Plant Industry alone who are almost constantly in the field and in touch with the needs and opportunities existing. These men can and do look out for any good new things or for a chance to take up a profitable line of work. Many of them are studying farm practice, and in the course of their work note where a new crop would fit in well. In such cases arrangements are made through these men for a test of that crop to determine whether it will succeed. If it does succeed, enough seed is distributed to give those interested a start with the crop. Such cooperation is helpful all around. The student of farm practice has furnished the idea, and this Office has tested it, or, rather, has helped the farmer to test it.

Cotton and tobacco.—All the work done on these standard crops is in cooperation with the Department experts. A few years ago one of them demonstrated that some cotton plants were resistant to the wilt disease. The control of the disease therefore evidently lay along the line of using resistant varieties. Every year since that time this Office has distributed 200 bushels of wilt-resistant seed and has contracted for a small acreage planted to new varieties which are also resistant, and these new sorts will be introduced as soon as ready. The expert who understands cotton and cotton diseases supervises the work, and this Office grows the seed and distributes it, in like

manner cooperating in the introduction of other new varieties of cotton. As new varieties of merit are found seed is bought and distributed, and contracts are made for an acreage of such new varieties as are still in process of selection.

In the course of selection work on tobacco it was shown that improved types may readily be secured by selecting individual plants for seed bearers. When this was once shown, arrangements were made to have our tobacco seed secured in this way, and in the summer of 1905 the tobacco experts visited the chief tobacco centers and personally selected the seed parents for this work.

Grains.—The most important cooperative enterprise now being carried on is the introduction of cereals. This work is all done through the Cerealist of the Bureau and covers the introduction of durum wheat, hardy winter wheats, oats, barleys, and the Russian or proso millets. While the work affects more or less the entire United States, by far the most attention has been given to grains for the arid and semiarid regions extending from North Dakota to Texas and for the high altitudes of the Rocky Mountains.

New citrus fruits.—After years of effort Dr. H. J. Webber produced three new citrus varieties, which appear to be worthy of wide distribution. If they succeed, they will add materially to the citrus varieties in cultivation, and it has been the duty of this Office to distribute them. During the past two years, therefore, contracts have been made for thousands of these trees, which have been sent wherever it was thought they would be of value.

Miscellaneous introduction work.—In numerous other ways this Office cooperates to test or to establish new crops. In 1904 more than 10,000 bushels of seed of early varieties of cotton were sent to Texas to aid in fighting the boll weevil. Tubers of 98 varieties of potatoes were purchased, with the object of selecting a disease-resistant sort. Ten acres of watermelons of a strain being bred to wilt resistance were contracted for. One of the Bureau experts is being aided to inaugurate an extensive series of tests to find out what kind of alfalfa seed should be used in various parts of the United States. This Office has cooperated with the Bureau of Chemistry to find out whether cassava can be made a more profitable crop in Florida. It is helping the Drug Plant Laboratory to demonstrate that two valuable plant products—camphor and morphine—can be successfully produced in this country, and when the demonstration has been made it will take up the wide distribution of the seeds and plants. This Office is also assisting the Subtropical Laboratory to introduce the culture of the vanilla bean and the mango and other tropical fruits. These are some of the minor ways in which cooperation is being carried on in work having for its object the establishment of new plant industries or the introduction of better varieties. There are many more of these little

projects that might be mentioned. New ones come up all the time, and a careful hearing is always given to plans that promise to pay. In these ways the Office of Seed and Plant Introduction and Distribution can put before the people the results of some of the best work of the Department, much of which would otherwise not be so widely known.

FOREIGN EXPLORATIONS.

This line of work was actively inaugurated in 1897, when the Secretary of Agriculture sent Prof. N. E. Hansen to Turkestan to obtain seed of the hardy alfalfa growing there. For several years this work was conducted by the Section of Foreign Seed and Plant Introduction, and is now an important line of activity in the business of introducing new seeds and plants. Many of our best crops have come from foreign parts, and there are, without any doubt, many other choice varieties waiting to be recognized and introduced. As the title indicates, it is the business of this branch of the work to explore foreign countries and to find out what can be brought to America and made to pay here. Specific expeditions are undertaken in order to secure one or more important crops the existence of which is known and the introduction of which is thought to be desirable and possible. Of course the explorer would be a poor one, indeed, who did not keep his eyes open for any other good things the country visited might afford. Such expeditions usually have their origin in the studies of Department experts, who show that climatic conditions in some part of the United States are similar to those in certain countries abroad, where profitable crops not now produced in the United States are grown. It may be found that such products are now imported, either raw or manufactured, to the value of millions of dollars annually, and it is then evident that it would pay to introduce these cultures, especially if they can be grown on land not now profitably occupied. A careful study of the conditions is made and a competent man is sent abroad with instructions to bring back seeds or plants of the desired sorts in quantity, and also to report on the methods of handling the crop.

Prof. N. E. Hansen in 1897 went to Turkestan in search of hardy alfalfa, and he brought back, besides this, seeds and plants of many other kinds. Dr. S. A. Knapp went twice to the Orient in search of better varieties of rice and brought back the Kiushu rice, which has given such an impetus to rice culture in the South. Mr. E. A. Bessey went to Turkestan and Russia to secure a new supply of Turkestan alfalfa, and he also secured valuable grains and other seeds. Mr. W. T. Swingle sent from Smyrna the insect required for fertilizing the fig, and also secured in Africa a large consignment of valuable varieties of date palms. Mr. M. A. Carleton on two expeditions secured the varieties of durum and other wheats which are proving such important factors in the semiarid regions of the West. Mr. D. G. Fairchild, at present

in charge of this branch of the work, has traveled extensively both for the Department and with Mr. Barbour Lathrop, who has sent many of our recent introductions. Messrs. T. H. Kearney and T. H. Means made most valuable observations on plants grown under irrigation in the Nile Valley, and Mr. Kearney later secured the largest single shipment of date palms yet brought over. Others have searched for plants in Mexico, Central America, China, and Africa, and a special explorer is now working in north China and Manchuria, in which regions it is hoped to secure hardy fruits and field crops.

As seeds and plants are brought in by the various explorers they are numbered and full records are made of their source, character, and expected possibilities. They are then distributed for testing or are placed in the Department gardens or greenhouses for propagation. When these seeds and plants are received they go into the hands of the men in charge of the various crop lines, and the responsibility of those in charge of the foreign explorations then ceases.

TESTING GARDENS AND PROPAGATING HOUSES.

The testing gardens and propagating houses are two indispensable accessories to the successful prosecution of this work. (See Pl. XXIV, fig. 2.) Many of the introductions that finally proved to be among the best things discovered came in small quantities—a handful of seeds, a few buds or scions, for which stocks must be on hand, or a Wardian case of potted plants. (Pl. XXIV, fig. 1.) Unfortunately, our greenhouse space is limited, and most of our work has to be done in the outdoor gardens.

There are two principal gardens, besides many smaller stations, where tests of grains or forage crops are being made for local conditions, and three date-palm gardens.

The home testing garden is at the Arlington Farm, where extensive annual tests are made and where plants that are believed to be hardy in the climate of Washington, D. C., are placed for testing and observation. The most important of all the introduction gardens, however, is at Chico, Cal., where a plant-introduction garden has been established to nurse, test, propagate, and produce new and choice varieties adapted to mild, temperate conditions. The climate of this place, while not suitable for tender subtropicals, is adapted to the orange or any plant equally hardy. There seeds are planted in quantities, and thousands of seedlings are raised of those cultures for the introduction of which special efforts are being made. The garden covers 80 acres, mostly choice land, and, though only one year has passed since the work was begun, already many thousands of plants are ready for stocks or for distribution. Here have been established collections of useful plants, so that in time there may be opportunities to breed new varieties of value to the whole country.

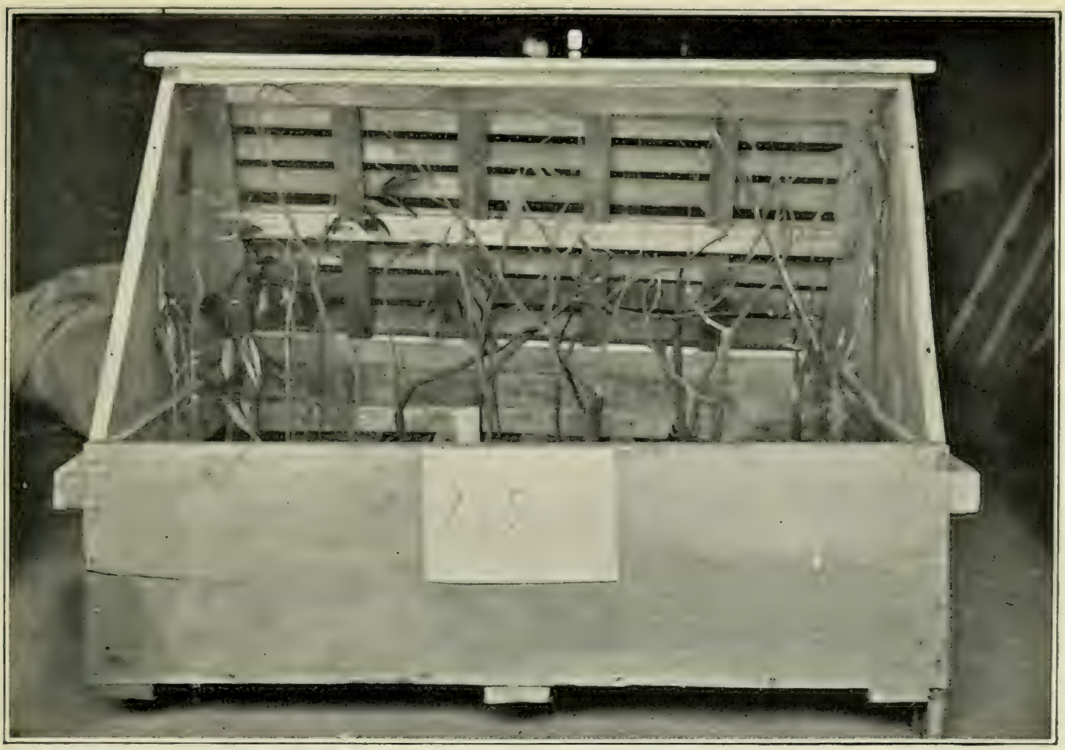

FIG. 1.—WARDIAN CASE OF POTTED PLANTS AS RECEIVED FROM ABROAD BY THE OFFICE OF SEED AND PLANT INTRODUCTION AND DISTRIBUTION.

FIG. 2.—MANGO HOUSE OF THE OFFICE OF SEED AND PLANT INTRODUCTION AND DISTRIBUTION.

DATE-PALM GARDENS.

The introduction of date-palm culture is, because of the nature of the tree, a task of unusual difficulty, being at the same time one of unusual importance for those regions adapted to this fruit. It was necessary, therefore, to bring together a collection of varieties in special gardens where they could be cared for, studied, and propagated. The first garden was established at Tempe, Ariz., in cooperation with the Arizona experiment station, and in it are now 930 trees of more than 125 varieties. Later a tract of 15 acres was secured at Mecca, Cal., in cooperation with the California experiment station, and on this there are 724 trees of more than 100 varieties. During the past season a third garden has been planted at Yuma, Ariz., and here the work is carried on in cooperation with the Arizona experiment station. These gardens are equipped with fumigation houses, because it is important that no insect pests should be introduced with the palms from foreign countries. Here and there, where special conditions existed, young trees were sent to private growers, but the right to control the offshoots was reserved. Later the introduction gardens and the earlier distributions will serve as sources of supply from which young plants may be sent to those who wish to go into the business of raising date palms.

SMALLER TESTING STATIONS.

Besides the work carried on at the main testing stations, introductions are tested at special stations in Pullman, Wash.; San Antonio, Tex., and Chillicothe, Tex., and grains at stations throughout the western grain belt. At all of these stations careful records are kept, and, as soon as a new thing is known to be promising, seed is saved and more seed is purchased or grown under contract. These stations are necessary for testing the relative value of new varieties. If the seeds were distributed to various cooperators no one would have more than a few kinds and a comparison of value would be out of the question. These stations are needed, therefore, to find out what the introductions are worth and also to raise seed of varieties of which there was but little seed at first.

TESTING THE VALUE OF NEW VARIETIES AND PLACING THE BEST BEFORE THE PUBLIC.

In the history of every introduction there are three steps—securing the variety, testing it, and finally introducing it or attracting to it the favorable notice of the public. Varieties are secured by keeping in touch with what the Department experts and field men do and learn, through foreign explorers, and through extensive correspondence. When received the varieties must be tested, and while this is done largely

in the Department's gardens, such tests can not cover the whole field and are at best merely preliminary. All varieties must be tested through a series of years before a final decision can be reached as to their value. Much of this work is done by an extensive corps of cooperators living in every part of the United States and interested in the various crops. Whenever a special introduction of a new variety or crop which has already been studied is made, the seeds or plants are at once sent out according to a prearranged plan, so that such seeds are not usually kept on hand for a long time. Miscellaneous seeds are placed on the Department's grounds or are sent to special cooperators interested in that particular kind of plant.

The time during which varieties must be tested before they can be confidently distributed varies widely with the varieties and also with the character of the seasons during which they are tested. The introduction work with grains, which has been carried on more extensively than any other one line, may serve as an illustration. During the first year small plats are grown at the testing stations or at the various cooperating State experiment stations. No seed is sent anywhere save to these places. The behavior of the plants is carefully noted as to quality and quantity of the crop, as to resistance or lack of resistance to disease and drought, and any other points that would affect the profitableness of the variety. The seed from these plats is carefully saved and planted the second year on a larger scale; and, besides this, if the variety has given marked indications of value, seed is sent to a few carefully selected cooperating farmers. The observations of the first year are repeated, and, if the variety makes good the promises of the first season, a larger quantity is sent out the third year to a number of cooperators, and, besides, the seed is planted on an acreage basis on our own testing grounds. At the close of the third year the reports of those who have received seed are compiled, and if the results are favorable the variety is declared ready for distribution and a quantity of seed is secured.

At the conclusion of the testing work, note is made of the area over which the variety has proved valuable, and, as applications come in through Senators, Representatives, and Delegates in Congress or direct to the Department, the seed of this variety is sent out to farmers living in that area. In the case of a new fruit a much longer time must necessarily elapse before results can be secured. The scions or buds are sent to reliable cooperators for fruiting tests in comparison with standard varieties of the same kind. This requires from three to six or more years, after which, if a given variety proves valuable, further time is required for the propagation of sufficient material for distribution. In all such cases the valuable kinds are put into the hands of reliable nurserymen as soon as possible, because it is thought that,

after the variety is in trade, this Office can better devote its time and energies to new work than to continue the propagation and distribution of varieties that may be obtained in the trade.

In some cases, of course, special measures are necessary to establish an industry. This is the case, among many others that might be cited, with the date palm, the Japanese matting rush, and also with new vegetable and salad plants which are wholly unknown to American consumers. The date is a slow-growing, long-lived plant that can not be top-worked or budded like an apple or orange tree. If a worthless variety has been used to plant a grove the planter will wait five or more years and expend probably not less than a total of $10 per tree only to find that his grove is worthless. On the other hand, this culture is so peculiarly adapted to our southwestern arid region, and the annual importation of dates is so considerable, as to justify a heavy expenditure on the part of the Government to assist in establishing this industry. Consequently, a special garden is maintained at Mecca, Cal., and a large number of suckers have been imported for the two cooperative gardens in Arizona. As the varieties fruit, it will be possible to determine which give good results in the United States, and the natural increase from these trees, though slow, will assist in building up the industry. This will require many years and much money, but it is the only way to carry on this part of the work.

We need not be troubled about a market for dates. If we can produce the fruit the market will be found ready. In some cases, however, this is not so. To some extent a market had to be made for macaroni wheat, especially as a bread wheat, and such new vegetables as the udo and chayote will not sell at present, even if truckers should grow them. In such cases this Office arranges to have a quantity grown at Government expense or by a cooperator who is willing to take the risk and who can induce the stewards of prominent hotels to put the new vegetable on the menu. If the new dish meets with the approval of the guests it is necessary to provide a continuous supply, so that the favor once gained may not be lost. In this way, if the new thing has real merit, the demand will gradually increase, and if the supply keeps pace with the demand a new culture may be permanently established.

A special garden has also been established for the matting grass. This being a new industry, it will be necessary to study out for the United States the methods of propagation, fertilization, etc., required for this plant. If it succeeds, the abandoned rice fields of the Atlantic coast will once more be profitable. The methods employed must be adapted to the requirements of each case.

FORAGE-CROP WORK.

While the important line of cereal introductions is still conducted on the cooperative plan, the equally important work of introducing and distributing grasses, clovers, and other forage crops is carried on wholly by this Office and forms one of the important divisions of the business. Some of the best work ever done in seed introduction has been in the line of forage crops. With the revival, in 1897, of interest in the introduction of crops from abroad this was one of the first matters to receive the attention of the Secretary of Agriculture, and he then sent Professor Hansen to Asia to get seed of the hardy Turkestan alfalfa. The relatively slow progress of this variety, though it was of undoubted value under certain conditions, illustrated one difficulty always to be looked for in the work with new varieties—especially of field crops—that is, the difficulty of getting good seed. Largely because of the uncertain and unsatisfactory supply of seed from abroad and the total absence of a home supply, the spread of this variety lagged, and it was found necessary to distribute the second consignment of seed in such a way as to do something toward establishing a home supply. The method adopted in this case had, therefore, to be somewhat different from that usually followed, and enough seed was sent to each individual to plant from 2 to 25 acres, and contracts were made by which this Office controlled the seed produced. In the case of most forage crops, the course pursued with all introductions is followed, and often unlooked-for success follows what is thought to be merely a routine distribution.

GENERAL DISTRIBUTION.

In its warehouse the Office keeps a supply of seed of such of the standard forage plants and grains as are considered worthy of wide distribution, and to this list is added from time to time some new variety which has been tested and found valuable for a given section. The seeds of all leguminous crops are inoculated with nitrifying organisms in accordance with the methods discovered in the Laboratory of Plant Physiology of the Bureau of Plant Industry, and for this branch of the business drying machinery and cleaning mills of various sorts are required, so that the seeds may be sent out in the best possible condition. The constantly increasing number of requests for seeds of forage plants and grains received from farmers all over the country, many of them coming through members of Congress, necessitated the adoption of some definite position in regard to this work. The object being to accomplish the greatest good from such distribution, it is important to distinguish between idle curiosity, a mere desire to get seeds for nothing, and a genuine wish to try a new crop. So far as practicable, seeds are sent only to persons who will make a

report, even if the report be one of failure. For this work the United States is districted, and the Department's experts select the new or valuable forage and grain crops that should be distributed in each district. Of the varieties so selected, preparations are made to send one or more to any responsible applicant, according as his correspondence may indicate that he can profitably use one or several kinds. As the final tests of new varieties are completed, those sorts that prove valuable will be added to the distribution list. The system which has been organized will eventually, it is hoped, result in the establishment of a corps of good cooperators throughout the United States, and these men will make the final tests of new sorts and assist materially in the introduction of the crop.

SEED GROWING.

Not only is the whole subject of seed growing closely related to this work in a general way, but the establishment of a new seed-growing business will add to the plant industries of the country and is therefore directly in line with the work of this Office.

One of the branches of seed production which it is most important to establish in this country is that of sugar-beet seed. The United States is rapidly becoming a great beet-sugar producer, and yet up to within a few years it was said that we could not grow sugar-beet seed. The best interests of the beet industry, however, demand that we be independent of Europe for our seed and that seed shall be grown for our special conditions. Besides this, the industry itself is worth about half a million dollars a year.

This Office has undertaken, therefore, to do its part in establishing this industry and has been at work for three years developing select strains of pedigreed seed which might serve as a foundation for the production of choice commercial seed. Such seed as has been produced by growers has been purchased and distributed in order at the same time to determine its value and to introduce the American seed to factories. There is no doubt that this industry will be established in due time.

Attention is also being given to the matter of growing flower and field seeds, the latter especially in cases where a new crop is introduced, for which home-grown seed will be wanted.

BULB GROWING AND TRIAL GROUNDS.

This Office is concerned not only with field crops and vegetables but also with cultures that interest the florist and ornamental gardener. So far as it has facilities, it will aid in the introduction of cultures of this class and in the development of new varieties.

There has long been a more or less desultory interest in the culture of Dutch bulbs—tulips, narcissi, and hyacinths—in the United States. Good bulbs of these kinds have been grown at various times but never in commercial quantities. This Office has undertaken to help along this industry by furnishing good stock in some cases and testing such American-grown bulbs as could be obtained. During the spring of 1905, blooms of Emperor narcissus from American-grown bulbs, forced in the Department of Agriculture greenhouses, graced the table of the President of the United States. An expert propagator has been twice sent to the bulb growers to assist them with advice as to methods and to see what was being done. Besides this help given to those interested in bulb culture, a trial ground for bulbs has been maintained on the Potomac Flats, near Washington, so that the chief varieties could be compared and the questions of fertilizers, harvesting, and handling under conditions prevailing on the Atlantic coast could be studied. Here many thousands of bulbs are planted, the stocks of the leading Dutch dealers being compared as to quality. (See Pl. XXV, fig. 2.)

EASTER-LILY BULBS.

Special attention has also been given to the production of the Easter lily in the United States. The bulbs of this lily, so important to the florist, are now imported, and a large percentage is usually diseased. If a place can be found in the United States where healthy stock can be grown and put on the market as early as the bulbs are now received from Bermuda, we shall solve a problem that will be worth much to the commercial florist. Substantial progress has already been made, full reports of which will be made public in due time. This is only mentioned here as one of the lines of work in which this Office is engaged.

VEGETABLE TRIAL GROUNDS.

In order to have first-hand information about the quality of the seed used for Congressional distribution, to keep up with the times in the matter of new varieties, and to do something toward systematizing the knowledge of varieties of American vegetables, trial grounds are maintained at the Arlington Farm and on the Potomac Flats, near Washington, and annual trials are conducted at various places in the United States. (See Pl. XXV, fig. 1.) All of this work is under the direction of Mr. W. W. Tracy, sr., whose long experience at the head of a large commercial trial ground and whose intimate knowledge of vegetable varieties especially qualify him for this work. At the Arlington Farm tests are made of samples of all lots of vegetable seeds distributed through Congressional orders. Here also the principal new varieties offered by seedsmen each year are tested. Besides the tests at Arlington, the trial-ground work looking to the preparation of

FIG. 1.—VEGETABLE TRIAL GROUNDS OF THE OFFICE OF SEED AND PLANT INTRODUCTION AND DISTRIBUTION ON THE POTOMAC FLATS.

FIG. 2.—BULB TRIAL GROUNDS OF THE OFFICE OF SEED AND PLANT INTRODUCTION AND DISTRIBUTION, SHOWING TULIPS AND HYACINTHS.

PACKETING SEEDS FOR CONGRESSIONAL DISTRIBUTION.

standard descriptions of all the recognized vegetable varieties is carried on at a number of places in the United States. Several hundred samples are planted on each of these tracts, so that the effect of different soil and climate may be noted for each variety. Careful notes are kept on these tests, and from the field descriptions that are made it is proposed to issue standard descriptions of all the recognized varieties as soon as possible. It is hoped that these bulletins may become useful handbooks for the seedsmen, especially for such as can not well conduct extensive trial grounds, and that in course of time the catalogue descriptions may be more unified than is the case at present.

CONGRESSIONAL DISTRIBUTION OF VEGETABLE AND FLOWER SEEDS.

The distribution of vegetable and flower seeds on Congressional orders is the largest single business this Office has to handle. The total number of packets put up and mailed during the fiscal year 1905 was 35,773,400. These were assembled into packages of five packets each, making 7,110,680 packages. The seed purchased to fill all these packets was enough to fill 28 cars of 30,000 pounds per car. The work of packeting begins about November 1 of each year and is completed before the end of the April following, the greater part of the work being done in a little more than four and a half months of this period. If we consider the work to extend over six months 500 packets are put up every minute of every working day of eight hours during that time. During much of the time as many as 1,000 packets per minute are put up.

The Secretary of Agriculture has pointed out that, while it is his duty to carry on the distribution in accordance with the wishes of Congress, the money expended for vegetable and flower seeds could probably be more profitably used for the introduction of new and rare seeds, such as grains, forage crops, cotton, tobacco, and the like. The large quantities of seed needed make it impossible to use the rare varieties even if there were a sufficient number of new and valuable varieties of vegetable seeds each year to fill the requirements. The number of really new and desirable varieties of vegetables that appear each year is extremely small, and the seedsmen of to-day are so thoroughly awake to the importance of introducing novelties that any new variety quickly finds its way into the trade.

It is only the standard varieties of vegetable and flower seeds, therefore, that can be used in the general free distribution. These are in more or less regular supply in the trade, and while the stocks vary in quality it is not difficult for those who understand the business and who know the sources of supply to secure each year first-class seeds at reasonable prices. This Office aims to get seeds of the best value. This, of course, does not mean the cheapest seed, as everyone knows

that the value of vegetable seed is not measured solely by the price. Vitality and trueness to type, or purity of stock, are of the utmost importance, and of these the latter can be determined only by a field inspection. Experts must therefore be employed who know the general character of each grower's stock, and part of whose business it is to visit the principal growers at least once each year to keep posted on their work and on the quality of their stock. The objects kept in view are (1) to obtain good seeds—as good as those sold by the best mail-trade houses (though they are no better, since the seeds are bought mostly from the growers who supply the seed trade); and (2) to get these seeds at the best prices.

The first step in arranging for a new annual distribution is to prepare suitable combinations to send into the different sections of the United States. For convenience the country is divided into four sections; and in order to send as wide a range of desirable sorts as possible into each section a number of combinations are made up, each of five kinds of vegetable seed, and each is so planned that it shall contain a good assortment.

These combinations are made up with much care and are the foundation of our work. The number of Senators, Representatives, and Delegates in Congress in each section being known, this number is multiplied by 12,000, the number of packages constituting a "quota," and the result shows the aggregate number of packages of all combinations needed for that section. The various combinations in a section are made equal in number, or nearly so, and when all the combinations are made the number of packets of each kind needed can be readily determined. This information is necessary before buying can begin, so that all the seeds bought may be purchased with a definite purpose.

The seed needed is secured in one of two ways: (1) It is bought outright, the seeds being on hand at the time of purchase, or (2) it is contracted for, the Department agreeing to pay a fixed sum for all seed of satisfactory quality delivered up to a given amount. All seeds offered are considered by a special committee which consults with the seed experts of the Bureau of Plant Industry and recommends purchases in accordance with the following considerations:

(1) The known quality of the stocks offered.

(2) The reputation of the firm making the offer.

(3) The price, calculated upon delivery at Washington, D. C.

The price, though important, is never the first consideration; good seeds must be secured at a fair price, and "the best value" is the watchword in the work. The packeting of the seed is done by contract. A view of the room in which the work is done is given in Plate XXVI.

FRUIT AND ITS USES AS FOOD.

By C. F. Langworthy, Ph. D.,
Of the Office of Experiment Stations.

INTRODUCTION.

Edible fruits show the greatest range in form, color, and appearance and are found in almost countless varieties; yet from the botanist's standpoint all our fruits are the seed-bearing portion of the plant. The edible fruits of temperate regions fall into a few groups—stone fruits, like cherries and plums; pome fruits, like apples and pears; grapes; and berries, like strawberries, blackberries, and currants. There are several products, such as muskmelons, cantaloupes, and watermelons, sometimes classed as fruits and sometimes as vegetables, which, of course, would not belong to any one of these groups. Tropical fruits are not so easily classified, though the citrus family (oranges, lemons, etc.) includes many of the more common sorts.

COLOR AND FLAVOR OF FRUITS.

Fruits, like leaves and flowers, owe their varied color to a number of chemical compounds, the green to chlorophyll (the characteristic coloring matter of green leaves), the yellow to xanthin bodies and other yellow pigments, and the blue and red to solutions in the cell sap of complex coloring matters which have in most cases been isolated and classified. Several coloring matters are often present in combination and give rise to the great variety of shades which different fruits present. In white fruits coloring matter is absent from the epidermis and the cells are said to be filled with air. As fruits develop, mature, and deteriorate, the coloring matters present undergo marked chemical changes, and color is one of the most common means of judging of ripeness.

Attractive color has a decided effect on market value, and the public demand varies greatly in different regions. Thus, a yellow or russet dessert apple is demanded in the French market, while in many parts of the United States the red apple has the preference. A faded, dull color is often an indication of staleness; strawberries and raspberries which have been kept too long have little of the brilliant color of freshly gathered fruit. That fruit colors in general are not very permanent is shown by the way the color deteriorates on long-continued

cooking or fades when canned and preserved fruits are exposed to the light.

The brown discoloration of the freshly cut surfaces of fruit on exposure to the air is due to the oxidizing action of active ferments normally present in the fruit.

Fruits owe their flavor in considerable degree to the sugars and the malic, citric, and other acids which they contain, but the flavor which is so characteristic of different kinds is almost entirely due to ethereal bodies. The amount present is often too small for determination by the usual chemical methods. However, in many cases these flavor-giving bodies have been studied and their chemical nature is known. With the orange and other citrus fruits the oil found in the skin has a very characteristic odor and flavor which are always associated in our minds with the flavor of the fruit. Obviously, the small amount of these bodies of pronounced odor and flavor can not materially modify the nutritive value of fruits, but they are of great importance in considering the place of fruit in the diet, as they are very largely responsible for its attractiveness and palatability. There is no doubt that we all eat more readily the foods which please our palate than those which are of indifferent flavor, and there is every reason to believe that the foods which please are actually digested more easily than those which do not, since they stimulate a normal and abundant production of digestive juices.

COMPOSITION OF FRUITS.

Determining the proportion of water, protein, fat, carbohydrates (nitrogen-free extract and crude fiber), and ash in fruits as in other foods furnishes a convenient basis for judging of their relative food value. It is quite common for chemists to determine, instead of their proximate constituents, the proportions of the different nitrogenous bodies present, as well as the amounts of the different sugars, etc., which in the ordinary method of analysis are grouped with the carbohydrates.

The more detailed analyses are of great interest and value for many reasons, but with our present knowledge it seems fair to assume that the various sugars and starches, for instance, have the same nutritive value, and so a knowledge of the total quantity of these bodies present gives very satisfactory data for estimating the food value of the group.[a] Very many analyses and studies of fruit and fruit products have been made by chemists of the agricultural experiment stations, as well as by the different Bureaus of the Department of Agriculture. The following table summarizes a large amount of such data and shows the composition of fresh, dried, and preserved fruits and

[a] An extended summary of the more detailed analyses of fruits and fruit products may be found in König's Chemie der menschlichen Nahrungs- und Genussmittel. Berlin: 1903, vol. 1, 4th ed., pp. 820–895.

fruit products, and for comparison the composition of a few other foods as well.

Average composition of fruits and fruit products.

FRESH FRUITS.

Kind of fruit.	Refuse.	Edible portion.						
		Water.	Protein.	Ether extract.	Carbohydrates.		Ash.	Fuel value per pound.
					Nitrogen-free extract.	Crude fiber.		
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories*
Apples	25.0	84.6	0.4	0.5	13.0	1.2	0.3	290
Apricots	6.0	85.0	1.1	....	13.4		.5	270
Avocado	29.0	81.1	1.0	10.2	6.8		.9	512
Bananas	35.0	75.3	1.3	.6	21.0	1.0	.8	460
Blackberries	....	86.3	1.3	1.0	8.4	2.5	.5	270
Cherries	5.0	80.9	1.0	.8	16.5	.2	.6	365
Cranberries	....	88.9	.4	.6	8.4	1.5	.2	215
Currants	....	85.0	1.5	....	12.8		.7	265
Figs	....	79.1	1.5	....	18.8		.6	380
Grapes	25.0	77.4	1.3	1.6	14.9	4.3	.5	450
Huckleberries	....	81.9	.6	.6	16.6		.3	345
Lemons	30.0	89.3	1.0	.7	7.4	1.1	.5	205
Muskmelons	50.0	89.5	.6	....	7.2	2.1	.6	185
Nectarines	6.6	82.9	.6	....	15.9		.6	305
Olives	17.9	67.0	2.5	17.1	5.7	3.3	4.4	407
Oranges	27.0	86.9	.8	.2	11.6		.5	240
Peaches	18.0	89.4	.7	.1	5.8	3.6	.4	190
Pears	10.0	80.9	1.0	.5	15.7	1.5	.4	163
Persimmons	[a]25.0	66.1	.8	.7	29.7	1.8	.9	630
Persimmons (Japanese)	24.0	80.2	1.4	.6	15.1	2.1	.6	174
Pineapples	40.0	89.3	.4	.3	9.3	.4	.3	200
Plums	5.0	78.4	1.0	....	20.1		.5	395
Pomegranates	[a]30.0	76.8	1.5	1.6	16.8	2.7	.6	460
Prunes	5.8	79.6	.9	....	18.9		.6	370
Raspberries (red)	....	85.8	1.0	....	9.7	2.9	.6	255
Raspberries (black)	....	84.1	1.7	1.0	12.6		.6	310
Scarlet haws	20.0	75.8	2.0	.7	18.6	2.1	.8	212
Strawberries	5.0	90.4	1.0	.6	6.0	1.4	.6	180
Watermelons	59.4	92.4	.4	.2	6.7		.3	140
Whortleberries	....	82.4	.7	3.0	10.3	3.2	.4	390

DRIED FRUITS.

Apples	....	26.1	1.6	2.2	62.0	6.1	2.0	1,350
Apricots	....	29.4	4.7	1.0	62.5		2.4	1,290
Bananas [b]	....	29.2	5.3	2.3	55.8	2.1	5.3	1,240
Banana flour	....	9.7	3.1	.5	83.4	.7	2.6	1,610
Citrons	....	19.0	.5	1.5	78.1		.9	1,525
Dates	10.0	15.4	2.1	2.8	74.6	3.8	1.3	1,615
Figs	....	18.8	4.3	.3	68.0	6.2	2.4	1,475
Pears	....	16.5	2.8	5.4	66.0	6.9	2.4	1,635
Prunes	15.0	22.3	2.1	....	71.2	2.1	2.3	1,400
Raisins	10.0	14.6	2.6	3.3	73.6	2.5	3.4	1,605
Raspberries	....	8.1	7.3	1.8	80.2		2.6	1,705
Zante currants	....	17.2	2.4	1.7	71.2	3.0	4.5	1,495

[a] Assumed. [b] European analysis.

Average composition of fruits and fruit products—Continued.

CANNED FRUITS, PRESERVES, JELLIES, ETC.

Kind of fruit.	Refuse.	Edible portion.						
		Water.	Protein.	Ether extract.	Carbohydrates.		Ash.	Fuel value per pound.
					Nitrogen-free extract.	Crude fiber.		
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories*
Crab apples (canned)	....	42.4	0.3	2.4	54.4		0.5	1,120
Apple sauce	....	61.1	.2	.8	37.2		.7	730
Apricots (canned)	....	81.4	.9	....	17.3		.4	340
Apricot sauce	....	45.2	1.9	1.3	48.8		2.8	1,000
Blackberries (canned)	....	40.0	.8	2.1	56.4		.7	1,150
Blueberries (canned)	....	85.6	.6	.6	12.8		.4	275
Cherries (canned)	....	77.2	1.1	.1	21.1		.5	415
Cherry jelly	....	21.0	1.1	....	77.2		.7	1,455
Figs, stewed	....	56.5	1.2	.3	40.9		1.1	785
Grape butter	....	36.7	1.2	.1	58.5		3.5	1,115
Olives, green, pickled	27.0	58.0	1.1	27.6	11.6		1.7	1,400
Olives, ripe, pickled	19.0	64.7	1.7	25.9	4.3		3.4	1,205
Orange marmalade	....	14.5	.6	.1	84.5		.3	1,585
Peaches (canned)	....	88.1	.7	.1	10.8		.3	220
Pears (canned)	....	81.1	.3	.3	18.0		.3	355
Pineapples (canned)	....	61.8	.4	.7	36.4		.7	715
Prunes, stewed	....	76.6	.5	.1	22.3		.5	430
Strawberries, stewed	....	74.8	.7	....	21.0		.5	460

OTHER FOODS FOR COMPARISON.

Cabbage	15.0	91.5	1.6	0.3	4.5	1.1	1.0	145
Potatoes	20.0	78.3	2.2	.1	18.0	.4	1.0	385
Wheat flour, high grade	....	12.0	11.4	1.0	74.8	.3	.5	1,650
Corn meal, bolted	....	12.5	9.2	1.9	74.4	1.0	1.0	1,655
White bread	....	35.3	9.2	1.3	52.6	.5	1.1	1,215
Beans, dried	....	12.6	22.5	1.8	55.2	4.4	3.5	1,605

Most fruits, like other classes of foods, contain more or less material, such as pits, skin, etc., which is inedible. When such portions are removed a larger or smaller part of the edible material is almost always of necessity removed also, and is spoken of as "waste." In reporting analyses the amounts of inedible material and waste are grouped together under the heading "refuse." As may be seen from the above table, the proportion of refuse in fruits varies within rather wide limits. Thus, of pears it constitutes on an average 10 per cent of the total fruit, peaches 18 per cent, apples and grapes 25 per cent, and bananas 35 per cent, while in the case of raspberries and blackberries there is no refuse and the whole fruit can be eaten. The composition of some fresh and dried fruits is shown graphically in figure 81.

The analytical data quoted above show that fresh fruits are in general dilute foods—that is, the proportion of water which they contain is large compared with the total amount of nutritive material. It has been suggested that fruits containing 80 per cent or more of water be

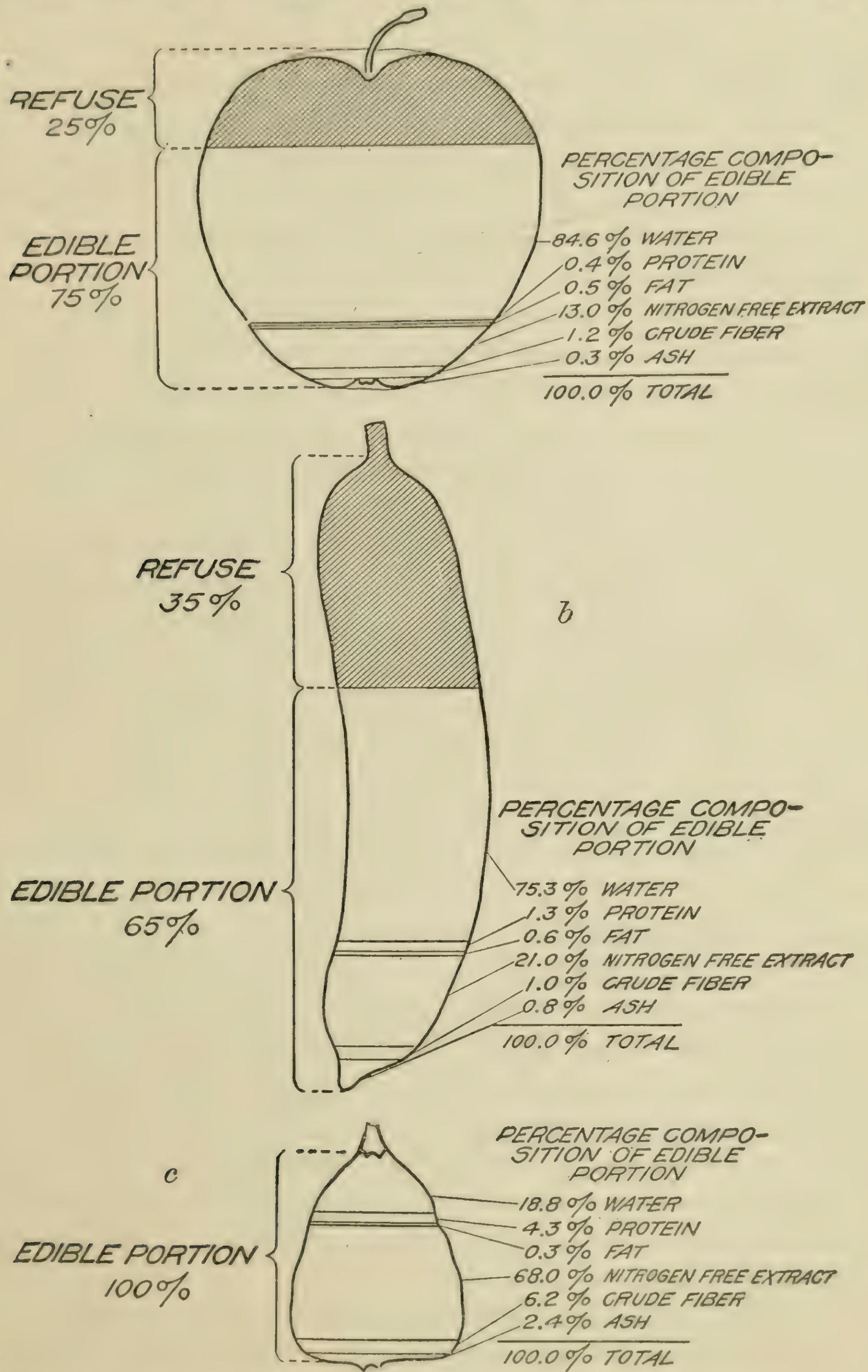

FIG. 81.—Composition of apple (*a*), banana (*b*), and dried fig (*c*).

classed as flavor fruits and those with less than 80 per cent as food fruits. As may be seen from the table (p. 309), such fruits as strawberries, blackberries, and raspberries would be included in the first

class, and fresh figs, bananas, grapes, etc., in the second. In dried fruits, which have been concentrated by evaporation, the percentage of nutrients is very much higher than in fresh fruits. Some preserved fruits also possess a comparatively high nutritive value, owing to the evaporation of water by the heat of cooking or to the addition of sugar, or to both factors.

Olives and the avocado are remarkable for the large percentage of fat which they contain, but in general it may be said that this constituent is present in very small proportion in fresh fruits. In the case of the apple, pear, etc., it seems probable that the small amount of fat obtained in chemical analysis consists of the coloring matter contained in the fruit.

In the majority of fruits and fruit products the carbohydrates are the food constituents most abundantly represented. The figures in the table show that the proportion of nitrogen-free extract varies greatly, being lowest in the fresh and highest in the dried and preserved fruits. It is interesting to consider also the values which have been reported for some of the constituents not shown in the table but included in the group "nitrogen-free extract." In seeds which are commonly eaten, such as the cereal grains, and beans, peas, and other legumes, the nitrogen-free extract is quite largely made up of starches. In fruits, however, sugars and the so-called pectin bodies, with very often more or less starch, make up the group. The principal sugars in fruit are cane sugar, grape sugar (glucose), and fruit sugar (levulose), the last two being usually present together in equal quantity and designated invert sugar or reducing sugar. The stage of growth and the degree of ripeness have a very marked effect on the kind and amount of sugar, and it is therefore difficult to give average figures for the quantities present which will be fairly representative. An idea of the range in the sugar content of ripe fruits may be gathered from figures quoted from a summary[a] published several years ago. According to these data, invert sugar ranged from 2 per cent in round numbers in large early apricots to 15 per cent in grapes and a variety of sweet cherries. A number of fruits (strawberries, gooseberries, raspberries, and apples) contained about half the latter quantity. The cane sugar ranged from less than 1 per cent in lemons to 14 per cent in a variety of plums. Bananas also contained a fairly high percentage, namely, 11 per cent.

Fruit sugar rarely occurs unaccompanied by grape sugar, but has been thus reported in the mango and in amounts large in proportion to the grape sugar in sweet apples and sweet pears and a number of varieties of grapes. In the case of grape sugar large amounts—18 to 30 per cent—have been reported in juice of different sorts of grapes,

[a] Lippmann: Chemie der Zuckerarten, 1895, 3d ed., pp. 493, 591; 1904, 4th ed., pp. 200, 794.

while in dried fruits the values are even higher, 32 per cent having been found in prunes, 54 per cent in Zante currants, 61 per cent in raisins, 48 per cent in figs, and 66 per cent in dates.

The acid in fruits, which in proximate analyses is not usually determined separately, varies within rather wide limits, 1 to 2 per cent being reported on an average in such fruits as apples, pears, plums, strawberries, etc., and as high as 7 per cent or more in lemon juice. It often happens that of two fruits with the same acid content one has a much sourer taste than the other, because the acid is not so much masked by sugar.

Fruits contain a comparatively small amount of mineral matter—less than 1 per cent on an average—consisting quite largely of potassium salts, with a little phosphoric acid, iron, lime, etc.

As a class, it is apparent that fresh fruits are directly comparable with green vegetables and root crops rather than with more concentrated foods, such as flour or meal. The dried and some of the preserved fruits, which are more concentrated than the fresh, compare favorably with bread, dried beans, and similar foods on the basis of total food material present. There is this difference, however, that the cereals and dried legumes contain fairly large proportions of protein, while the quantity present in fruits is always small. In other words, fruits—fresh, dried, and preserved—are sources of energy rather than of tissue-forming material.

RIPENING AND ITS EFFECT ON COMPOSITION.[a]

As fruits grow to their full size and ripen they undergo marked changes in chemical composition with respect both to the total and to the relative amount of the different chemical bodies present. When stored after gathering, the changes continue, some fruits improving on storage and others deteriorating very rapidly. In general, ripe fruits are less acid than green, and contain less starch, woody material, crude fiber, and the carbohydrates known as pectin bodies, and correspondingly larger amounts of the different sugars.

A knowledge of the changes which accompany the growth, ripening, and storage of fruits is very important commercially as well as from the housekeeper's standpoint. For instance, in cider making it is desirable that the fruit should be used when the sugar content is high, as the quality of cider and vinegar is largely determined by the amount of sugar present. As every housewife knows, underripe fruit—that is, fruit which still contains the so-called pectin bodies rather than the sugars characteristic of fully ripened fruit—is the most satisfactory for jelly making. In the case of bananas the underripe fruit, rich in

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[a] A number of investigations on this subject have been reported from the Bureau of Chemistry by Bigelow and his associates. U. S. Dept. Agr., Bur. Chem. Buls. 94 and 97.

starch, is best for cooking, and the very ripe fruit, in which the starch has been changed into sugar, for use uncooked. It is not unlikely that failure to recognize this distinction is responsible for the digestive disturbance which many persons experience when bananas are eaten, as the raw, underripe, starchy fruits are generally conceded to be difficult of digestion. The underripe bananas, when dried, sliced, and ground, yield a flour or meal rich in starch, while the riper fruit with the higher sugar content, sliced and dried, is very sweet and not unlike figs in composition.

PLACE OF FRUIT IN THE DIET.

In most families fruits are commonly thought of as a food accessory, and are prized for their pleasant flavor or for supposed hygienic reasons rather than for their food value; yet a study of available figures shows that they constitute a by no means unimportant part of the diet, since they supply, on the basis of recent statistics, 5.6 per cent of the total food and 4.9 per cent of the total carbohydrates of the average American diet. With a view to learning something more definite regarding the possibilities of fruits as sources of nutrients, the relative cost of nutrients supplied by fruits and other foods, the digestibility of a fruit diet as compared with an ordinary mixed diet, and related questions, extended investigations were undertaken at the California Agricultural Experiment Station by Prof. M. E. Jaffa, the work as a whole being carried on in cooperation with the nutrition investigations of the Office of Experiment Stations. In the first series reported six dietary studies were made with fruitarians—two women and four children who had lived on a fruit and nut diet for several years. The dietary studies covered from twenty to twenty-eight days, and the daily food consisted of different combinations of fruits and nuts, of which the following day's ration may serve as a sample: 475 gm. apples, 110 gm. bananas, 850 gm. oranges, 5 gm. dates, 2 gm. honey, 10 gm. olive oil, 55 gm. almonds, 70 gm. pine nuts, and 50 gm. walnuts.

The later studies were made with one of the women and two of the children included in the first group, and in addition with two elderly men who had been vegetarians for years and had limited their diet almost exclusively to fruits and nuts, and with two young men, university students, who were accustomed to the ordinary diet, though one of them had experimented with a vegetarian and fruitarian diet for some time. The students and one of the elderly men ate three meals a day at the usual hours. The others ate but twice, the first meal being taken between 10 and 11 o'clock in the morning and the second between 5 and 6 o'clock in the afternoon. As before, the diet included a large assortment of fresh fruits, with considerable quantities of dried fruits and nuts, and some honey and olive oil. In a few cases small quantities of other foods were also eaten.

Considering these studies as a whole, the diet of the women and children furnished from 32 to 43 gm. of protein and 1,190 to 1,430 calories of energy per day, the cost ranging from 15.7 to 27.5 cents. It is the usual custom to discuss dietary studies on the basis of the amounts eaten per man per day, and the results obtained with these women and children, when recalculated to this basis, showed a range of 47 to 80 gm. of protein and 1,850 to 2,805 calories of energy, the cost of the daily food ranging from 21 to 55 cents per man per day. In the studies with the young and the old men the protein supplied by the daily diet ranged from 40 to 85 gm. and the energy from 1,712 to 3,305 calories, the average being 62 gm. protein and 2,493 calories, the cost ranging from 18.1 to 47 cents per person per day. These amounts are considerably smaller than have been found on an average with families living in many different regions of the United States and under a variety of conditions, as is shown by the fact that with 52 families in comfortable circumstances the average protein in the daily diet was 103 gm. and the average energy 3,500 calories. On the other hand, in many of the dietary studies made under the auspices of the Office of Experiment Stations it has been found that persons living on a mixed diet have obtained amounts directly comparable with those supplied by the fruitarian diet. Thus, at the North Dakota Agricultural College several years ago a dietary study showed that the food consumed per man per day by a group of students furnished 64 gm. protein and 2,579 calories, and at Lake Erie College 68 gm. protein and 2,610 calories, calculated on a uniform basis per man per day.

In a recent investigation carried on at Harvard it was found that the diet of 9 students who lived at the college commons and from necessity or choice endeavored to live cheaply supplied, on an average, 89 gm. protein and 3,068 calories. In this case the average cost was 39.9 cents per day, and at the North Dakota and the Lake Erie colleges 13 and 18 cents, respectively. It will thus be seen that in the California investigations the fruit and nut diet supplied the subjects with amounts of protein and energy which are directly comparable with those obtained by many other persons from a mixed diet, though in general the quantities were smaller than is supplied by the diet of the average family. It should be said that the persons living on a fruit and nut diet apparently maintained their normal health and strength, and it is only fair to conclude that if for any reason such a course seems desirable it is perfectly possible to select a diet made up of fruits and nuts, which for long periods at any rate will supply the body with the requisite protein and energy, as was shown by a detailed study of the results of the California experiments. In such a diet nuts were the principal source of protein, and nuts, olives, or the expressed olive oil the chief source of fat, while fruits, fresh and dried, supplied the bulk of the carbohydrates.

As regards cost, it will be seen that there was a considerable range with the fruitarian diet, the amount expended per person per day being in some cases quite low and in others quite high. On the whole, the range did not differ greatly from that observed in many instances on an ordinary mixed diet.

It would seem from the recorded data that it is more difficult for the subjects to obtain the requisite amount of protein when on a limited diet of one kind of nut combined with fruits than it is when they are unrestricted and eat a variety of both fruits and nuts. In nearly all cases where the diet was limited to combinations of one or two fruits with one kind of nuts the subjects complained of a constant craving for some other food, such as green vegetables or cereals, and in these cases it was found that the coefficients of digestibility were lower than in those tests in which some vegetable or cereal was eaten, which made the diet more appetizing. The addition of a small amount of some cereal food to the diet markedly increased its protein and energy value.

It would be going too far to conclude on the basis of the California investigations that a fruitarian diet in general is equal or superior to the ordinary diet, and indeed the study of this question was not a part of the investigation. Before such a conclusion could be drawn it would be necessary to make investigations extending over a long period of years and with a variety of subjects, and which would take into account resistance to disease and other unfavorable conditions, body development, the health and condition of the offspring of persons living for years on such a diet, and other similar questions. It seems fair to say, however, that at the present time the consensus of opinion of well-informed physiologists is that the ordinary mixed diet is most convenient and satisfactory for the average individual. It is equally clear from the investigations reported that fruits and nuts should not be looked upon simply as food accessories, but should be considered a fairly economical source of nutritive material. It must be remembered, too, that the use of fruits, fresh and preserved, often makes palatable an otherwise rather tasteless meal. Jam with our bread is a reasonable combination, the highly flavored fruit product whetting the appetite for the needed quantity of rather flavorless bread.

DIGESTIBILITY OF FRUIT.

In addition to the dietary studies, a large number of digestion experiments were made at the California Experiment Station for the purpose of learning how thoroughly a diet made up of various combinations of fruits and nuts was assimilated. In such an experiment covering 10 days, made with a child 7 years old, on an average 82 per cent of the protein, 87 per cent of the fat, 96 per cent of the nitrogen-free extract (sugar, starches, etc.), 80 per cent of the crude fiber, and 54 per cent of

the ash of the food eaten were digested, and 87 per cent of the energy of the diet was available to the body. In 30 experiments with men 75 per cent of the protein, 86 per cent of the fat, 95 per cent of the nitrogen-free extract, 79 per cent of the crude fiber, and 55 per cent of the ash of the fruit and nut diet were digested, and 86 per cent of the energy was available. These values are comparable with those obtained from an ordinary mixed diet, as is shown by the fact that in 93 experiments with young men 93 per cent of the protein, 95 per cent of the fat, and 98 per cent of the total carbohydrates supplied were assimilated. The average coefficients of digestibility which have been calculated for fruits in connection with the nutrition investigations carried on under the auspices of the Office of Experiment Stations are protein 85 per cent, fat 90 per cent, and carbohydrates 90 per cent, and those for fresh vegetables, protein 83 per cent, fat 90 per cent, and carbohydrates 95 per cent.

The feces excreted per person per day on the fruit and nut diet in the California experiments were less in amount than has been the case in some experiments with a mixed diet or a ration of bread and milk. This is contrary to what has been commonly found with a vegetarian diet made up of bread and other cereal foods, garden vegetables, etc., and containing little if any fruit or nuts. The percentage of so-called metabolic nitrogen in the feces from the fruit and nut diet did not exceed that reported by other investigators in tests with a bread and milk diet. In other words, if the amount of metabolic products can be looked upon as a measure of the work of digestion, no more effort is required to digest the fruit and nuts than is needed for bread and milk. Although, as Professor Jaffa points out, it is undoubtedly advisable to wait until more data have been obtained before making definite statements regarding the digestibility of fruits and nuts, enough has been done to show that they are thoroughly digested and have a higher nutritive value than is popularly attributed to them. In view of this it is certainly an error to regard fruit as something of value only for its pleasant flavor or for its hygienic or medicinal properties, or to consider nuts simply as an accessory to an already hearty meal. As shown by the composition and digestibility of both fruit and nuts, they can be favorably compared with other and more common food.

So far as can be learned, comparatively few investigations have been made to ascertain the digestibility of particular fruits, raw or cooked. In a series of investigations recently reported by Bryant and Milner the digestibility of apple sauce was determined when eaten with a simple basal ration. The coefficients of digestibility for apple sauce alone were calculated in the usual way and were, protein 28 per cent, nitrogen-free extract 99.6 per cent, crude fiber 96 per cent, and ash 100 per cent, while all the energy supplied by the apple sauce was

considered to be available to the body. The coefficient of digestibility of protein is low, but, as the authors pointed out, the total amount of this constituent present was so small that it may be disregarded. This investigation, like those at the California Experiment Station, indicates that the fruit carbohydrates (sugar, starches, etc.), that is, the principal nutritive materials which fruits supply, are very thoroughly assimilated.

Few studies seem to have been made to determine the ease or rapidity of digestion of different fruits in the stomach, but a comparison of available data indicates that fruits compare favorably with other common foods as regards stomach digestion. Apparently it is fair to say that stomach digestion is influenced by the nature of the fruit and its stage of ripeness. Beaumont states that mellow sour apples eaten uncooked require 2 hours for digestion in the stomach and mellow sweet apples 1.5 hours. Another observer notes that about 5 ounces of raw ripe apple requires 3 hours and 10 minutes for digestion in the stomach, but states that if the fruit is unripe, and consequently contains a high proportion of cellulose, a much longer time may be required.

Little is definitely known regarding the relative digestion and absorption of fruits in the intestine, but experiments indicate that as a class ripe fruits are quite thoroughly digested, and it is evident that, generally speaking, fruits, like other foods, usually remain in the intestinal tract long enough for the body to absorb the nutritive material present, and that therefore the rate of intestinal digestion would not be a matter of special importance.

RELATIVE ECONOMY OF FRUITS AND OTHER FOODS.

In connection with his studies of the comparative value of fruits Professor Jaffa summarizes data regarding the cost of nutrients and energy supplied by fruits as compared with some other foods at certain values per pound. Some of his data follow:

Comparative cost of total nutrients and energy in fruits and other food materials at certain average prices.

FRESH FRUITS.

Kind of food material.	Price per pound.	Cost of 1 pound protein.	Cost of 1,000 calories energy.	Amounts for 10 cents. Total weight of food materials.	Protein.	Fat.	Carbohydrates.	Energy.
	Cents.	Dollars.	Cents.	Pounds.	Pounds.	Pounds.	Pounds.	Calories
Apples	1.5	5.00	7.3	6.67	0.02	0.02	0.72	1,467
Bananas	7.0	8.75	23.3	1.43	.01	....	.21	429
Grapes	4.0	4.00	11.9	2.50	.03	.03	.36	837
Oranges	6.0	10.00	35.2	1.67	.01	....	.14	284
Peaches	4.0	8.00	25.1	2.50	.01	....	.19	398
Pears	3.0	6.00	11.5	3.33	.02	.01	.42	866

Comparative cost of total nutrients and energy in fruits and other food materials at certain average prices—Continued.

FRESH FRUITS—Continued.

Kind of food material.	Price per pound.	Cost of 1 pound protein.	Cost of 1,000 calories energy.	Amounts for 10 cents.				
				Total weight of food materials.	Protein.	Fat.	Carbohydrates.	Energy.
	Cents.	*Dollars.*	*Cents.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Calories.*
Plums	3.0	3.33	8.1	3.33	0.03	....	0.64	1,232
Watermelons	1.5	7.50	25.0	6.67	.01	....	.18	400
Blackberries	7.0	5.38	25.9	1.43	.02	0.01	.16	386
Cranberries	5.0	12.50	23.3	2.00	.01	.01	.20	430
Currants	5.0	3.33	18.9	2.00	.03	....	.26	530
Raspberries	7.0	7.00	27.4	1.43	.01	....	.18	365
Strawberries	7.0	7.78	40.0	1.43	.01	.01	.10	250
DRIED FRUITS.								
Apples	12.0	7.50	8.9	0.83	0.01	0.02	0.55	1,121
Dates	10.0	5.26	6.9	1.00	.02	.03	.71	1,450
Figs	15.0	3.50	10.2	.67	.03	....	.50	988
Prunes	10.0	5.56	8.4	1.00	.02	....	.62	1,190
Raisins	10.0	4.35	6.9	1.00	.02	.03	.69	1,445
JAMS, PRESERVES, ETC.								
Apple preserves	16.0	91.43	13.8	0.62	....	....	0.39	727
Apple butter	5.0	10.00	5.6	2.00	0.01	....	.94	1,780
Currant and raspberry jam	16.0	26.66	12.8	.62	....	....	.42	781
Gooseberry jam	16.0	32.00	13.2	.62	....	....	.40	752
Orange marmalade	16.0	26.66	10.1	.62	....	....	.52	983
Prune sauce	16.0	32.00	37.2	.62	....	....	.14	267
Strawberry preserves	16.0	26.67	12.0	.62	....	....	.44	833
Apple jelly	16.0	53.33	12.2	.62	....	....	.43	812
Currant jelly	16.0	40.00	13.4	.62	....	....	.40	744
Guava jelly	16.0	53.33	10.5	.62	....	....	.51	952
Quince jelly	16.0	80.00	13.3	.62	....	....	.40	750
Apricots, canned	16.0	17.78	47.1	.62	.01	....	.11	211
Pears, canned	16.0	53.33	45.5	.62	....	....	.11	220
Peaches, canned	16.0	20.00	53.2	.62	....	....	.09	188
Grape juice	20.0	83.33	128.2	.50	....	....	.04	78
OTHER FOODS FOR COMPARISON.								
Porterhouse steak	25.0	1.31	22.5	0.40	0.07	0.07	....	444
Leg mutton, hind	20.0	1.30	22.2	.50	.07	.07	....	445
Whole milk	3.5	1.06	10.5	2.86	.09	.11	0.14	925
Skim milk	2.0	.59	11.8	5.00	.17	.02	.26	850
Wheat flour, patent roller process, high grade and medium	2.5	.22	1.5	4.00	.46	.04	3.00	6,600
White bread	5.0	.54	4.2	2.00	.18	.03	1.06	2,430
Rye bread	5.0	.56	4.3	2.00	.18	.01	1.06	2,360
Sugar	6.0	....	3.2	1.67	....	....	1.67	3,106
Candy	20.0	....	11.2	.50	....	....	.48	892
Beans, dried	5.0	.22	3.1	2.00	.45	.03	1.19	3,210
Celery	5.0	5.56	71.4	2.00	.02	....	.05	140
Potatoes, 90 cents per bushel	1.5	.83	4.8	6.67	.12	.01	.98	2,068

From the data in the foregoing table it appears that fruits are comparatively expensive sources of protein as compared with flour or dried legumes, the fruit juices being the most expensive and the dried fruits the cheapest of the fruit products. Ten cents on an average will purchase fully as much energy when spent for fresh fruits and more when spent for dried fruits than for lean meats, but much less than when expended for wheat flour. From the data as a whole it is apparent that fruits are reasonably cheap sources of energy in the diet and are well suited on grounds of economy for combination in reasonable quantity with cheap proteid foods to furnish a well-balanced ration.

RAW AND COOKED FRUIT.

In different countries opinions vary markedly regarding the relative wholesomeness of raw and cooked fruit. Thus, as has often been pointed out, the Germans use comparatively little raw fruit and consider it far less wholesome than cooked fruit. On the other hand, in the United States raw fruit of good quality is considered extremely wholesome and is used in very large quantities, being as much relished as cooked fruit, if indeed it is not preferred to it. It has been suggested that the European prejudice against raw fruit may be an unconscious protest against unsanitary methods of marketing or handling and the recognition of cooking as a practical method of preventing the spread of disease by fruit accidentally soiled with fertilizers in the fields or with street dust. The cooking of fruit has practical advantages in many cases, since it softens the flesh and renders it more readily acted upon by the digestive juices. This is obviously a more important matter with fruits like the quince, which are so hard that they are unpalatable raw, than it is with soft fruit like strawberries. Cooking also gelatinizes some of the characteristic carbohydrates of fruit, and this also has a decided influence upon texture, a fact which is taken advantage of in making jellies and other fruit products.

The water in which fruit is cooked removes some of the nutritive material present. Thus, a German investigator found that, after boiling, apples and pears contained 4 or 5 per cent and peaches about 7 per cent less carbohydrates than the uncooked fruit. Since the juice is usually eaten with the fruit, this extraction of material in cooking is of little practical importance.

When fruits are used for making pies, puddings, etc., the nutritive value of the dish is of course increased by the addition of flour, sugar, etc., and the dish as a whole may constitute a better balanced food than the fruit alone. It is commonly believed that dishes in which fruits are cooked with the addition of sugar, butter, and a flour crust of some sort are less easily digested than simple rations of bread, butter, and fruit, having an equivalent nutritive value. The large number of digestion experiments which have been made with various mixed

diets do not indicate that there is any special difference between the two rations as regards thoroughness of digestion, but additional experiments must be undertaken before it can be said with certainty whether or not there are actual differences in the ease and rapidity of digestion.

OVERRIPE, DECAYED, AND UNRIPE FRUIT.

Overripe fruit is often injurious, very probably because it has begun to ferment, and stale or partially decayed fruit is obviously undesirable for food purposes. In addition to a deterioration in flavor there is always the possibility of digestive disturbance if such fruit is eaten raw. Of course, where apples are raised or where they are bought in large quantities for family use, the thrifty housewife will sort them over and use for cooking the sound portions of those which have begun to decay. In such cases, however, the best available methods of storing should be followed and sorting should be done at frequent intervals, for if decay has proceeded very far the flavor is without doubt injured.

It is not at all strange that decayed fruit should have a decided characteristic odor and flavor when we remember that the decay is very commonly caused by fungi, especially molds and rots, which penetrate the pulp and grow and develop rapidly. The fungi live upon the cell contents, particularly sugars and proteids, and produce bodies of marked chemical characteristics, including odor and flavor. It is said that the most unpleasant effects are due to one of the common molds.

It is almost universally believed that green fruit is unwholesome and causes serious digestive disturbances, yet those who have been brought up in the country know that if illness had always followed eating it there would have been few well children in the community in the summer. Recognizing that green fruit may be a cause of illness at times and at other times apparently harmless, two German scientists have recently carried on extensive studies to ascertain the truth of the matter. Chemical analyses were made of fruits of varying degrees of ripeness, and studies in which green fruit was eaten in considerable quantities and under varying conditions were carried on with both animals and men. It appears from the results of the experiments that, although unripe fruit is undoubtedly often harmful, particularly for children, the danger from such foods, especially green gooseberries, plums, pears, and apples, when eaten raw, is less than is commonly thought, and the effects depend in marked degree upon individual peculiarities.

The green fruit was found to contain the same chemical compounds as the ripe fruit, though in different proportions—that is, no chemical element was found in the green fruit which was foreign to the ripe fruit

and which could be considered in itself a cause of illness. The injurious effects of raw unripe fruit, therefore, it appears, do not depend upon chemical constituents, but rather on the unusual proportions in which the constituents occur, and especially the large percentage of hard cell tissue, which, if imperfectly masticated, it will readily be seen, might be a source of digestive derangement. Possibly the excess of acid in the green fruit is also a cause of digestive disturbance. Cooked green fruit was found to be practically harmless, being especially palatable and wholesome when cooked with sugar.

The possibility of injury by bacterial contamination was considered, though the data available were not sufficient for final deductions. It is now well known that such diseases are usually caused by micro-organisms, so possibly the green fruit very frequently picked up beneath the tree is only an accidental carrier of the real cause of the digestive " turbances which may follow eating it.

HANDLING AND MARKETING FRUIT.

It is very important that fruits should be handled, stored, and marketed under sanitary conditions, as they are very commonly eaten raw, and not all persons are careful to wash them before serving. Fruit which has fallen to the ground may be readily soiled with earth, water, or other material which may contain typhoid or other bacteria. Indeed, cases of infection have been traced to fruits contaminated in this or some similar way and which were eaten raw without being washed. Investigations have also shown that fruits exposed to street dust and to other unfavorable conditions become covered with bacteria, which are always present in such dust-laden air, and may be possible sources of contagion. Flies and other insects are also known to be a source of dirt and possible contamination. Samples of fruit purchased in the street and examined by a German investigator (Ehrlich) showed tuberculosis bacteria and many other forms of micro-organisms, the number present varying considerably with different sorts of fruit. As might be expected, those with a firm dry skin, such as apples, did not furnish as good a lodging place for bacteria and dust as fruits with a sticky surface, such as berries. Sticky dried fruits, such as dates, raisins, and figs, are also, as will be readily seen, favorable resting places for dirt and dust, as almost anything which the moving air currents lodge on the sticky surface will remain there. Fortunately, it is becoming a common practice to market such fruits in closed packages, usually of cardboard, which protect them to a great extent from dust and insects, so that the dried fruit, if clean in the first place, will remain clean.

It is often urged that washing fruit destroys flavor. On the other hand, skillful housewives maintain that if properly done the loss of

flavor is inappreciable, and on the grounds of common cleanliness it would seem best to sacrifice a little flavor, if necessary, for the sake of removing filth and possibly dangerous bodies, even if the amount of dirt present is too small to be offensive to sight or taste.

Ehrlich, whose work has been cited, found that washing fresh fruit once thoroughly in running water was sufficient to remove the micro-organisms present. If the fruit had been kept until the sticky surface was more or less dry, washing two or three times was found desirable. With apples and pears he recommends wiping with a clean dry cloth, followed by rinsing under the water tap. As is well known, berries and such soft fruits sour and mold very readily if damp; they should therefore be washed just before they are served.

When fruit is washed the amount of material removed is small. In the case of soft fruits, like berries, with a surface skin which is very thin and easily broken, it is almost certain that larger quantities will be removed than with firm fruit.

On the whole, it seems fair to conclude that, notwithstanding the prejudice which many housewives have against this practice, it is unquestionably safest never to omit the precaution of washing fruit which is to be eaten raw, unless one can be quite certain that it has not been exposed to possible contamination.

Much of the dust and dirt and other unpleasant features might be avoided if our methods of handling and marketing fruit and other food products were at all comparable with our standards of sanitation in other lines and with what is easily possible. Improvements in present market conditions, however, can hardly be expected until the public demands them.

THE HYGIENE OF FRUIT.

Generally speaking, fruits are wholesome and palatable foods, yet it is not at all uncommon to find that one or more sorts can not be eaten by an individual. Thus, many persons find that strawberries cause distress and many others that any acid fruit is a cause of digestive disturbance. Such cases are explained on the ground of some personal idiosyncrasy.

The extended use of fruit in the diet is certainly justified on the ground of palatability, food value, and esthetic considerations, but there are those who seek a further justification on the score of hygiene. It is commonly conceded that most fruits are laxative, and it seems probable that they owe this property to the considerable amount of water which they contain, to the salts in solution, or to the irritating crude fiber, small seeds, or other indigestible materials present, or to all these together. Man seems to crave and require some acid in his diet, and the citric, malic, and other fruit acids are undoubtedly wholesome.

In earlier times remarkable virtues or the opposite were commonly attributed to fruits, plants, precious stones, and other animate and inanimate objects, and it seems not improbable that the medicinal virtues which are often ascribed to various fruits in popular writings are survivals of this custom. No well-informed person would to-day share the belief, once so widespread, that tomatoes are the cause of cancer, yet many apparently give credence to statements that certain fruits are a satisfactory food for brain workers, while others must be avoided. At any rate, such statements are often found in print. In general, it may be said that very few investigations have been made which indicate that the different fruits possess specific medicinal qualities. Those which contain an abundance of sugar are naturally excluded in a large measure from the diet of diabetics, while there are other conditions in which acid fruits are conceded to be undesirable.

Some fruits, notably the tropical papaw and the pineapple, contain very active ferments. The ferment present in the papaw is separated in commercial quantities and used as a digester of nitrogenous materials. Perhaps it is quite natural that much stress should have been laid on the ferment present in the pineapple and that this fruit should be recommended for use at the end of a meal so that its ferment may aid the body in digesting food. It should be remembered, however, that the body in health does not need artificial aid in performing its normal functions and that for digestive disturbances it would be wiser to seek competent medical advice than to depend on the casual use of pineapple or other plant ferment, especially when it is remembered that there is great doubt as to the efficacy of any ferments introduced artificially into the stomach.

Fortunately there are so many other good reasons for using fruits that we have no need to base our use of them in quantity on supposed medicinal virtues.

CONCLUSIONS.

In general, it may be said that fruits are wholesome, palatable, and attractive additions to our diet, and may be readily made to furnish a considerable part of the nutrients and energy required in the daily fare. Fresh fruits are dilute foods and closely resemble green vegetables in total nutritive value, but dried fruits and many preserves, etc., are much more concentrated, comparing favorably with some of the cereals and other dry vegetable foods in the amount of total nutrients and energy which they supply per pound. The characteristic chemical constituents of fruits are carbohydrates, and so they are naturally and properly used in a well-balanced diet to supplement foods richer in protein, as cereal grains, legumes, nuts, eggs, dairy products, meats, and fish. Intelligently used, fruits are a valuable part of a well-balanced diet and may well be eaten in even larger quantities than at present.

THE PRINCIPAL INSECT ENEMIES OF THE PEACH.

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INTRODUCTION.

The depredations of insects constitute an important obstacle to the profitable cultivation of the peach. This is true not only in large commercial orchards, but also in the small home orchard, often of not more than a dozen trees; for wherever the peach is grown there will likely be found the "borer" infesting the root-crown and roots, scale insects on the trunk and branches, and in many sections the curculio to disfigure and destroy the fruit.

Of about 190 species of insects known to feed habitually or occasionally on the peach, comparatively few are at present seriously destructive, but the ravages of these, as the peach borer, the plum curculio, the San Jose and other scales, the peach twig-borer, etc., bring about in injury to the tree and fruit a loss in the United States of several million dollars annually. Much of this loss is preventable, as is shown by the experience of numerous individual orchardists who, by proper care and attention, have been able to greatly lessen losses from insect depredations.

Too much stress can not be placed on the importance in peach culture of maintaining the trees in a thrifty and vigorous condition by frequent cultivation, fertilization if necessary, the thorough pruning out of dead or otherwise useless wood, and the prompt removal and destruction of diseased and dying trees. Orchard management of this character does much to prevent insect injury by maintaining conditions unfavorable to the development and spread of the insects.

THE PLUM CURCULIO.

(*Conotrachelus nenuphar* Hbst.)

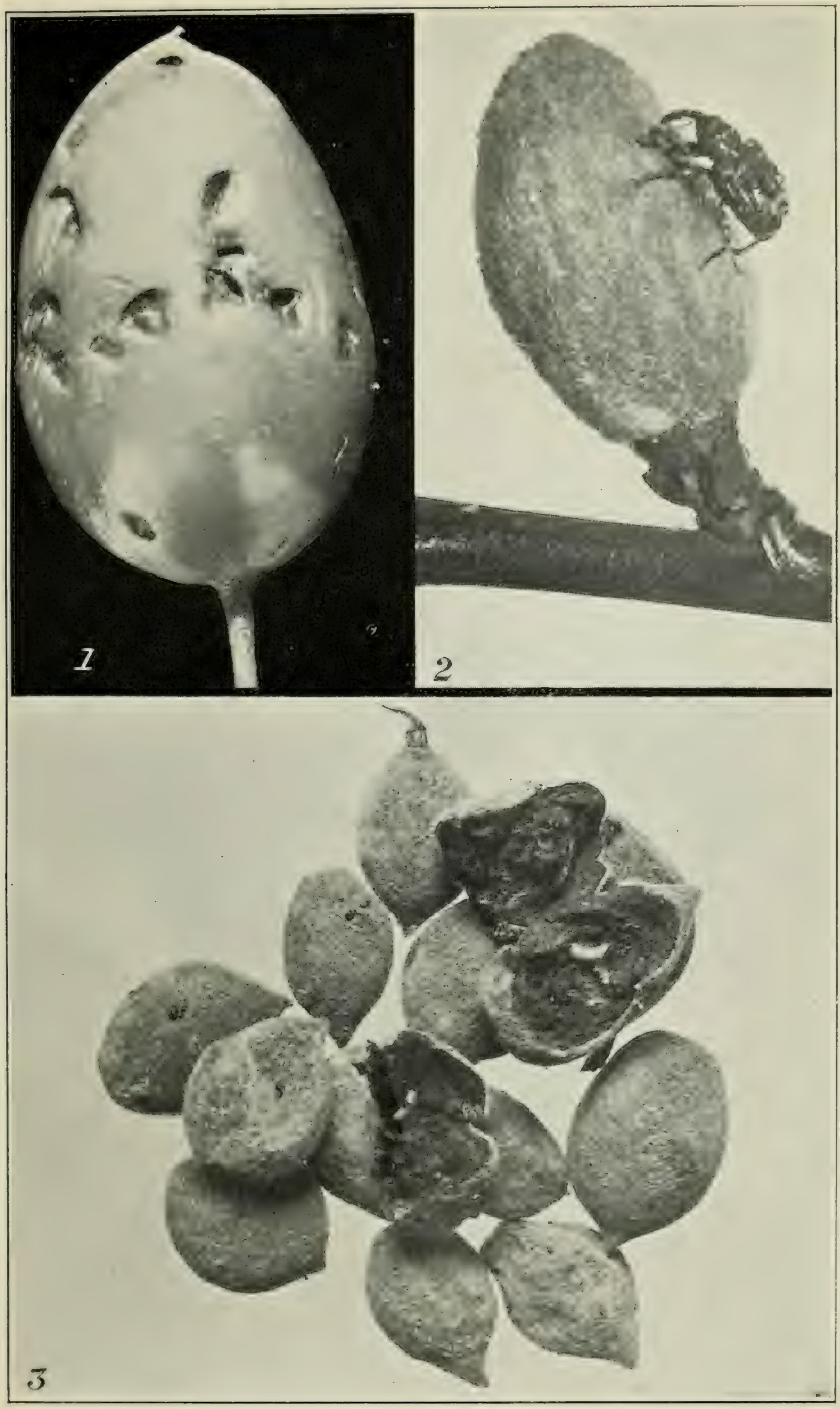
All peach growers in the East are familiar with the "worm" in the peach, the larva or grub of the so-called plum curculio, or "little Turk." This is a native American insect, and was among the first to attract the attention of the early settlers by its depredations on the plums, peaches, and other fruits growing around their homes. Before the introduction of cultivated varieties of stone and pome

fruits the curculio undoubtedly fed and bred on wild plums, hawthorns, and crab apples, as it does at the present day, and it is probable that from the earliest times it has been quite generally distributed eastward of the Rocky Mountains wherever its food plants grow. The plum curculio is known to occur from southern Canada south to about middle Florida and westward to the region of the Rocky Mountains. West of about the one hundredth meridian, however, it loses much of its importance as a pest, owing to the more arid climate.

LIFE HISTORY AND HABITS.

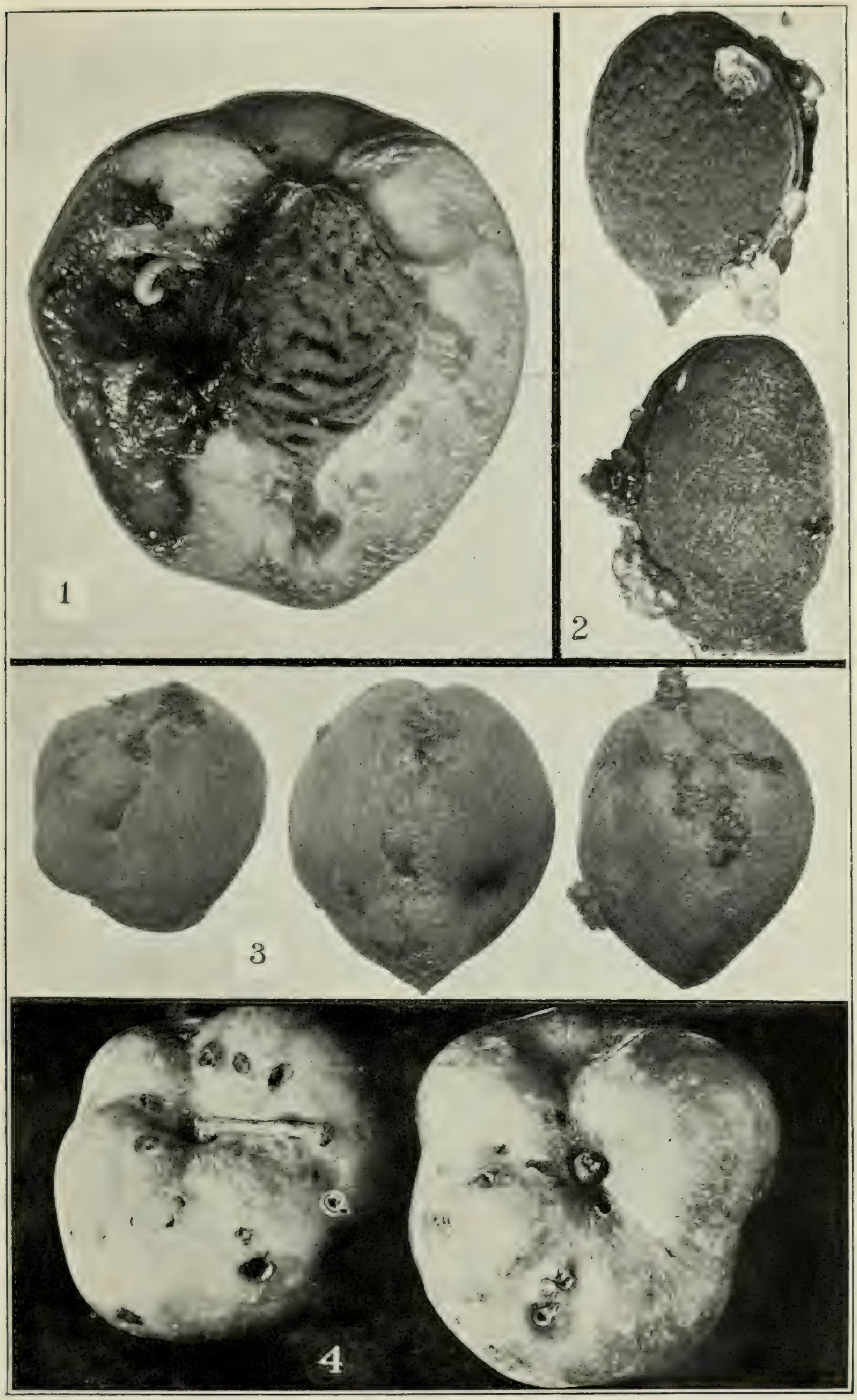
The insect passes the winter in the adult or beetle stage (Pl. XXVII, fig. 2) under trash on the ground in and around orchards, or in other situations where suitable protection from the weather may be secured. By about the time in spring when the fruit buds are swelling or the trees are in bloom, the beetles come from their winter quarters, and as soon as the fruit is well set it is attacked for feeding and egg-laying purposes, though the beetles also feed on the buds, unfolding leaves, and blossoms. Figure 1, Plate XXVII, is an enlarged illustration of a young plum, showing the characteristic crescent-shaped egg punctures of the female. Egg laying and feeding continue for several weeks, or even months in the case of the hardier individuals. Oviposition, however, is most active during the first four or five weeks. The total number of eggs which may be deposited by an individual female varies widely, probably depending upon climatic conditions and the sort of fruit attacked.

From three to five days, according to the temperature, are required for the egg to hatch, and the resulting larva soon bores into the fruit, where it feeds, usually around the pit in stone fruits, until completing its growth. The larval stage lasts from about twelve to eighteen days. The presence of the larva in the young peach will usually cause it to fall (Pl. XXVII, fig. 3), and much of the infested fruit, if it does not drop earlier, falls with the so-called "June drop," just as the pit begins to harden. Upon completing its growth, whether in the fruit on the tree or on the ground, the larva bores out of the fruit and enters the soil, usually to a depth of not more than 2 inches, where it pupates. Some three or four weeks are required for the completion of the pupal stage and the emergence of the normally colored beetle. The beetles may, however, remain in the pupal cell days, or even weeks, before leaving the soil, especially if the weather be dry, whereas a copious shower may bring them out in numbers. The period of development of the curculio from egg to adult thus lasts from about five to seven weeks, and as there is but one generation annually, the insect spends about ten to eleven months of the year in the adult condition. Owing to the long period during which the beetles oviposit in the spring,



THE PLUM CURCULIO AND ITS WORK.

[Fig. 1.—Young plum, showing crescent-shaped egg-laying punctures. Fig. 2.—The adult, or beetle, on a young peach. Fig. 3.—Young peaches infested with larvæ, from ground under tree. Figs. 1 and 2, enlarged 4 times; fig. 3, reduced about one-half. (Original.)]



WORK OF THE PLUM CURCULIO.

[Fig. 1.—Larva and its work, in ripe peach. Fig. 2.—Gum exudations from punctures in green peaches. Fig. 3.—Deformed peaches, due to curculio punctures. Fig. 4.—Deformed apples, due to curculio punctures. Fig. 1, natural size; figs. 2, 3, and 4, reduced about one-half. (Original.)]

beetles of the new generation, from eggs first laid, are out some time before the parent beetles have disappeared. Beetles of the new generation, after their emergence from the soil, feed on the fruit and foliage of various fruit trees until the approach of cold weather, when they seek shelter for the winter, emerging the following spring to attack the new fruit, as already indicated.

FOOD PLANTS.

The natural and original food of the curculio is the wild plum. It also breeds in wild crab apples and hawthorns and is recorded as breeding in persimmon. Practically all cultivated varieties of stone and pome fruits are attacked, as plums, peaches, cherries, nectarines, apricots, apples, and pears, though a preference is shown for the smooth-skinned sorts, notably plums.

CHARACTER OF INJURY.

Injury to fruit by this insect is due to the punctures made by the beetles in feeding and to the punctures of the females in ovipositing, and also to the work of the larvæ within the fruit itself. Much of the fruit injured when small shortly falls to the ground, but if punctured when of some size it may remain on the tree, and if the punctures are numerous it becomes knotty and misshapen as it grows (see Pl. XXVIII, figs. 3 and 4). From the punctures made, gum may exude and form globules, which during moist or rainy weather become quite conspicuous, as shown in Plate XXVIII, figure 2. Cherries, with the exception of one or two varieties, do not fall, the larva completing its growth in the fruit on the tree. Much injury is also done, particularly in the more northern States, to apples and plums by the feeding on the fruit, during the late summer and fall, of beetles of the new generation before they go into hibernation for the winter. In some sections this may be the more important injury. In the South, where early maturing fruit is generally grown, injury by the new generation of beetles is of little importance.

NATURAL ENEMIES.

It has been discovered recently that the eggs of the curculio are destroyed by a minute parasite (*Anaphes conotracheli* Girault), which, according to the limited observations made, destroys from 60 to 70 per cent of them. The larvæ are attacked by two parasites, *Sigalphus curculionis* Fitch and *Porizon conotracheli* Riley, the former species being much the more important. Certain predaceous insects are known to destroy the curculio larvæ as they are leaving the fruit to enter the soil.

PREVENTIVE MEASURES.

Of many different methods which have been proposed for the prevention of injury to fruit by the curculio, comparatively few are worthy of consideration.

JARRING.—One of the best and perhaps most generally practiced preventive measures at the present day is the so-called jarring method. Its value depends on the fact that a sudden jar to the tree will cause the beetles to fold their legs and fall to the ground, feigning death as a means of escaping detection. Advantage is taken of this habit to collect the beetles on sheets held, or placed on the ground, under the trees. Jarring is begun in the spring as soon as the fruit is well set, and should be done preferably in the early morning or late evening, when the insects are somewhat torpid with cold and drop quickly. In large orchards it is often necessary to work during midday, though not so many beetles are caught, as they cling to the tree more tenaciously and after falling escape more quickly. During seasons when the beetles are numerous it is best to jar the trees every day for a period of four or five weeks, until it is observed that but few beetles are being caught.

Various forms of curculio catchers have been devised, but perhaps the simplest, and one suitable for work on a small scale, consists of a sheet some 12 feet square, made by sewing together strips of heavy muslin, the central seam being left open to the middle of the sheet. The canvas is placed on the ground under the tree, being centered by passing the midseam around the trunk and one margin along the seam being overlapped to entirely cover the ground. A padded pole for jarring the tree completes the outfit.

In jarring on a larger scale the work must be done more expeditiously. A form of catcher much in use in extensive eastern orchards is shown in Plate XXIX, figure 1. This form of catcher consists of a cart on which is carried an inverted umbrella-shaped canvas on a folding frame, with an opening in front to receive the trunk of the tree. In operation the cart is pushed under the tree, which is given a sudden jar by means of a padded bumper at the base of the slit, or preferably with a padded pole. The beetles falling on the hopper-like canvas are brushed down through the opening in the bottom into a can of kerosene fastened beneath. The method of jarring practiced in a large Georgia orchard is illustrated in Plate XXIX, figure 2. The work is done by gangs of five hands each, the apparatus consisting of two sheets stretched on frames, each 6 by 12 feet, and a padded pole for jarring the tree. The sheets are momentarily held under the respective trees as they are being carried along, at which instant the tree is given a jar with the padded pole. At the end of the row the sheets are placed on the ground, the curculios are picked off, and the beneficial insects permitted to escape.

POISONING.—It has been known for several years that the adult curculios feed freely on the foliage and fruit of the plants used for egg-laying purposes, and numerous experiments have shown that injury to fruit may be greatly lessened by thoroughly spraying the trees with arsenical poisons. In the case of the peach, however, repeated applications of poisons, such as Paris green or arsenate of lead, are likely to be followed by injury to and subsequent dropping of the foliage. But some peach growers habitually spray their trees with arsenical poisons for the curculio and report no injurious effects; and in localities where it has been established that no injury results the practice is to be recommended. But the grower who is using arsenicals on the peach for the first time should proceed with caution. Of the poisons available for this work, arsenate of lead is likely to be least injurious, and it has the advantage of adhering well to the foliage. To be reasonably effective in killing the beetles, it should be used at the rate of about 2 pounds to 50 gallons of water. Paris green, or "green arsenoid," should not be used stronger than 1 pound to 150 or 200 gallons of water. The caustic properties of these poisons will be greatly reduced by the addition to the liquid of the milk of lime, made from slaking some 2 or 3 pounds of stone lime; or the poisons may be used in Bordeaux mixture which it is proposed to use in the control of fungous diseases.

In the control of the curculio several applications of the poison are necessary. The first application should be made at once after the blossoms fall, and other applications should be made at intervals of eight to ten days until three or four applications have been made.

CULTIVATION.—In the discussion of the life history of the curculio it was shown that the pupa or quiescent stage of the insect is passed for the great majority of individuals not more than 2 inches below the surface of the ground. The destruction of these soft, helpless pupæ by the crushing action of a cultivator would therefore appear reasonable; and, as it involves no outlay for labor not essential to successful fruit growing, the practice is to be strongly recommended. Pains should be taken to run the cultivators as near the trees as possible, as the majority of the larvæ pupate beneath the spread of the limbs. Since the period of maximum oviposition lasts for four or five weeks, it follows that the pupæ will be in the ground in numbers over an equal length of time. In the latitude of Washington and southward the larvæ begin to enter the soil for pupation in about six weeks after the time of full bloom of the trees, and cultivation should hence be begun by about this time. In Illinois, as shown by Professor Crandall, and probably elsewhere in the more northern States, the larvæ are entering the soil in about two months from the blooming period of the trees.

GATHERING FALLEN FRUIT.—A large proportion of the fruit, other than cherries, punctured while small, will fall before the larvæ have completed their growth. Infested fruit will thus be on the ground some days before the larvæ leave it to enter the ground. The systematic collection and destruction of this fallen fruit would serve greatly to keep the insect in check, and, where practicable, this method should be followed. Fruit should be collected every two or three days to insure the destruction of the larvæ before the fruit has been deserted. Plate XXVII, figure 3, shows the condition of a few peaches gathered from under a tree in a Georgia orchard.

GENERAL RECOMMENDATIONS.—In the control of this pest, as of most other destructive insects, clean culture is of great importance as removing conditions favorable to insect multiplication. The numerous plum thickets to be observed in the neighborhood of orchards and along roads, particularly in the South, are constant sources of infestation of orchards, and should be destroyed wherever possible. In fighting the curculio best results will come from a combination of two or more of the several methods recommended, and uniformity of action by all the orchardists of a community will bring about a great reduction of loss from this pest in that section.

THE PEACH BORER.

(*Sanninoidea exitiosa* Say.)

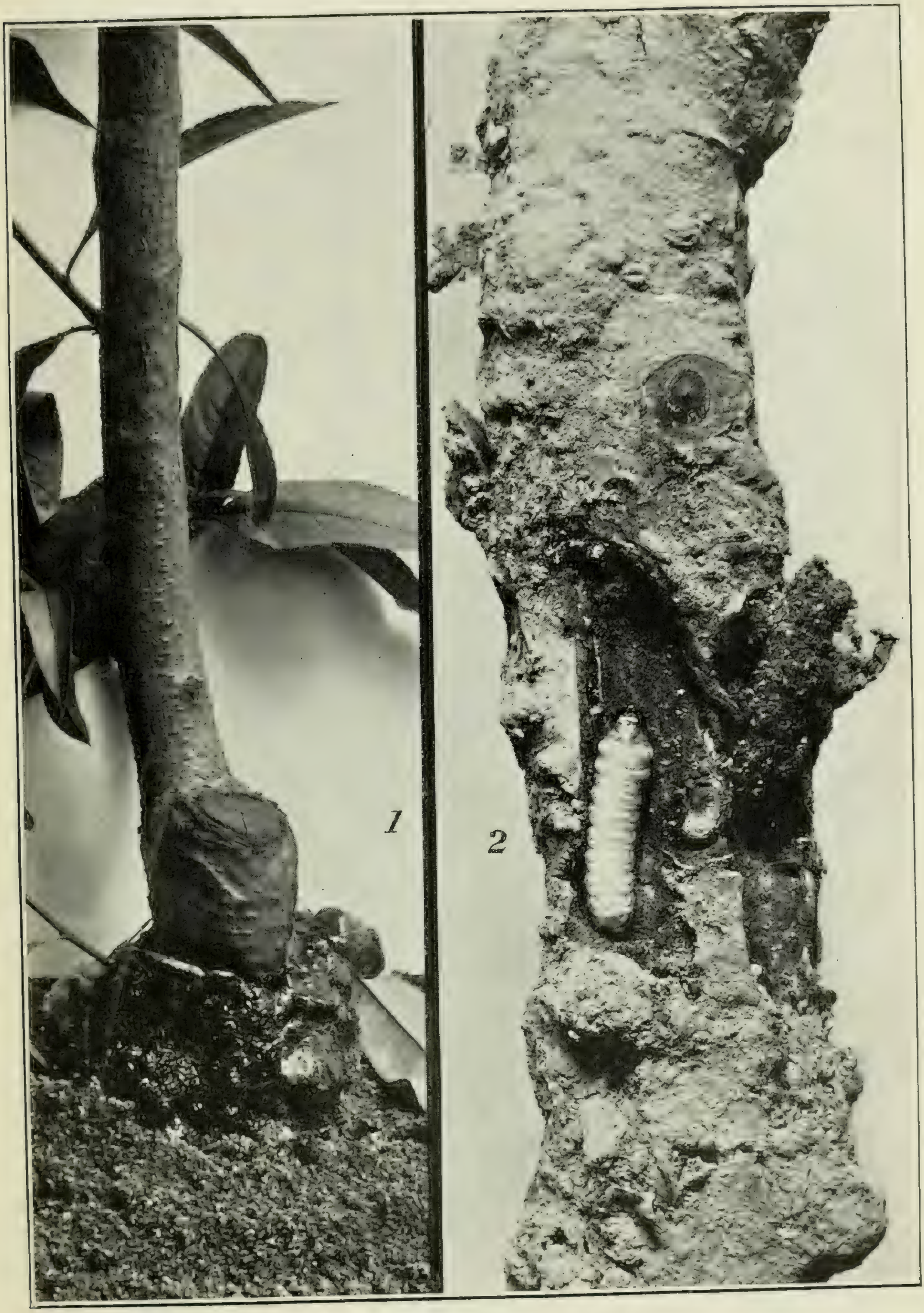
In many parts of the country the peach borer is perhaps the most destructive insect enemy of the peach. Injury is done by the larva or borer, which feeds on the soft inner bark at the crown of the root or on the adjacent roots (see Pl. XXX, fig. 2). The larvæ are voracious feeders, and trees are always greatly injured and often completely girdled by them. The peach is subject to attack throughout its entire life, from the seedling in the nursery row to the oldest relic, though injury is most severe on the younger trees. The presence of the borer is indicated by the exudation from the base of the tree of a brownish, gummy mass more or less mixed with soil, which, during damp or rainy weather, by the absorption of water, becomes gelatinous and often quite conspicuous (see Pl. XXX, fig. 1).

DISTRIBUTION AND FOOD PLANTS.

The peach borer, like the plum curculio, is a native species, and at present appears still to be confined to Canada and the United States. So far as is recorded, it has not yet become established on the Pacific coast nor west of the Rocky Mountains, except in Colorado and possibly in New Mexico. There occurs on the Pacific coast, however, a closely related species (*Sanninoidea opalescens* Hy. Ed.) of similar life history and habits and against which the same remedial measures may be practiced. Eastward of the Rocky Mountains, from Canada south

FIG. 1.—WHEELBARROW CURCULIO CATCHER USED IN NEW YORK STATE (FROM SLINGERLAND).

FIG. 2.—CURCULIO CATCHER MADE OF SHEETS ON FRAMES, USED IN GEORGIA (ORIGINAL).



THE PEACH BORER AND ITS WORK.

[Fig. 1.—Exudation of gum at base of infested tree. Fig. 2.—The "borer" and its cocoon at root-crown of 2-year-old peach tree. (Original.)]

to Florida and Texas, the peach borer is almost universally found wherever peach trees are grown.

Its native food plant is thought to have been the wild cherry, and possibly also the wild plum. With the introduction of the peach by the early settlers this plant soon became its favorite food, and complaints of its destructiveness are frequent in our early horticultural literature. It is now known to infest various cultivated varieties of stone fruits, as the apricot, nectarine, prune, and plum, but it is preeminently destructive to the peach.

LIFE HISTORY AND HABITS.

There is but one generation annually. The insect winters in the larval or borer condition, the larger individuals simply hibernating in their burrows under the bark, many of the smaller ones constructing a cell or hibernaculum outside of the burrow, on the bark of the tree. With the approach of spring, and probably during warm spells during the winter in the South, feeding is resumed. Larvæ of various sizes are to be found in the tree at almost any time, varying from quite small to nearly full grown, and the period of pupation and emergence of the moths is thus extended over several months. Upon completing its growth the borer leaves its burrow and constructs a cocoon at or near the surface of the ground, usually on the trunk of the tree near the burrow (see Pl. XXX, fig. 2), but often loose on the soil. Within the cocoon the borer transforms to a pupa, from which the moth or parent will emerge in the course of three or four weeks. Plate XXXI, figure 1, illustrates the two sexes, the female moth above and the male below. Soon after emergence the moths mate, and the female at once begins depositing her eggs. These are laid rather indiscriminately over the trunk of the tree, on adjacent weeds or trash, or even on the ground. Dissections of females show the ovaries to contain from about 200 to 800 fully developed eggs, the number varying with the size of the individual moth. The moths are day fliers, and both sexes are quite active. The eggs are small, reddish, oval in shape, and not readily detected on the bark of the tree. These hatch in from nine to ten days, the young larvæ at once seeking cracks in the bark, soon making their way into the soft bark of the tree. Their location is easily detected by the powdery, light brownish frass which they push out from their burrows. The young larvæ grow rapidly, feeding until forced into hibernation by the cool weather of fall. Growth is resumed with the coming of spring, as already indicated.

In the control of this species it is important to know as accurately as possible the period of greatest abundance of moths. According to Professor Slingerland, in New York State, and probably in that latitude generally, usually no moths emerge before July 1, and they

mostly appear from July 15 to August 15. It is noted, however, that during exceptional years moths may appear as early as June 15, and they have been reared at Buffalo late in September. Results of an investigation of this species at Youngstown, N. Y., by Mr. Fred Johnson, of the Bureau of Entomology, during the season of 1905, largely agree with the statements of Professor Slingerland. The period of emergence of moths was found to be from June 12 to August 24, not many appearing, however, until two or three weeks after the first date mentioned. No pupæ were found later than August 5.

In the vicinity of Washington, from observations made during 1905, it appears that a few moths may emerge during late May, but they do not begin to emerge to any extent until about the middle of June, and the period of maximum emergence is not reached until some four or five weeks later. The great majority of larvæ have pupated and the moths have emerged by the middle of September, though a few stragglers may emerge later. Much the same condition obtains in New Jersey, according to Dr. J. B. Smith, who states that moths of the peach borer emerge in greatest numbers from about June 15 to September 15.

Until recently there have been no accurate data on the period of emergence of the moths in the extreme South. During the past two years, however, Prof. H. N. Starnes, of the Georgia experiment station, has determined, by careful investigation, that the period of emergence of the majority of the moths is from about August 26 to September 15, a few earlier, and a few at later intervals, extending even into October.

Results of investigations by the Bureau of Entomology during 1905, at Fort Valley, Ga., agree fairly with the statements made by Professor Starnes. According to records made by Mr. James H. Beattie, no pupæ were found, with one exception, until July 10, from which date they became increasingly abundant. By August 20 it was estimated that fully 80 per cent of the larvæ had pupated and many of the moths emerged. By early September pupæ were relatively scarce. The period of flight of the moths in any numbers would thus extend roughly from about August 1 to late September. However, Messrs. Scott and Fiske, for some years entomologists to the Georgia State board of entomology, while inspecting nurseries during October and early November, often observed the moths in numbers, and further observations are necessary before final conclusions may be reached on this important point.

The periods of maximum emergence and oviposition of the moths for the respective regions indicated would doubtless be included within the following dates:

For New York and other States of about that latitude, from July 1 to September 1.

For States of about the latitude of Washington City, from June 15 to September 15.

For Georgia and other States of about that latitude, from August 1 to October 1, and possibly later.

NATURAL ENEMIES.

In all, 7 or 8 species of hymenopterous parasites have been found infesting the larva or pupa, and during 1905 Mr. A. A. Girault has bred from eggs collected on peach trees an important egg parasite, *Telenomus quaintancei* Girault MS. Limited observations in the vicinity of Washington indicate that about 50 per cent of the borer's eggs may be destroyed by this minute insect.

PREVENTIVE AND REMEDIAL MEASURES.

PREVENTIVE MEASURES.—Under this head are to be considered methods designed to prevent the deposition by the moth of her eggs on the trunk of the tree, or such measures as will hinder or prevent the entrance of the newly hatched larvæ. Of all of these, mounding has perhaps given as good results as any other. Slingerland found in New York State that from one-half to seven-tenths of the borers were kept out of the trees by this practice, and he considers it one of the cheapest and most effective of numerous methods tested by him. Many successful orchardists rely on this practice alone or in conjunction with "worming," to be mentioned later.

Mounding consists simply in dragging up the earth, by means of a hoe or otherwise, all around the base of the tree to a height of 8 or 10 inches. This artificial earth surface will induce the moths to deposit eggs higher on the trunk, and but few larvæ will enter the bark much below the place of contact of the mound with the tree, and they may thus be readily destroyed upon the removal of the mound after the period of egg laying of the moths has passed. Of much the same order is the use of strips of tarred paper, newspaper, or other forms of sheathing, wrapped around the trunk. Two or three inches of soil is first removed from around the base of the tree and the protector applied. The return of the earth will hold the bottom of the sheathing in place, and it is secured above with a string or other suitable means. Wrapping, or the application of a wash, is often followed by mounding, and when these are employed in conjunction a greater degree of freedom from injury should result.

Perhaps the method most generally relied on, usually in conjunction with worming, is the use of some kind of wash painted on the trunks of the trees. The number of these washes is very large; many are quite worthless, while others are positively injurious to the tree. Lime, soap, clay, glue, white lead, carbolic acid, tobacco decoction, kerosene, sulphur, and Paris green are some of the ingredients, in

various combinations, which enter into their composition. Many washes are concocted in the belief that some one ingredient, as carbolic acid, will be offensive to the moths, while another, as Paris green, will destroy the just-hatched larvæ as they bore into the tree. There is no evidence to show that the moths are affected by such odoriferous substances, and the fact that the great majority of the young larvæ enter the bark through cracks and do not bore directly through the poisoned coating renders substances of a poisonous nature ineffective. Washes containing Paris green or other arsenites, especially with glue or paint as a base, are likely to be injurious, though moderate quantities of poison in a wash, with lime as a base, have been used without injurious results. On young, thin-barked trees, however, washes containing arsenites should be used with the greatest caution. Lime perhaps forms the base of the greatest number of washes, one or more other ingredients being added according to the fancy of the user. One of these which, in the hands of Mr. J. H. Hale, is reported as giving good results is made as follows:

> Two quarts of soap, one-half pint of crude carbolic acid, and 2 ounces of Paris green, all thoroughly mixed with a bucketful of water, to which enough lime and clay have been added to make a thin paste.

Several substances which maintain a fairly impervious character have been tried at different times, but unfortunately their use is not without risk of injury. Of these, white paint, printer's ink, and two of the common brands of insect lime are, according to Professor Slingerland, fatal or injurious. In his hands gas tar proved very effective, keeping out from four-fifths to all of the borers and doing no injury to the trees. In the hands of others, however, serious injury has at times resulted, and where its use is contemplated it should first be tried in a small way.

Whatever the method or methods adopted, whether mounding, the use of paper or other similar protectors, or the use of washes, these should be applied to the trees before the period of flight of the moths, and should remain in working order until this period has passed.

REMEDIAL MEASURES.—After the borers have once penetrated beneath the bark the use of washes or mounding are of no avail, and the old-time process of digging them out or "worming" is still the best of the direct remedial measures. Worming is done usually in the spring or early summer, and often again in the fall, though at this time many of the larvæ are quite small and are liable to be overlooked.

In California Prof. C. M. Woodworth has been able to successfully treat the related borer infesting the peach, the larva of *Sanninoidea opalescens*, by the injection of carbon bisulphid into the ground around the base of the tree. The larvæ were killed in their burrows and no injury done to the trees. In New York State, however, this method

was condemned by Slingerland on account of its cost, as being ineffective in killing the borers and as being dangerous to the health of the tree.

THE LESSER PEACH BORER.

(*Ægeria pictipes* G. & R.)

In the course of investigations of the peach borer by the Bureau of Entomology during 1905 another borer was found infesting the peach, inhabiting principally the trunk, especially of old trees or those showing injury from freezing or other causes. This insect, to be known as the lesser peach borer, has been found in western New York and adjacent portions of Canada, in Maryland and Virginia, and in Georgia, so that it would appear to be widely distributed. In the last-mentioned State it is very abundant and is the cause of important injury, infesting principally the trunks of the older trees, feeding on the soft bark, excavating burrows after the manner of the true peach borer. It has, however, been frequently taken at the crown of the root, and under these circumstances might readily be confused with the other species. (See Pl. XXXI, figs. 3 and 4, showing the cocoon and empty pupa case and female and male moths, respectively, all enlarged on same scale with figs. 1 and 2, the true peach borer, of the same plate.)

To control this species it will be advisable to closely examine the trunks as well as the crowns of the roots during the time of worming for the peach borer.

THE SAN JOSE SCALE.

(*Aspidiotus perniciosus* Comst.)

But a few years ago the San Jose scale was considered a veritable menace to the growing of deciduous fruits in the East, and its discovery in an orchard was often followed by the destruction of the trees in the hope that its extermination might be secured. However, this feeling of alarm has now given way to one of confidence that the pest may be controlled by the proper use of insecticidal sprays, and without belittling the serious character of the insect, it may be said that it has simply taken its place among the several insect pests of the orchard, whose control must be enforced as a regular feature of orchard work.

Since its introduction into the East from California some seventeen or eighteen years ago it has become established in the principal deciduous-fruit regions in the more eastern States from Canada south to Florida and Texas. There are still many fruit-growing sections throughout this area where the scale has not made its appearance, and no effort should be spared to keep it out for as long a time as possible; but its appearance in an orchard should not be the occasion of the destruction of otherwise valuable trees, in view of the fact that it can be controlled by thorough and painstaking work with sprays. The

insect is introduced into new localities principally on nursery stock, but once established under conditions of neglect it spreads more or less rapidly from orchard to orchard. The system of inspection and fumigation of nursery stock which has been in practice for some years in most States has been an important means of restricting its more general distribution, and prospective purchasers of trees should assure themselves of their freedom from this and other pests likely to be distributed from nurseries.

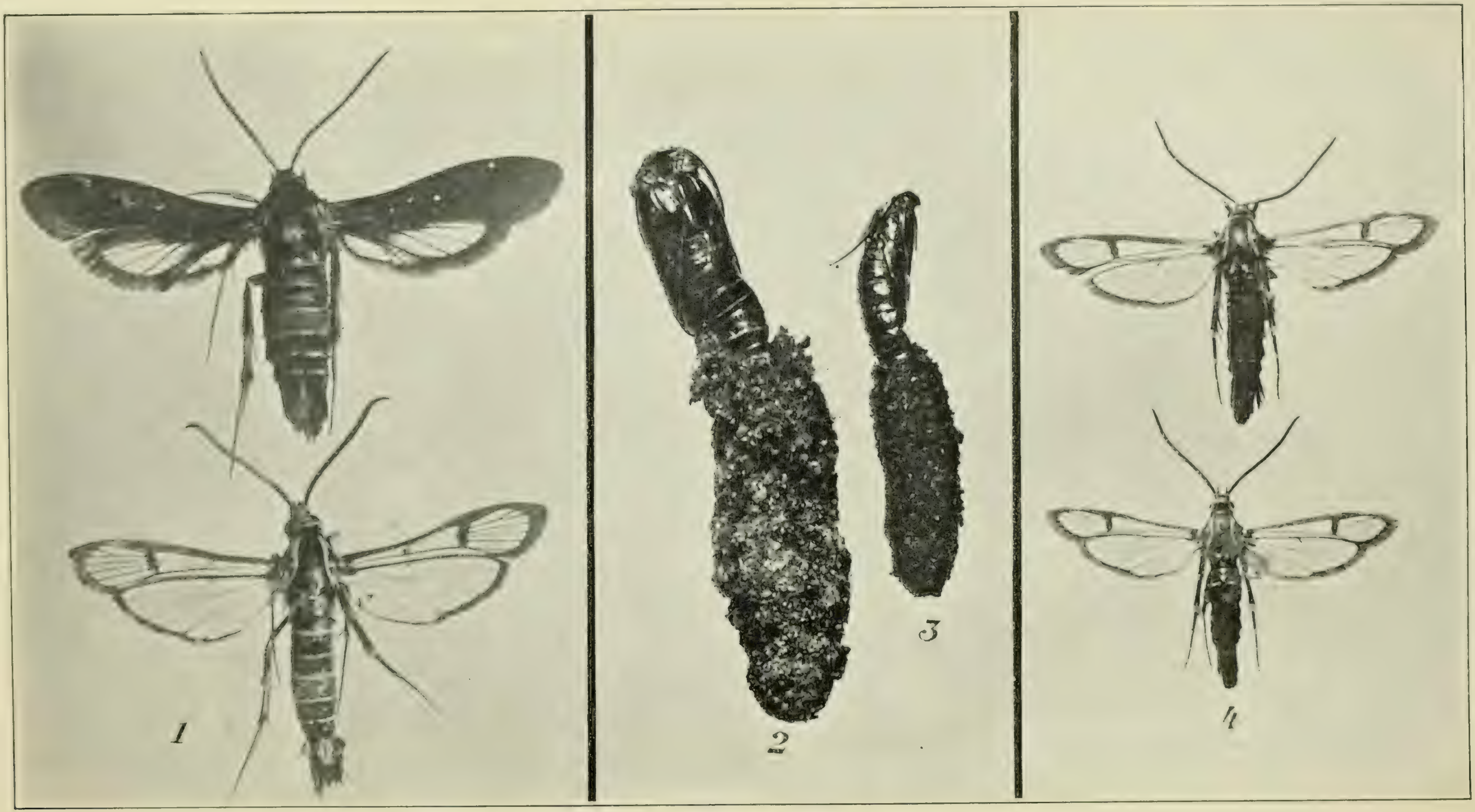
FOOD PLANTS AND DESTRUCTIVENESS.

The San Jose scale is practically an omnivorous feeder, it having been reported from some sixty plants, and the list is being gradually extended. It is worthy of note, however, that, with the exception of a few incidental plants, it is able to live and multiply in injurious numbers only on members of the Rosaceæ, to which family our deciduous fruits belong.

If permitted to multiply unrestricted, young trees will usually succumb to its ravages in three or four years, often in two or three years. Older trees may withstand it longer. The smaller limbs and branches are usually the first to be killed, and the tree will throw out from below a varying number of shoots (see Pl. XXXII, fig. 1, illustrating a peach tree thus injured). With trees in fruit, especially apples, plums, and pears, the fruit will frequently be quite ruined for market purposes by the settling upon it of the young scales.

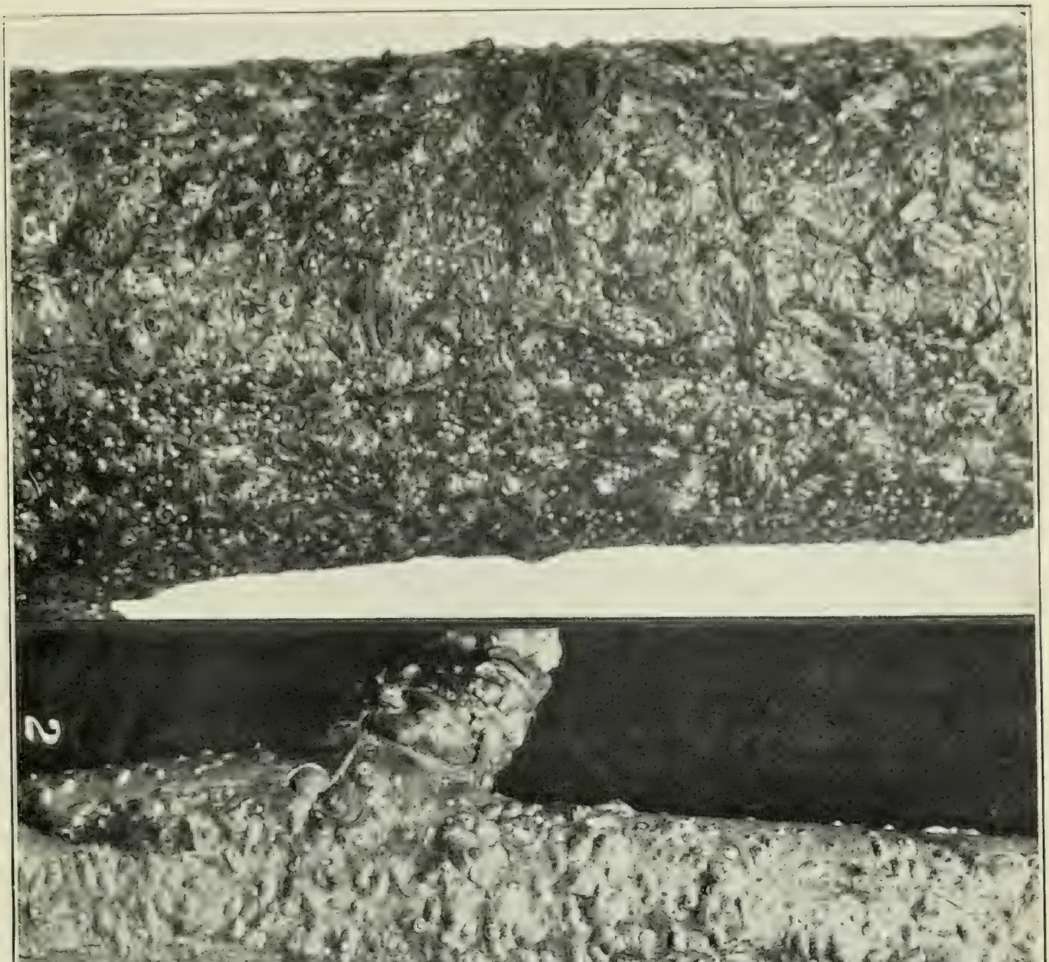
APPEARANCE OF THE INSECT.

An individual San Jose scale is quite small, grayish, circular in outline, somewhat convex, and with a nipple-like prominence in the center. The female scale is about 1 mm. in diameter, the male being smaller and elongate. (See Pl. XXXII, fig. 2, showing an infested peach twig, enlarged four times.) The insect itself is beneath the so-called scale, which is simply a waxy covering secreted by the soft, yellow, helpless louse for its own protection. Where trees are but slightly infested its presence is not readily detected by the casual observer; but in cases of severe infestation the bark of the tree and limbs will present an ash-gray appearance, and on examination will be found thoroughly incrusted with the scales. These may be readily scraped off with a knife, producing a yellowish, oily fluid from the crushed bodies of the insects. Plate XXXII, figure 3, illustrates a section of limb of peach tree thickly infested with the scales, twice enlarged. When thus abundant on a tree the foliage will be thoroughly infested, giving it a spotted and diseased appearance readily observed some feet away, thus aiding in its more ready detection.



ADULTS AND COCOONS OF THE PEACH BORER AND LESSER PEACH BORER.

[Fig. 1.—Peach borer moths, female above, male below. Fig. 2.—Cocoon and empty pupa case of peach borer. Fig. 3.—Cocoon and empty pupa case of lesser peach borer. Fig. 4.—Lesser peach borer moths, female above, male below. All figures twice enlarged. (Original.)]



THE SAN JOSE SCALE AND ITS WORK.

[Fig. 1.—Peach tree with top killed by the scale. Fig. 2.—Peach twig, moderately infested, showing male and female scale. Fig. 3.—Peach limb badly infested with scale. Fig. 2, enlarged 4 times; fig. 3, enlarged twice. (Original.)]

METHODS OF CONTROL.

Trees which from neglect of treatment have been practically killed by the scale should at once be cut down and burned, and, if desired, new ones planted in their places. Trees which have been severely injured, the tops being more or less killed, should be closely pruned and all parts thoroughly treated with a suitable spray. Trees thus injured may be much more quickly brought into condition by thorough cultivation of the land and the use of fertilizers.

Lime-sulphur-salt wash.—This wash is now perhaps the main reliance in the control of the San Jose scale in commercial peach orchards in the East, as it has been for many years on the Pacific slope. When properly made and thoroughly applied it has proven to be the most satisfactory of the several washes available for the control of this pest on all deciduous fruits. Its use on dormant peach trees, with unimportant exceptions, has proven to be without any injurious effects whatever to the tree or fruit buds. The exceptions to be noted are reports of injury to the terminal twigs, due apparently to their immature condition by reason of late growth in the fall. The wash is applied in the spring before the fruit buds open, or, in the case of badly infested orchards, both in the late fall and spring. In regions where peach-leaf curl is troublesome the spring application will almost entirely prevent it.

There is some variance at present as regards the quantities of the respective ingredients of the wash which should be used; also as to the details of its preparation. There seems to be, however, considerable latitude in these particulars without seriously affecting its efficiency. Of numerous formulas tested by the Bureau of Entomology in 1905, the following, which is substantially the formula hitherto recommended by the Bureau, reduced to the 50-gallon basis, was found satisfactory:

Best stone lime	pounds	20
Flowers (or flour) of sulphur	do	15
Common salt	do	10
Water to make	gallons	50

The lime should all be slaked in a cooking barrel or vessel, using of hot water about one-third of the total required; and while the lime is vigorously slaking add the sulphur, which should previously have been made into a thick paste with water, and next add the salt. When the lime has slaked add water to make up to about two-thirds of the total amount required, and cook for about one hour, after which add water to make the total required amount of wash. Strain as it is being poured into the spray tank or barrel and apply before it cools. The wash may be cooked in open kettles or with steam in barrels or tanks. The use of salt is apparently not essential to the effectiveness of the wash, and may be omitted if desired. In the case of badly infested orchards being treated for the first time it is advisable to strengthen the wash by the addition to the formula of 5 pounds each of lime and sulphur.

One application of the wash during the spring of each year is usually quite sufficient to keep the scale under control.

For the cooking of the wash on a small scale large open kettles may be used, but when large quantities are needed, the use of steam will be found much more convenient and economical. Most large orchards now have steam cooking plants, varying much in detail, as shown in Plate XXXIII. Many growers prefer large tanks to barrels for cooking vessels, making up large quantities of the wash at once, thereby effecting a saving in fuel and labor.

Whale-oil soap.—Whale-oil or fish-oil soap is especially useful where only a few trees are to be treated. It is dissolved in water by boiling at the rate of 2 pounds to the gallon, and if a spray pump is to be used, the solution should be applied hot. A wash made from potash-lye soap is preferable to one made of a soda soap, since the latter used at the strength mentioned is likely to become gelatinous on cooling, and hence will be difficult of application. Perhaps the principal objection to whale-oil soap is its cost as compared with other washes, and to the fact that as sold on the market it is of quite variable composition. A potash-lye soap should be insisted on, and one that contains not more than 30 per cent of water. The wash is applied in late spring.

Kerosene and crude petroleum.—In general the use of kerosene and crude petroleum on peach trees in the East is attended with much risk of injury to trees and fruit buds, though in the hands of many growers such injury has never been noted. Theoretically these oils constitute an ideal treatment for scale-infested peach trees, but the serious injury often following their use has placed them in disrepute, and they are now practically displaced by the safer and cheaper lime-sulphur-salt wash.

Kerosene and crude petroleum are used either pure or in soap or mechanical emulsions with water. When used undiluted, the greatest care must be exercised that the trees be sprayed only sufficiently to moisten the trunk and branches, and especially that no oil be allowed to form puddles around the tree. Applications should be made only during bright, dry days, so that the oil will evaporate from the trees as quickly as possible. The ordinary kerosene or coal oil (150° flash test) is used. The crude petroleum should show from 43° to 45° Baumé. Kerosene and crude petroleum are more commonly used diluted—that is, in soap or mechanical emulsions with water. A 20 per cent soap emulsion, which is about the right strength for a dormant peach tree, is made as follows:

Whale-oil or other soap	pounds	2½
Kerosene or crude petroleum	gallons	10
Water to make	do	50

STEAM PLANTS FOR COOKING LIME-SULPHUR-SALT WASH.

[Photographs by Jas. H. Beattie.]

The soap is dissolved in 5 gallons of hot water, which is at once poured into the spray-pump barrel. The 10 gallons of kerosene or crude petroleum is next added, and the whole thoroughly emulsified by pumping it back through the hose into the barrel for six or eight minutes. After the oil has become thoroughly emulsified the barrel is filled with water, and the preparation is ready for use.

Various spray pumps are now on the market which are designed to mechanically mix with water any desired percentage of kerosene or crude petroleum in the act of spraying. In the use of such pumps care must always be exercised to see that the desired percentage of oil is being discharged from the nozzle, or injury to the trees or ineffective work is likely to result.

THE WEST INDIAN PEACH SCALE.

(*Diaspis pentagona* Targ.)

Next to the San Jose scale, the West Indian peach scale is undoubtedly the most destructive of the scale insects affecting the peach in the United States. According to Mr. Marlatt, it is a native of eastern Asia. It was first discovered in the United States in 1892 infesting seedling peach trees growing on the Department grounds at Washington, though old trees throughout the city were soon afterwards found to be infested in a way to indicate that it had been present in the District of Columbia for a number of years. The species has been discussed at length by Riley and Howard in Insect Life (Vol. VI, p. 287), and again by Doctor Howard in the Yearbook of this Department for 1894. Owing to its general occurrence in the West Indies it was at one time supposed to be native to those islands, hence its common name. It is known, however, to occur in many parts of the world.

Throughout its wide range this species attacks many different species of plants. In the United States it is injurious particularly to the plum, peach, prune, cherry, and apricot among deciduous fruits, and to a considerable list of ornamental shrubs and plants, as lilac, hibiscus, etc.

DESCRIPTION AND LIFE HISTORY.

This species is illustrated in figure 82, in which *a* shows a branch covered with female and male scales, natural size, and these are shown enlarged at *b* and *c*, respectively. The scale of an adult female is circular, rather convex, grayish in color, and often not readily distinguished from the adjacent bark, the scales of which may more or less cover it. The male scales are elongate, white, and on badly infested trees occur in such numbers as to give the tree a whitish appearance, as if whitewashed. In the latitude of Washington there are three broods each year. In Georgia, according to Mr. W. M. Scott, there are three or four broods each year, the young of the first

brood appearing during a favorable season about the middle of March. Mr. G. F. Mills, of Quintette, Fla., according to Prof. H. A. Gossard, believes that there are in that latitude four broods per year, and sometimes five. On account of its prolificness and rapidity of development it is capable of doing serious damage even during a single season, and if treatment be neglected the death of infested trees is certain to result. In the South where it has become established it is almost equally destructive with the San Jose scale.

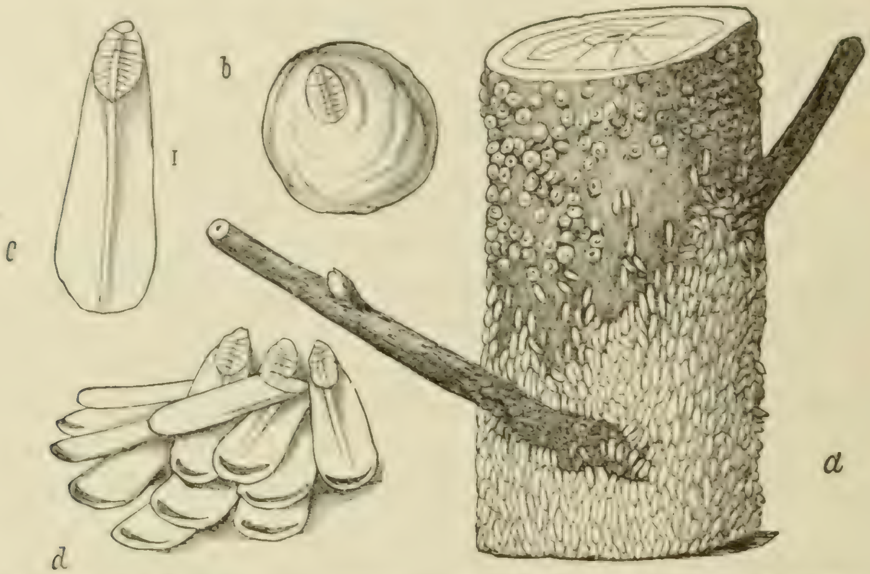


FIG. 82.—The West Indian peach scale (*Diaspis pentagona*): *a*, infested branch; *b*, female scale; *c*, male scale; *d*, group of male scales. (From Howard.)

REMEDIES.

The treatment of orchards and remedies advised in the control of the San Jose scale will be equally effective in the control of this species.

THE PEACH LECANIUM.

(*Eulecanium nigrofasciatum* Perg.)

The branches and foliage of the peach are often noticed to have a dark, smutty appearance, as if covered with soot. This usually indicates the presence of the peach lecanium, though not always, as this condition may result from the presence of plant lice, or, more properly speaking, aphides. The black, sooty substance is a fungus which grows on the honeydew excreted in considerable quantities by these scales, which infest the smaller branches and twigs of the tree, the males often occurring on the foliage. The peach lecanium, or "terrapin scale," was long considered identical with the European peach lecanium (*Eulecanium persicæ*), but it was established by Pergande in 1898 to be a distinct species. Mr. Pergande considers it a native of the United States, and probably indigenous to the territory south of New York

and north of the Potomac River. Whatever its origin, it has now become quite widely distributed, being known to occur in many localities in the eastern United States, from Canada to Florida. Throughout its range it subsists on a considerable number of food plants, as plum, peach, apple, olive, maple, sycamore, linden, and birch.

DESCRIPTION AND NATURAL HISTORY.

The female insect is illustrated, about natural size, on twig, in figure 83, and enlarged, in ventral, dorsal, and lateral views, to the left. The males are much smaller, elongate, slightly convex, and greenish white in color. They occur on the twigs among the female scales, some usually making their way to the foliage. There is apparently but one generation each year, the insect passing the winter mainly in the condition of the advanced female. The overwintering insect matures early in

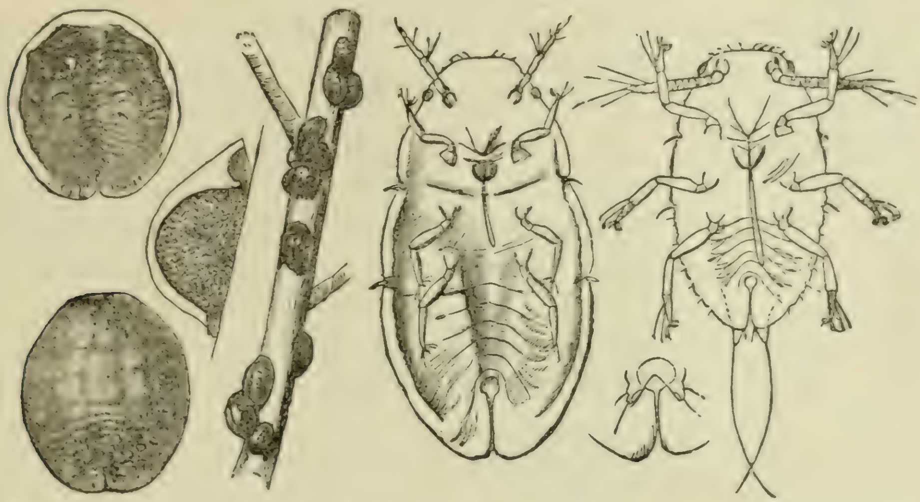


FIG. 83.—The peach lecanium (*Eulecanium nigrofasciatum*): Adults at left, natural size and enlarged; young at right, much enlarged. (From Howard.)

spring, depositing her numerous eggs in a mass beneath her body scale. In Missouri, where this species has been studied by Miss Murtfeldt, the eggs begin to hatch by June 10, and hatching continues for about a month. The males begin to appear by July 22, living about one week. The females continue growth until the approach of cold weather, hibernating in an immature condition, as stated.

TREATMENT.

It is probable that in orchards treated for the San Jose scale the treatment will also serve to keep this species under control. Where this pest only is present it is best treated by thoroughly spraying the infested trees with 15 or 20 per cent kerosene emulsion or whale-oil soap solution, 1 pound to 4 or 5 gallons of water, just as the eggs are beginning to hatch. As the period of hatching extends over about one month, one or two subsequent applications are advisable.

THE BLACK PEACH APHIS.

(*Aphis persicæ-niger* Er. Sm.)

The black peach aphis infests the roots, tender shoots, and foliage of the peach, causing more serious injury when occurring on the roots. Its presence on the roots is often unsuspected, the failure of the trees being attributed to other causes. Young trees recently planted are most subject to injury, before they have become well established in the soil. Infested trees may fail to grow off well, at the end of two or three years being scarcely larger than when planted. The foliage assumes a yellowish green, sickly appearance, the leaves becoming somewhat curled on the edges and blotched with red, suggesting a wet soil or incipient "yellows."

DESCRIPTION AND LIFE HISTORY.

The insects occur in two forms—winged and wingless—the former occurring only on the shoots and leaves, while the latter occur on both the foliage and roots. An individual aphis is quite small, the body in both forms averaging about 2 mm. in length, shining jet black or dark brown in color, oval in shape, though the body of the wingless form is stouter. Both forms are illustrated, much enlarged, in figure 84. The young are faint greenish-brown in color, gradually becoming darker as they grow, till the jet black condition of the adult is reached. Aphides of all ages occur promiscuously together, often in such numbers as to practically hide the infested parts. They feed by means of a beak, which is thrust into the tissues of the plant, and the sap removed by their combined attack constitutes a serious drain on plant vitality. The insect lives on the roots of the plant during the entire season, and breeding is continuous, except during the winter, which is spent in hibernation. The aphides are usually attended by ants, which aid them in securing food, transporting them from place to place and otherwise caring for them. The ants secure from the aphides for food quantities of honeydew which is excreted by them. In the spring the aphides make their way above the ground and begin to feed and breed on the tender growth just pushing out. The young are born alive, the progeny soon becoming mature and giving birth to living young in their turn. They thus multiply very rapidly, an aphis soon becoming the progenitor of many thousands. The winged aphides fly readily and migrate to other trees, where new colonies are started. The insect is thus principally spread in orchards or localities where it has once become established. During summer the aphides for the most part are to be found on the roots, though a few may be found on the foliage and shoots in badly infested orchards at almost any time during the growing season. Below ground they occur more or less promis-

cuously on roots of all sizes, but the smaller and more tender ones are preferred. Some of the aphides may retain their hold on the

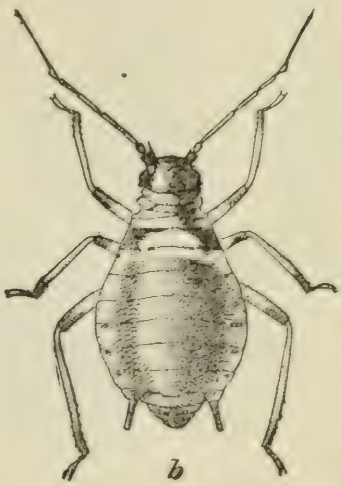


FIG. 84.—The black peach aphis (*Aphis persicæ-niger*): *a*, winged agamic female; *b*, wingless agamic female. Much enlarged (original).

roots after the trees are dug, and the insect is thus frequently distributed on nursery stock. The general practice of fumigation by nurserymen now renders their distribution much more unlikely than formerly. Light, sandy soils are worst infested, though they have been found in abundance on stiff clay soils.

REMEDIAL AND PREVENTIVE MEASURES.

Trees from the nursery should be carefully examined before planting, and if aphides are found on the roots these should be destroyed by dipping the roots in strong tobacco water, kerosene emulsion, or whale-oil soap solution. The precaution should be taken to purchase trees only from nurserymen who practice fumigation. Where the pest has already become established on the roots of orchard trees its control is often quite difficult. Heavy dressings of kainit, according to Dr. J. B. Smith, are effectual in killing the aphides. The fertilizer should be applied over the ground covering the root area of the tree, preferably just before a rain. Unleached wood ashes, from one-half to one bushel per tree, is recommended by Pettit as being very effective. It is better to first remove the soil over approximately the root area of the tree, replacing it after the ashes have been applied. Ground tobacco dust may be used in the same way. In all of these substances the insecticidal properties leach out, coming in contact with the soft bodies of the aphides on the roots and thus killing many of them.

Mr. H. G. Welch, of Douglas, Mich., reports much success from the free use of stable manure applied around the trees, which are thus

enabled to outgrow the effects of the aphides. In general, it would seem that injuries from the pest would be overcome to a considerable extent by supplying the tree with an abundance of plant food in the way of fertilizers and by cultivation. Prof. Wesley Webb, of Delaware, reports success in the control of this pest in nurseries in the sandy soils of that State by the free use of tobacco dust as a fertilizer, drilled in with the seed, or later along the rows of the trees.

THE PEACH TWIG-BORER.

(*Anarsia lineatella* Zell.)

The peach twig-borer, of European origin and first noticed in this country in 1860, is now probably quite generally distributed over the United States. It is particularly destructive in the more western States, as California, Oregon, and Washington, there constituting a permanent and serious enemy of the peach, attacking also the prune, nectarine, apricot, almond, and pear. In California, where it has been carefully studied by Mr. E. M. Ehrhorn and also by Mr. W. T. Clark, it is perhaps the most serious pest with which the peach growers have to contend. The losses of fruit during the four years from 1898 to 1901, as estimated by Mr. Clark, amounted to $1,373,000. Injury is done (1) by the overwintering larvæ to the tender shoots in early spring, and (2) by the summer generations of larvæ to the fruit, especially to the later varieties. The latter constitutes its principal injury.

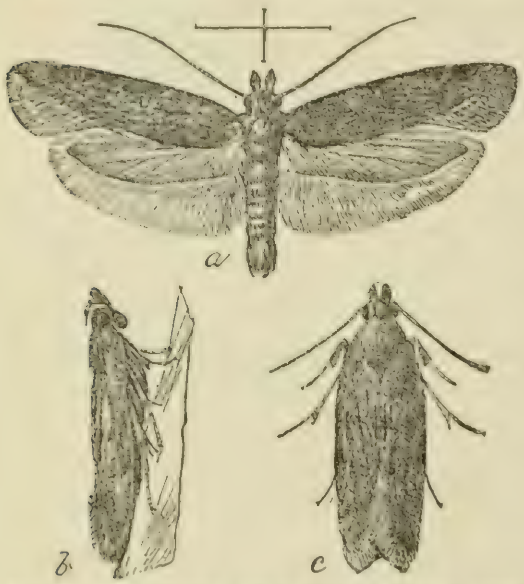


FIG. 85.—The peach twig-borer (*Anarsia lineatella*): *a*, moth with spread wings; *b* and *c*, same with wings closed. All much enlarged (from Marlatt).

In the Eastern States this species has at times been the occasion of serious injury, though this has practically been limited to the destruction of the tender shoots of the peach in early spring by the overwintering larvæ.

DESCRIPTION AND LIFE HISTORY.

The adult, a moth of the family Gelechiidæ, is shown enlarged in figure 85, the exact length of body and wing expanse being indicated by the hair lines at the top of the figure. The larva and pupa are shown at *b* and *c*, respectively, of figure 86, and *a* illustrates the withering effect on a young peach shoot resulting from attack by the larva. As shown by the hair line, the larva is about one-half inch long, and

the pupa somewhat less. The larva is pinkish or brownish in color, while the pupa varies from light to dark yellow.

Several observers have contributed to our present knowledge of the life and habits of this species, notably Messrs. Ehrhorn and Clark in California, Cordley in Oregon, and Marlatt at Washington. The insect passes the winter as a very small larva in silken-lined cells or burrows in the spongy tissue of the bark at the crotches of the limbs. Their presence is indicated by small mounds of comminuted bark, as shown in figure 87, at *a* and *b*. Early in the spring, as the foliage is putting out, the larvæ begin to leave their burrows and attack the tender shoots, boring into and down the pith, the galleries ranging from about one-third inch to 1½ inches in length. The shoot thus injured soon wilts and dies, as shown in figure 86, at *a*. Many shoots may be attacked by a single larva, which is thus capable of doing considerable harm.

FIG. 86.—The peach twig-borer: *a*, a new peach shoot withering from work of larva; *b* and *c*, larva and pupa, respectively; *d*, tip of pupa, side view. Hair line indicates actual length (from Marlatt).

There are two or three generations of larvæ during the summer in the West, those of the second and third attacking the fruit, the later varieties being the worst injured. According to Prof. C. V. Piper, the larva enters the peach at the stem end, usually boring into the pit, the seed of which it seems to prefer, usually causing the stone to split as the fruit ripens; or simply the flesh may be tunneled, depending on whether or not the stone is hard when the fruit is attacked. In California, according to Clark, the larva usually enters the fruit along the suture at the stem end, excavating a chamber beneath the skin, which blackens and shrivels somewhat, affording entrance to organisms of decay. In the ripe fruit the larvæ frequently make their way to and around the stone, which, if split, may be entered and the seed fed upon. According to the observations of Mr. Marlatt, at Washington, the larvæ of the summer broods feed beneath the bark or in the fruit

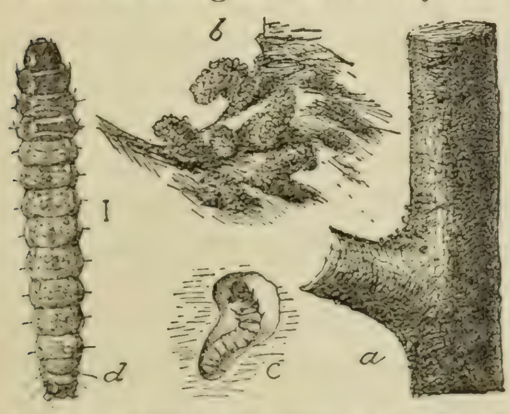


FIG. 87.—The peach twig-borer: *a*, twig of peach showing in crotch minute masses of chewed bark above larval chambers; *b*, same, more enlarged; *c*, larva in its cell, enlarged; *d*, young larva from above, more enlarged. (From Marlatt.)

stems of the peach, occasionally when nearly full grown boring into the fruit. Early in the fall, about September 1 in California, the very young larvæ from eggs of the last generation of moths construct their hibernation cells in the soft tissue in crotches of limbs (see fig. 87), where they remain until the following spring, thus spending some six months in this condition.

TREATMENT.

Mr. Ehrhorn secured excellent results by winter spraying of trees with strong kerosene emulsion. The castings at the mouth of the burrows, referred to under the discussion of the life history, readily absorb the oil, which, penetrating the burrow, destroys the larva. These results were confirmed by Professor Piper in the Snake River Valley (Farmers' Bulletin No. 153, U. S. Department of Agriculture).

In the experience of Professor Piper, the use of lime-sulphur-salt wash was without beneficial results. However, in recent extensive experiments with this wash in California by Mr. Clark he finds it a most effective remedy. The application should be begun as the buds begin to swell, and may be continued without injurious results until after the blossoms have begun to appear, this period coinciding with the escape of the larvæ from their hibernation burrows. With either treatment the applications must be made with great thoroughness to insure the coating of every part of the tree.

THE FRUIT-TREE BARKBEETLE.

(*Scolytus rugulosus* Ratz.)

Injury to the peach by the fruit-tree barkbeetle is usually first indicated by the exudation of gum from the trunk and branches, forming numerous globules, and later by the presence in the bark of numerous small round holes, as if the tree had been peppered with shot. As a rule, only trees in a weakened or sickly condition are attacked, but injury to apparently healthy trees has been observed. The insect causing this trouble is a small cylindrical beetle, about one-tenth of an inch in length and about one-third as wide. Closely examined, it is seen to be uniformly black in color, except a portion of the legs and the tips of the wing covers, which are dull red. The insect is shown in the adult, pupal, and larval stages in figure 88, the hair lines indicating the natural length.

LIFE HISTORY AND HABITS.

Generally speaking, the beetles infest only such trees as are sickly or weakened, as from neglect, injury from borers, or other causes. The copious gum exuded by hardy peach trees seems to be fatal to the purposes of the beetles by filling up their holes and breeding chambers. Where the insects are very abundant, as becomes possible in

orchards containing many sickly and dying trees, their continued attack on healthy trees and the resulting loss of sap may so weaken them that they finally become suitable for the breeding purposes of the insect. Upon the decline of a tree, from whatever cause, it at once becomes subject to attack. The beetle bores a small hole through the bark, beneath which a vertical brood chamber is constructed, along the sides of which little pockets are excavated, where the eggs are deposited. Egg laying begins by the time the brood chamber is about three-fourths of an inch long, and is continued from time to time as the burrow is lengthened. The completed burrows average about 1½ inches in length. The young larvæ start boring galleries more or less at right angles to the brood chamber, but these galleries soon take various directions. If attack has been severe the trees may soon be girdled. There are several generations annually. In the latitude of Washington, Doctor Chittenden is of the opinion that there may be

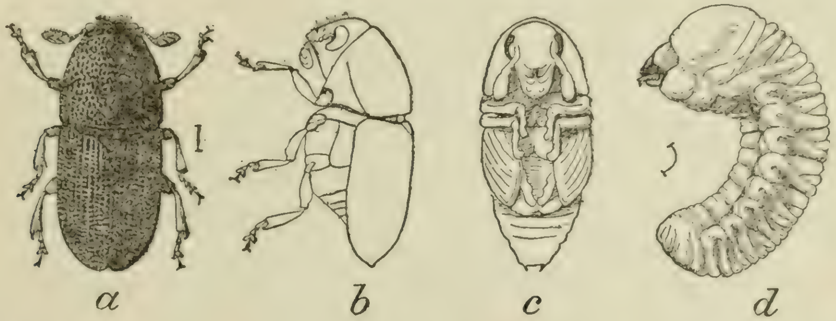


FIG. 88.—The fruit-tree barkbeetle (*Scolytus rugulosus*): *a*, adult beetle; *b*, same in profile; *c*, pupa; *d*, larva. Enlarged about ten times (from Chittenden).

three broods, while in the extreme South, according to Mr. C. F. Baker, breeding is apparently continuous through the spring, summer, and fall.

FOOD PLANTS.

The fruit-tree barkbeetle attacks plum in preference to other plants, and apple, peach, and cherry are about equally attractive. Pear, quince, apricot, nectarine, mountain ash, and Juneberry are also infested, and in Europe, to which country it is native, hawthorn, elm, and mountain ash are said to be among its food plants.

PREVENTIVE AND REMEDIAL MEASURES.

In orchards where proper attention is given to maintaining a healthy, vigorous condition of the trees but little is to be feared from the fruit-tree barkbeetle. Since it is not able to multiply to any extent save in trees that are in a weak, diseased, or dying condition, these should frequently be searched for and at once destroyed by burning. It will not be sufficient to simply cut them down, for the beetles will continue to breed in portions of a tree left lying or piled on the ground, thus reinfesting the orchard.

NEMATODE ROOT-GALL.

(*Heterodera radicicola* (Greeff) Müll.)

In the light sandy soils of the Southern States a very prevalent and important affection of the peach is the so-called "root-knot" or "root-gall," due to the work on the roots of a microscopic nematode worm (*Heterodera radicicola* (Greeff) Müll). Although the organism responsible for this malady is not an insect nor is it nearly related to insects, its importance as a pest of the peach in the territory mentioned warrants its brief consideration in this connection, especially since, in the minds of many orchardists, the root-knot is believed to be the result of insect work. At the present time this and other nematode diseases are the subject of special investigation by Dr. Ernst Bessey, of this Department.

The affection is too well known to southern orchardists and nurserymen to require special description. In addition to the peach a very long list of plants are attacked with varying severity, according to the species, including most garden vegetables and common weeds. The cowpea is especially subject to attack, and the expediency of the cultivation of this crop for soiling purposes in orchards where the nematode prevails is a question concerning which considerable difference of opinion prevails among practical orchardists. On the whole, it is probably the consensus of opinion that the benefits to the soil do not offset the increased injury to the trees by the propagation and spread of the disease. A variety of cowpea, namely, the Iron, is practically immune from nematode injury, and the planting in orchards of this variety is to be recommended. The small nitrogen tubercles, normal to the roots of the cowpea and other legumes, should not be confused with the deformities caused by the parasite under consideration.

PREVENTIVE AND REMEDIAL MEASURES.

In planting orchards new land, uninfested by the parasite, should be selected, if possible, and care should be exercised to secure trees for planting free from the root-knots. Trees infested from the nursery fail to grow off well, often dying in from one to two years, and trees infested soon after planting by reason of the presence of the nematode in the soil rarely attain normal growth and productiveness. Theoretically, conditions of high fertility which would induce a vigorous growth of tender roots are favorable to the parasite. However, some orchardists have found that the free use of fertilizers, as stable manure, mulches, or commercial fertilizers, will in most instances insure a vigorous tree in spite of the parasite. Owing to the considerable number of weeds and other plants upon which this pest will breed, clean culture in orchards is very essential in its control.

The use of Marianna and other plums as a stock for the peach, once much in vogue on account of the immunity of the roots of these varieties from nematode injury, has been practically discontinued on account of their unsuitableness for this purpose.

THE HANDLING OF FRUIT FOR TRANSPORTATION.

By G. Harold Powell,

Pomologist in Charge of Fruit Transportation and Storage Investigations, Bureau of Plant Industry.

INTRODUCTION.

The fruit-growing and the transportation interests of the country are inseparably bound together. There is no use in growing apples, oranges, or peaches commercially without an efficient system of safe and rapid distribution. The intricate system of railroads and waterways that spreads out like a network over the country has converted vast areas of unproductive land into highly specialized fruit-growing regions, and distributes the products of the orchard, the plantation, and the vineyard to the remotest parts of the country and to many foreign markets. There has been a gradual evolution of special transportation facilities from the box car, the pony refrigerators, and the slow express or boat service, with their irregular schedules, of forty years ago. The fast fruit-train service, the fruit-express car, the refrigerator-car lines, the special fruit boats, the refrigerator compartments on shipboard, and the development of cold-storage warehouses as a link in the chain of distribution have brought together the producer and the consumer in the most distant parts of the United States and Canada. They have made accessible to the American fruit grower the principal markets of Europe, of Asia, and of other foreign lands.

RECENT GROWTH OF CERTAIN PHASES OF THE FRUIT INDUSTRY.

The citrus fruit business of California is a striking example of a large commercial industry that has grown up within thirty years. The first carload of 300 boxes of oranges is said to have been shipped from the State in 1876. The shipments reached 1,000 cars ten years later, in 1886. A decade afterwards, in 1896, nearly 16,000 cars were forwarded, while about 30,000 carloads of oranges and lemons, amounting to over 10,000,000 boxes of fruit, valued in California at $27,000,000, were shipped during the forwarding season of 1904–5, the fruit reaching every town of importance in the United States and Canada, as well as many European and other foreign markets.

The deciduous-fruit industry of California has also shown a remarkable development. The first carload of fresh fruit was shipped East in 1869. The fresh-fruit shipments in 1895 amounted to 4,568 carloads, while in 1905 between 8,000 and 10,000 cars were shipped from the State, many of the apples, pears, plums, and peaches finding their way across the Atlantic and the Pacific as well.

The western coast has not been alone in the rapid development of commercial fruit growing. About fifteen years ago strawberry culture began to develop as an important commercial industry in North Carolina and South Carolina. In 1897 the marketed crop reached about 500 carloads, while in 1905 it was between four and five times as large. Peach growing in Georgia is another example of the rapid development of an American fruit industry. About thirty years ago a few peaches were shipped from the State by express. The refrigerator chests devised in 1866 by Mr. Parker Earle for the shipment of strawberries were used in Georgia as early as 1878 to prevent the rots and overripeness of peaches in transit. Two years later some of the crop was forwarded to Savannah by freight and thence in refrigerator compartments by boat to New York. About 1882, crude forms of the refrigerator car were introduced for the carrying of the fruit. The Elberta peach, which originated at Marshallville, Ga., came into prominence in the early eighties, giving the industry a great impetus, which has resulted in the growth of the shipments in the last ten years from about 700 to 5,000 cars of fruit annually. The Georgia peach orchards represent now nearly 20,000,000 trees. The distribution of the fruit crop from these widely separated areas is one of the most difficult problems in transportation.

THE HAZARDOUS NATURE OF FRUIT SHIPPING.

No commodity is more likely to deteriorate in transit than the fruit crop. The ripening and the rots continue to develop in the cars in hot, moist seasons unless they are checked by a cold temperature soon after picking. Summer fruits, like the cherry, the peach, the plum, or the berries of different kinds, are likely to reach the market soft and decaying unless handled under the most favorable conditions. It is not uncommon to find the markets filled with overripe peaches from Texas, Georgia, or Michigan, or strawberries from the Carolina district, during hot, moist shipping seasons. The Bartlett pear often reaches the distant market in a "slack" condition on account of the ripening and shrinkage of the fruit in transit. The slow-ripening fall or winter fruits are less likely to develop troubles in transit, but on long trips the ripening processes may bring them to the point of

deterioration, or the development of rots may cause serious commercial loss.

CAUSES OF LOSSES IN TRANSIT.

The reader should distinguish between the losses that result from the continued ripening of the fruit and the deterioration from decay which the fruit may have contracted while growing or after it is picked. Either of these factors, or both of them working together, may be responsible for transportation troubles.

FUNGOUS DISEASES.

Many of the diseases that attack the growing fruit continue to develop in transit. The bitter-rot is one of the worst apple diseases in the central-western and eastern-southern apple-growing States. The disease is often in an early stage of development when the apples are packed for shipment. It develops with great rapidity in the moist, warm air of the package and renders the fruit worthless in a few days unless it is shipped or stored immediately after picking in a temperature as low as 40° F. It grows luxuriantly in warm weather if the shipping is delayed, or if the apples are forwarded in warm cars. The scab may grow slightly in transit, but the most serious result from shipping scabby apples follows the growth of the blue mold and the pink mold or rot in the tissue around the diseased spots. These secondary troubles grow rapidly if the fruit is warm and moist in transit, but are retarded by cold temperatures, the former disease growing very slowly in a temperature as low as 32° F., the latter not developing when the temperature drops to 40° F.

The monilia or brown-rot of the peach, a serious transportation trouble, may attack the fruit before or after it is picked. The peach is especially susceptible in warm, moist seasons, when the early varieties may decay badly on the trees. The disease grows with astonishing rapidity, a small point of infection developing into a spot as large as a quarter of a dollar in twenty-four hours in warm weather. Delaying the shipping of the fruit a few hours, or shipping it without thorough icing and ventilation in transit, is invariably followed by a large amount of decay. This rot is most severe in the comparatively warm, moist air in the top tiers of packages in a refrigerator car. There may be none of the trouble in the cooler, bottom tiers of packages. This condition in the different parts of a car leads to the conclusion that the monilia and the overripeness can both be controlled in transit when all of the fruit is cooled as quickly as the bottom tiers of packages.

The diseases that affect the fruit after picking cause the most serious losses in transit. The molds of various kinds, such as Penicillium,

Mucor, Aspergillus, and Botrytus, probably cause more losses in transit and in fruits in cold storage than all other diseases combined. The blue molds (Penicillium), shown in Plates XXXIV and XXXV, produce the principal rots in apples and pears in storage and in transit, and in oranges and lemons in transit. These molds do not usually penetrate the uninjured surface of thick-skinned fruits like the orange, the lemon, the apple, or the pear. The delicate fruits, like the strawberry, are more easily attacked by a mold like Botrytus. The molds attack all fruits more readily when their vital processes are at low ebb from overripeness or from any other cause, but they gain entrance to a fruit commonly when a spore comes in contact with a broken part of the skin, the disease growing rapidly if there is sufficient moisture with a temperature high enough to start it.

These diseases grow luxuriantly in warm, moist air. The limits of temperature in which they will grow are not well understood. Some of the blue molds probably grow at the freezing point of water, though slowly at a temperature below 40° F. If the fruit remains in the orchard in warm weather after picking the molds develop rapidly in injured fruit.

CONTACT INJURIES.

Another type of injury is due to packing the fruit so loosely that it moves in the package in transit, or to severe pressing, or to rubbing the fruit in any way. This injury is apparent on arrival in market. It frequently shows in brown, discolored spots on the Yellow Newtown apple or on the Wickson plum when the latter comes in contact with the package. It is primarily a packing difficulty that may be overcome by wrapping the fruit and by packing it more carefully.

CARELESS HANDLING.

The care with which a fruit is handled in the orchard or plantation and in the packing house is one of the important factors in determining the shipping quality. It is the one factor above all others that keeps the thick-skinned fruits, like the orange or the apple, immune from the attacks of the common molds. These fruits do not often decay as long as the skin is whole, unless they are weakened by overripeness or by other adverse conditions. The least abrasion or cut in the skin gives the molds a foothold, and once started the decay is likely to continue under the most favorable transportation conditions.

It is equally important that soft-fleshed fruits, like the strawberry and the raspberry, be protected from injury. No fruit is more difficult to transport than a ripe strawberry; yet it can be shipped long distances and arrive in perfect condition under efficient refrigeration if the surface of the berry is intact.

DECAY IN THE LEMON AND ORANGE AS THE RESULT OF CUTS FROM CLIPPERS.

DECAY IN APPLES RESULTING FROM MECHANICAL BRUISING (UPPER FIGURE) AND FROM CODLING MOTH INJURY (LOWER FIGURE).

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FIG. 1.—CARELESS PILING OF PEACHES. FRUIT IS OFTEN INJURED IN THIS WAY.

FIG. 2.—ORANGE PACKING HOUSE, CALIFORNIA, SHOWING COMPLICATED MACHINERY.

THE EXTENT OF MECHANICAL INJURIES.

It is well known that decay in fruit in transit and in storage generally develops from a wound on the surface, though few persons know how common these injuries are. The commonest injuries are caused by the punctures of insects, by the stem of one fruit penetrating another, by cuts from the finger nails of the handler, by dropping the fruit on a sharp surface, by ruptures caused by the rapid growth of the fruit, by windstorms, or by cutting the surface in some way. In Plate XXXV, figure 1, decay is shown starting from a cut on the surface of an apple; in the lower figure decay occurs around a codling-moth injury. Decay from clipper cuts in the lemon and orange is shown in Plate XXXIV, figure 1.

There has been a gradual improvement since the beginning of the fruit business in the methods of handling the crop. The early, crude manner of harvesting and packing is giving way to better methods in the orchard and in the packing houses. There needs to be further improvement along these lines in every branch of the fruit industry. In the apple industry, for example, where the crop is handled with more than average care, 10 per cent of the fruit is frequently made susceptible to decay by stem punctures caused by dropping the fruit roughly into the basket, on the sorting pile or table, or into the shipping package. A package of peaches will reveal a greater number of bruises, the trouble arising from the tearing of the skin in pulling the fruit from the stem, from packing it so firmly as to squeeze the fruit against the edges of the package, and from the pressure of the fingers of the picker; and, in addition to these causes, many injuries are the result of the rough handling of the packages in the orchards, in the packing houses, and in loading them in the cars. The softer fruits, like the strawberry, are damaged in the ordinary course of handling to a still greater degree.

None of the thick-skinned fruits is injured in handling more than the orange. The orange is not picked like an apple or a pear by separating it from the fruit spur. The fruit is attached firmly to the branch, from which it must be cut off with shears or clippers to prevent tearing the skin around the stem. In a variety like the Washington Navel, having a distinct cavity at the base, the picker often sticks the clippers into the edge of the cavity beyond the stem, especially if a sharp-pointed pair of shears is used. If the stem is cut too short, the skin may be shaved with the clippers, or if too long, the stem may puncture another orange with which it comes in contact. If the fruit is packed in a house equipped with machinery, the chances for bruising are further increased.

Until recently, when the attention of the grower and packer was directed to these injuries, it was difficult to find a box in which 10 per

cent of the fruit had not been mechanically bruised. The injury from clipper cuts alone may vary from 5 to 50 per cent. In addition, the oranges may have been injured by stem punctures or by the finger-nails of the picker, and still more bruising occurs in the field in dropping the fruit roughly into boxes, bags, or baskets, by filling boxes too full, or by throwing the packages carelessly on or off the wagon. An easy method of injuring the peach in the piling of the packages is shown in Plate XXXVI, figure 1.

It is more difficult to locate the cause of injury in packing the fruit. There is a wide variation in the equipment and management of packing houses and in the care exercised in packing the fruit in the field. In machine-equipped packing houses these troubles are likely to result from an apparently trifling disarrangement of some part of the machinery. In an orange or lemon packing house the fruit may be cut or scratched by a wire that projects from a brush, by a nail protruding in a runway, by a sharp corner exposed without padding, or by some other mechanical defect. Ten per cent or more of the peaches or plums in a package often have the skin broken by the sharp edges of the baskets or boxes, especially when the fruit extends above the package. A similar amount of injury may result in covering the packages with undue pressure or in dropping the fruit in some part of the packing operation. A packing house equipped with complicated machinery like the orange house shown in Plate XXXVI, figure 2, is likely to injure the fruit.

THE PRESENT METHODS OF HANDLING.

Few experienced fruit handlers realize how much the fruit is injured in the orchards, plantations, and packing houses. The fruit shipper is likely to seek an explanation of the losses in transit in factors other than the condition of the fruit when it is shipped. This phase of the fruit business is one that needs to be made more prominent and which requires a determined effort to improve. An efficient labor foreman who appreciates the nature of these troubles can reduce to a minimum such bruises as result from the dropping of an apple or a peach or from the clipping of an orange. The writer has seen an average injury of 20 per cent of the oranges in a grove in which more than 100 men were employed reduced to 5 per cent in a few days by the persistent efforts of a competent foreman, with an additional cost of less than one-half cent a box for the more careful picking.

The responsibility for rough handling may often lie back of the individual picker or packer. It is often the result of the system of handling the labor and the fruit in the plantations and packing houses. The fruit-growing business has not yet developed to that point where every picker or packer is held responsible for the quality

of his work. No two persons handle the fruit with equal care. One orange picker, for example, may cut 1 per cent of the fruit in picking, while another injures from 50 to 75 per cent. One leaves 5 per cent with stems too long; another, 50 per cent. A careful apple picker or a peach picker may not injure 2 per cent of the fruit by pinching it, while a clumsy-handed picker may bruise 90 per cent.

These differences are common rather than unusual. They may be overcome to a large extent by the persistent effort of those in charge of labor, but a system by which the fruit of every picker or packer can be identified might be adopted in order that the persistently careless worker may be eliminated. If the picker and the packer each places a number, or a numbered ticket, on the package when the fruit leaves his hands, an inspector is able to trace the fruit to the one who is responsible for the handling. An efficient system of inspection of the work in the plantations and packing houses is an essential feature of the organization of a large fruit business. In cases like the California orange industry, where the growers of a community may pool the fruit, the inspection of the work of the individual picker by the grower and of the fruit of each grower by the management of the packing house is necessary to prevent an injustice to a careful handler who may otherwise pool his fruit with oranges showing a large amount of injury.

Another prolific cause of careless handling in the orchards and packing houses comes from paying the labor by a package rate, without inspecting the work of the individual. Under these conditions, the quantity rather than the quality of the work is the prime consideration of the picker or packer, and it often leads to the most flagrant carelessness. If the work of the individual can be traced by an inspection system, this method of fruit handling is less objectionable.

FACTORS THAT INFLUENCE KEEPING QUALITY.

A cold, dry, pure air is ideal for the preservation of fruits of most kinds. Cold air checks the ripening processes and retards the growth of diseases. Dry air may prevent the development of rots, and pure air preserves the delicate quality of the fruit. The ripening must be checked soon after the fruit is picked to prevent premature deterioration. Ripening proceeds much more rapidly when a fruit is severed from the tree, so that it comes nearer the point of deterioration in a few hours or days than it would have been if left hanging on the tree in the same temperature for a much longer period. In cold storage the rots develop and most fruits ripen if the temperature remains much above 32° F. for any length of time. The molds grow if the room is moist; the flavor deteriorates if the air is impure. If the temperature throughout the room is not uniform, the stored products

ripen unevenly. If the products are not piled so that the air can circulate freely about the packages, the ripening may proceed and the rots develop before the fruit is cooled.

The behavior of products in cold storage depends on their condition when stored, as well as on the conditions in the storage house. If fruit is bruised and susceptible to rot, the molds that grow in low temperatures cause it to decay early in the storage season. If it ripens or diseases develop during delays in storing, the fruit breaks down prematurely; or, if the packages are large and radiate the heat slowly, the fruit in the center of the package ripens and decays early in the storage season. These are some of the fundamental principles that govern the successful cold storage of fruit. They apply with equal force to the transportation of most fruits in cold temperatures. The successful transportation of perishable fruits in refrigeration depends primarily on the sound condition of the fruit; on cooling it soon after it is picked; on shipping it in packages which cool quickly throughout; on a dry, pure, cold air uniformly distributed in the car or compartment, and on a free circulation of air throughout the packages.

CONDITIONS IN A REFRIGERATOR CAR.

The principal difference between a cold-storage warehouse and a refrigerator car lies in the poorer control of the conditions in the latter. The temperature is higher, the moisture greater, the distribution of cold air less uniform, and the refrigerating power less efficient.

Perishable fruit is usually loaded for shipment soon after it is packed, the temperature of the fruit approximating the temperature of the atmosphere. In the South and in the western semiarid parts of the country it is sometimes loaded at a temperature of 95° F. In the refrigerator cars in common use the temperature may drop to 40° or 50° F. after a few days in transit; but the top and center of the car are usually several degrees warmer than the bottom and the ends. A car of peaches packed in Georgia carriers, which allow a free circulation of air around the fruit, may cool gradually to 42° to 45° F. in three days in the bottom of the car if the fruit is at 85° F. when loaded. At the same time the fruit in the top of the car may be 10 degrees warmer. A car of peaches in which the fruit is wrapped and packed in 20-pound boxes which are piled closely together may take twice as long to cool down on account of the insulating effect of the paper and the poorer circulation of air between the boxes. The temperature in a refrigerator car continues to fall uniformly. It seldom rises in transit if the icing is well done.

In the first few hours or days of the journey, while the fruit in a refrigerator car is warm and moist, the rots and the ripening processes

develop rapidly, and they continue unchecked longest in the warmer air in the top and center of the car.

THE NEED OF IMPROVEMENT IN TRANSPORTATION FACILITIES.

The foregoing remarks are made to bring out the need of further improvement, not only in the preparation of fruit for shipment, but in the conditions in transit as well. There has been a gradual improvement in the methods of refrigeration in transit from the pony refrigerators in use forty years ago, from the cooling by vertical cylinders in each corner of the car, and from cooling with V-shaped ice boxes suspended from the roof of the car. The refrigerator car of the present time is generally a well-built, thoroughly insulated structure capable of maintaining a uniform degree of cold under ordinary icing, after the fruit is cooled. Except in extreme cold weather, the temperature in a well-built car may not fluctuate 2 degrees in ten days. The most important improvement needed is a practical method of reducing the temperature of the fruit quickly in hot weather to prevent further ripening and the development of the rots during the early part of the trip. This improvement might be made by increasing the refrigerating power and by equalizing the distribution of cold dry air in the car. Or it could be accomplished by cooling the fruit before loading and maintaining refrigeration in transit only, as in the present methods of meat shipment. The discussion following will be confined largely to the preparation of the fruit for shipment rather than to the technical side of refrigerator-car improvement.

METHODS OF REDUCING THE TEMPERATURE OF FRUIT FOR SHIPMENT.

The fruit grower or handler can improve the carrying quality by delivering the fruit to the car or steamer in a cool condition. There is often a difference of 20 to 40 degrees Fahrenheit between the temperature of the air during the night and the day, especially on the Pacific slope. The cool night air ought to be utilized to the fullest extent in cooling the fruit. Peaches that are picked at midday or in the afternoon, then packed at once and delivered to the car, may be at least 20 degrees warmer than fruit picked early in the morning. If picked in the afternoon they should be delivered to the car the morning following, after standing in open packages exposed to the cool night air. A gain of 15 to 20 degrees in cooling before the fruit is loaded is a practical help to the carrying quality of the fruit. After the fruit is in the car, the temperature can be reduced more rapidly and to a lower degree by using a mixture of salt and ice instead of the large cakes of ice that are now in common use. Meat is refrigerated before shipment and is carried at a temperature ranging from 34 to 40 degrees in transit by the addition to the broken ice of about 8 to 10 per cent of salt.

COOLING IN COLD-STORAGE HOUSES.

A cold-storage house is the most efficient place to cool down fruit before shipping. The first shipments under these conditions known to the writer were made by Mr. Parker Earle in Illinois as early as 1872. Mr. Earle was a pioneer, in both the fruit and the refrigerator-car industries. On account of the serious losses in shipping strawberries in the early types of refrigerator cars, which held but 1½ tons of ice, he constructed several storage houses cooled with ice, in which the berries were cooled to about 50° F. before shipment. Before this time it had not been possible to ship strawberries to distant markets in sound condition, but fruit cooled in this way arrived at destination firm and sound. A little later Mr. Earle, with Mr. F. A. Thomas, developed a refrigerator car holding 5 instead of 1½ tons of ice. These cars carried the fruit so much better than the earlier cars that cooling in houses before the fruit was shipped was not extended at that time. In recent years this phase of the fruit-shipping business has received more attention on account of the more exacting conditions in the fruit trade as a whole.

Eastern-grown pears for export are refrigerated in cold-storage warehouses alongside the railroad before shipping. The pears are generally cooled after packing, as cold fruit condenses the moisture of the air and becomes wet if packed in a warm room. Sometimes the fruit is refrigerated in open-headed barrels or in picking boxes, and is afterwards packed in a cool room. Peaches that ordinarily develop considerable decay in the top tiers of packages have been shipped by the United States Department of Agriculture after cooling to about 40° F., and have reached distant markets in prime condition. In one shipment of 8,000 packages less than 1 per cent of soft and decayed fruit developed in the two upper tiers, while 5 to 30 per cent developed in cars cooled in the ordinary way.

At Coachella, in the semidesert Imperial Valley of California, a cold-storage plant has been erected for the manufacture of ice and for the cooling of cantaloupes before shipment. It was operated during the latter part of the season of 1905. The melons are frequently above 100° F. when picked, and when they are shipped without previous cooling are likely to arrive at destination in an overripe condition. The temperature is reduced to about 40° F. by placing the packed crates in a cold room, after which the melons are promptly loaded in an iced car, the fruit being protected against exposure to the warm air during the loading.

Cold-storage plants of this kind might be erected by the side of railroad tracks by large fruit growers or shippers, by associations of growers or shippers, or, in some instances, by refrigerator-car lines or by railroad companies and handled as a part of the refrigeration service.

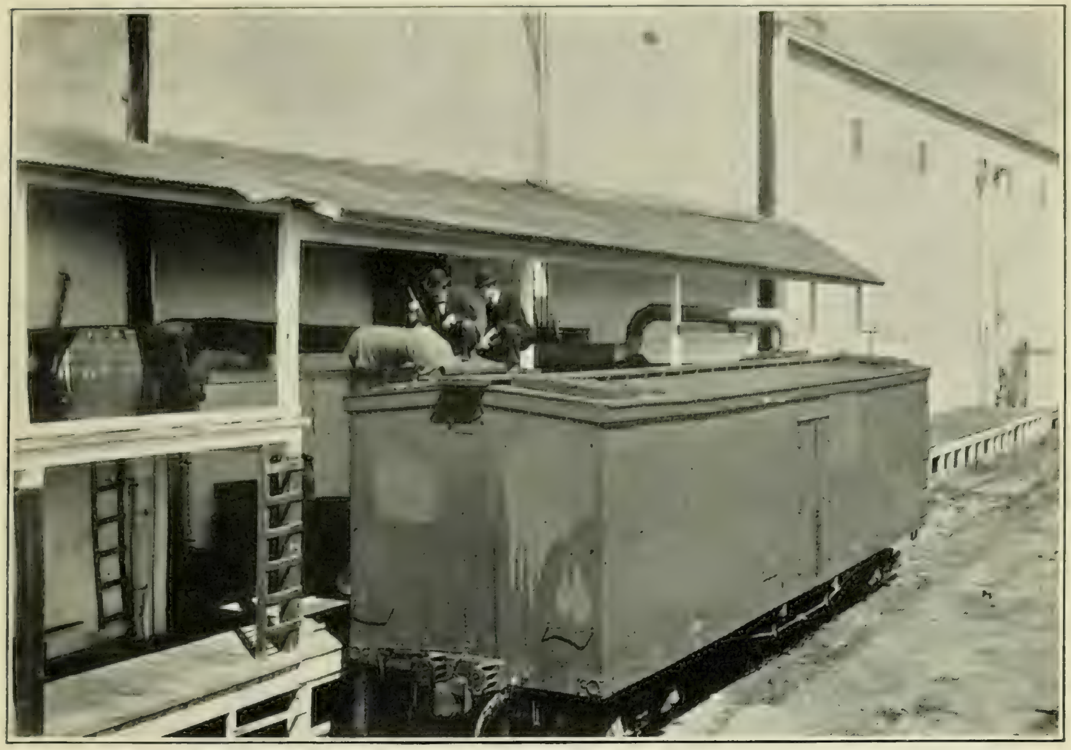

FIG. 1.—COOLING ORANGES IN CAR, LOS ANGELES, CAL., 1905.

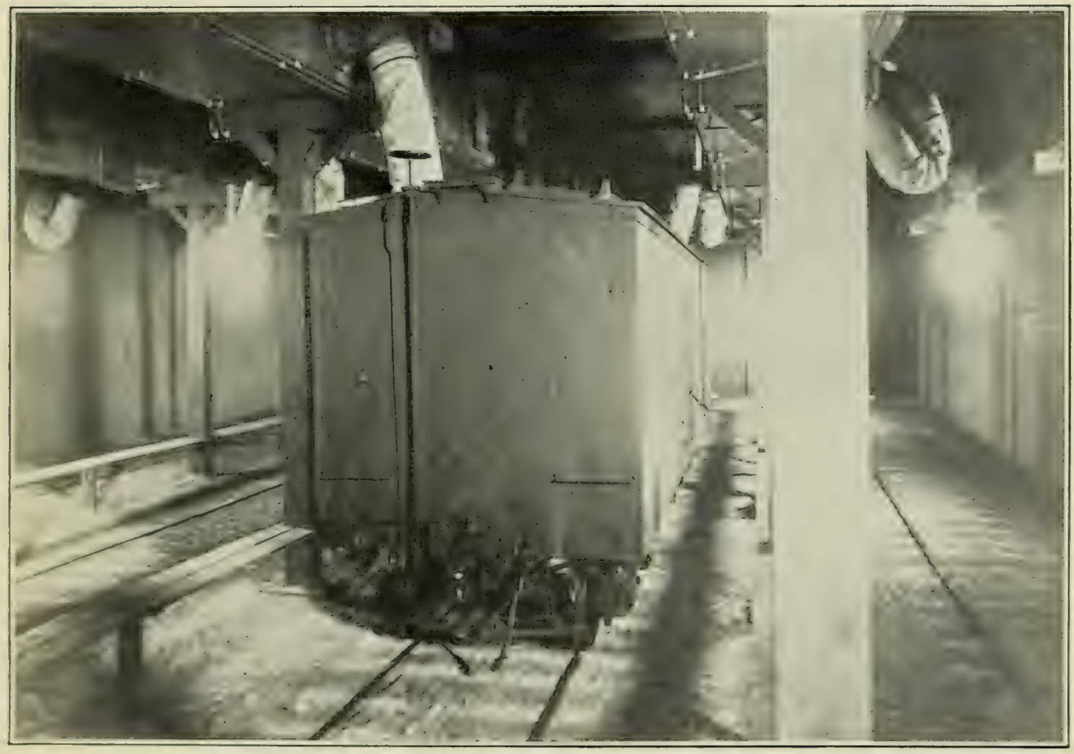

FIG. 2.—COOLING BANANAS IN CARS SPRINGFIELD, MO., 1905.

COOLING IN CARS FROM A COLD STORAGE PLANT.

Cold air is sometimes forced through the fruit after it is loaded in the car, in order to cool it quickly. This method was used by the Los Angeles Ice and Cold Storage Company, Los Angeles, Cal., in cooling oranges for the shipping experiments of the United States Department of Agriculture in 1905. (See Pl. XXXVII, fig. 1.) Cold air was blown through a large insulated tube leading from a bunker room in the storage plant to the ice trap in one end of the car. From a trap at the opposite end of the car another tube led back to the warehouse. The cold air was blown into the car at a temperature of 32° F., and after passing through the car was drawn back by an exhaust fan to the warehouse, where the moisture and gases from the fruit were frozen on the refrigerator pipes. The direction of the air current through the car could be changed. Although a powerful air current was used, it required from thirty to fifty hours to cool the fruit in the center of the packages to 40° F.

A large cold-storage plant has been erected recently at Springfield, Mo., by the St. Louis and San Francisco Railroad Company to cool bananas in cars in transit. The plant consists of four tracks inside of a shed, with light insulation, each track holding 10 cars. Large air ducts are carried along the top of this shed, and by means of canvas tubes the cool air is carried into a car at one end and taken out at the other after passing through the fruit, on the principle mentioned in the preceding paragraph. This same plant may be used in the winter to raise the temperature of the fruit when desired. Attempts have also been made to cool a car loaded with fruit by running it into a cold-storage room or shed. The first attempt of this kind known to the writer was made in Kansas City, Mo., several years ago, but the result was not satisfactory, as the refrigerating capacity of the machinery in use was insufficient. A car in the Springfield, Mo., plant, with the cold-air pipes attached, is shown in Plate XXXVII, figure 2.

COOLING IN CARS WITH A FAN.

Several devices are in experimental use for rapidly blowing the air from the melting ice in the car bunkers through the fruit. In one method a fan run by a small motor blows the air over the ice in one end of the car. It passes through the fruit and is drawn out of the other end of the car by an exhaust fan. It is then carried back to the end from which it started in a pipe surrounded by water from the melting ice. The same air is used over and over again. No fresh air is admitted to the car. Provision is made for reversing the direction of the air current. Sometimes the ice is crushed and salt added to produce a lower temperature.

Many experimental attempts have been made to apply chemical refrigeration to cars in transit by installing a refrigerating machine in a car in the train and by pumping the refrigerating medium through pipes in the cars. None of these devices, however, is in practical use at the present time.

TIME REQUIRED FOR COOLING FRUIT.

It takes a long time to cool a carload of fruit thoroughly. The temperature of the fruit, the temperature of the surrounding air, the rapidity of circulation of the air around the packages, and the character of the packages and their contents are important factors in the rapidity of cooling. The air around the fruit may be cooled quickly, but the package and its contents give up their heat slowly. Under the most favorable conditions in a cold-storage warehouse the fruit in the center of a tight barrel of Bartlett pears stored in a constant temperature of 32° F. may not cool to that temperature within four to seven days if the fruit is about 80° F. when picked, while similar fruit in a 20-pound box or in a slat bushel crate may reach 32° F. in from twelve to twenty-four hours.

A fruit wrapper retards the cooling. There may be a difference of 10 degrees in temperature at the end of one day between a 40-pound box of unwrapped fruit and a 40-pound box of wrapped fruit. The fruit wrapper, however, protects the fruit against bruising to such an extent that its usefulness for this purpose outweighs the disadvantage of slower cooling.

OTHER ADVANTAGES OF COOLING FRUIT FOR SHIPMENT.

The air in a car of fruit that is cooled before shipment is comparatively dry and pure throughout the trip, in contrast with the moist, impure air in the car under ordinary icing. The quality of the fruit is therefore preserved to a greater extent when it is precooled. It is a common impression that a cold temperature injures the quality of fruit. This is not necessarily the case. The flavor of fruit from cold temperatures is not always good, but the impaired quality is generally caused by the absorption of impure odors while the fruit is warm. The air in a closed car under ordinary icing is charged with the gases given off by the hot fruit, but when it is cooled before shipment both respiration and transpiration are retarded and the air of the car is comparatively dry and pure.

Another advantage of precooling is that the shipper can allow the fruit to develop a high color and a fine flavor on the tree. Under the present method of handling, quick-ripening fruits like the peach and the plum that are shipped long distances have to be picked when

partly developed in order to protect them against the ripening that occurs in transit. The quality of the fruit is not developed, and it arrives in market with an insipid flavor, giving a region in which this practice is followed a reputation for fruit of poor quality.

Cooling before shipment is likely to be followed by unsatisfactory results in fruits that decay in transit from molds, unless the grower and the packer improve the methods of handling. These diseases are directly connected with the rough handling of the fruit. Many of the susceptible oranges, for example, develop rot in transit, while others that were cooled quickly begin to decay as soon as the fruit is removed from the car to a warmer air. If the shipper depends merely on colder temperatures in transit to overcome the effects of bad handling, the rots, instead of developing during the trip, are transferred to the market. Under these conditions the fruit trade becomes suspicious of all fruits shipped under refrigeration and the industry as a whole is injured.

CONCLUSION.

The successful transportation of perishable fruit is a complex problem. It depends on the conditions under which the fruit is grown, the care in handling it, the conditions in transit, and the relation of these factors to the ripening of the fruit and to the development of decay. The losses in transit are the result of conditions the responsibility for which may be shared by the grower, the shipper, and the transportation company. A large proportion of the losses from decay is the inevitable result of handling a highly perishable type of product. Many of the losses are primarily orchard and packing-house troubles, which can be overcome by improving the methods of orchard culture and of handling the fruit. A well-grown, perfect fruit is a fundamental requirement in successful transportation. Every fruit that is bruised does not necessarily decay in transit, but if a mold spore comes in contact with an abrasion in the skin, decay is the inevitable result if there are moisture and heat enough to start it into growth. The rots develop rapidly in transit when the temperature is not low enough to check their growth. Most of the decays develop during the first few days of the trip, while the car is warm and moist. They might be reduced to a minimum if the fruit could be cooled more promptly after it is picked, either before or after loading in the car.

The losses from overripeness are equally complex. The fruit ripens rapidly as soon as it is picked and the ripening needs to be checked quickly at this time by a cold temperature. The grower may hasten the ripening by delivering the fruit to the car in a warm condition and by delaying the shipment after the fruit is picked. Once in the car the fruit continues to ripen until it is thoroughly refrigerated throughout. The losses of this nature are not wholly due to the grower, the

handler, or the transportation company, but may be due to causes for which each shares the responsibility.

The American fruit industry now requires better handling and better transportation facilities than in the early stages of its development. As the industry increases and the distribution of the products is extended, more careful treatment in the orchards and packing houses and an improvement in transportation service will be required if it is to be permanently successful. There has been great improvement along these lines, and unless the fruit industry and transportation facilities are exceptions to the general progress that is being made in all industries in America, the improvement in every particular should be greater in the years to come than in any period in the past.

MEADOW MICE IN RELATION TO AGRICULTURE AND HORTICULTURE.

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INTRODUCTION.

Among mammals that directly affect the interests of the farmer are many whose small size and secretive habits prevent them from receiving the attention bestowed upon more conspicuous species. This is true both of beneficial and of injurious kinds. The measure of the influence of small mammals either for good or evil depends largely upon their numbers. Beneficial mammals of small size, if not numerous, are slightly appreciated; and small injurious species, whose damage to crops under ordinary circumstances is too trifling to be noticed, become of enormous economic importance when they increase abnormally. Under such circumstances their presence in a community may result in a public calamity.

INCURSIONS.

To none of the smaller rodents do the above statements apply with more force than to the group which includes the rats and mice. Of this family the short-tailed field mice, the lemmings, and a few other genera are best known because of their erratic and mysterious incursions in vast hordes upon lands where usually they are absent or exist only in moderate numbers.

The story of the lemmings of Europe has been often told. Natives of the higher parts of Norway, Sweden, and Lapland, they increase greatly for several years, until their numbers create a demand for food which far exceeds the available supply, and they are forced to migrate. They move in vast troops, and once on the journey, continue in the same general direction, in spite of all obstacles, until eventually the great army is disintegrated and destroyed. They devastate all crops in their path, bore through hay and grain stacks, swim rivers, and while they turn aside for insurmountable objects, they soon resume their original course. They perish by thousands by drowning and in winter storms, and are continually preyed upon by carnivorous birds and mammals, so that comparatively few survive to reach the coast. These migrations sometimes cover a period of two or more

years, and terminate only when the sea presents an impassable barrier into which most of the survivors plunge and, after swimming until exhausted, perish.

Field mice of the genus *Microtus*,[a] although usually much smaller than lemmings, are closely allied to them, and are not unlike them in some of their habits.

PAST INVASIONS.

In the past, meadow mice have appeared in certain localities in such vast numbers that they inflicted serious damage upon many of the products of husbandry. Their appearance has sometimes been so sudden as to be regarded as miraculous. Plagues of field mice are recorded in the Bible[b] and in the works of Herodotus,[c] and Homer refers to a plague of mice during the Trojan war. The Greeks considered the animals so important that they incorporated into their religious system a mouse god, whose aid they invoked to avert plagues of mice.

Invasions of field or meadow mice have not been rare in Great Britain and on the Continent. J. H. Blasius records[d] outbreaks at Vienna, Magdeburg, Wurttemburg, and other parts of Germany. Stow's Chronicle,[e] quoting Holinshed, states that "about Hallontide last past (1581) in the marshes of Danesey Hundred in a place called South Minster in the County of Essex . . . . there sodainlie appeared an infinite number of mice, which overwhelmed the whole earth in the said marshes, did shear and gnaw the grass by the roots, spoyling and tainting the same with their venimous teeth . . . . which vermine by policie of man could not be destroyed, till at the last it came to pass that there flocked together such a number of owles . . . . whereby the marsh holders were shortly delivered from the vexation of the same mice. . . . ." Stow adds: "The like of this was also in Kent."

Parts of England were visited by similar plagues of meadow mice in

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[a] An appropriate vernacular name for these mice is lacking. The French call them "campagnols." English-speaking people outside of the United States often refer to them as "voles." In the United States they are generally called "field mice" or "meadow mice." Both names are open to objections. "Field mice" is too broad a term, since it includes long-tailed and short-tailed species of several other genera. "Meadow mice" is too narrow, because some species of *Microtus* live entirely in the woods. On the other hand, "vole," although used in some of the scientific publications of this country, has not yet come into such vogue as to warrant its general adoption. Moreover, the name is likely to be confused with "mole," which applies to a different animal. In this paper the more common name "meadow mouse" is generally used.

[b] "And the cities and fields in the midst of that region produced mice, and there was great confusion and much dearth in the city." I Samuel, v, 6 (Vulgate version).

[c] Euterpe, c. 141.

[d] Mammals of Germany, Brunswick, 1857.

[e] Annales, or a General Chronicle of England, by John Stow, London: Ralphe Newberie, 1615.

1648, 1660, 1745, 1754, 1814, 1825, 1863–67. Severe invasions occurred in Scotland in 1876 and 1892, the later one being so serious that a committee of the British Board of Agriculture was appointed to investigate it. A large portion of Hungary was devastated by field mice in 1875–76, and in recent years their invasions in portions of France, Greece, and Russia have attracted general attention.

POSSIBILITIES OF DAMAGES IN UNITED STATES.

North America thus far has been comparatively free from such extraordinary irruptions of meadow mice, and yet during the last thirty years serious ravages by them have been reported in the United States and Canada. Moreover, the depredations seem to be increasing in extent and seriousness from year to year. During the past three or four years reports of damages by these rodents have come from many and widely separated sections. Fortunately the damages have usually been confined to limited areas and to special interests, and have only slightly affected the general welfare. But the habits of meadow mice are everywhere much the same, and a serious outbreak of the pests in this country is not only possible, but, in view of the continued short-sighted destruction of their natural enemies, is extremely probable.

The object of this paper is to call the attention of the farmers of America to the dangerous possibilities of meadow mice as farm and orchard pests, to suggest measures to prevent outbreaks, and finally to prepare for intelligent action in the event of a serious invasion by them. A knowledge of the habits of the animals and of the conditions which lead to their enormous multiplication should materially aid in preventing such increase and in minimizing the damages to crops.

SPECIES AND DISTRIBUTION.

Meadow mice are readily recognized, being characterized by stout bodies, blunt, rounded muzzles, and short ears, the last being sometimes completely concealed in the fur. The tail is short, round, and hairy, and the soles of the feet are partly naked and provided with five or six tubercles. The fur is thick, rather long, and soft, and on the back is mixed with longer hairs.

The number of living species and subspecies of the genus *Microtus* is large, 165 having been recognized (1904), of which about 78 are North American.

The geographic range of the meadow mice is extensive, covering the greater part of the northern hemisphere—America, north of the Tropics; all of Europe, except Ireland; and Asia, except the southern part. Great Britain has three representatives of the genus.

The range of a single species is often remarkably wide. Thus the

common meadow mouse of the United States (*M. pennsylvanicus*, Pl. XXXVIII, fig. 1) occurs in at least twenty-five States, from Maine to the Dakotas and southward to the latitude of North Carolina, and if the several closely related subspecies be included, the range is almost twice as great.

Another species (*M. mordax*) occurs in nearly all the higher mountainous country from Colorado to California, and from Arizona to Alaska. The meadow vole of Great Britain (*M. agrestis*), common from the Orkneys to the Isle of Man, is distributed over much of northern Europe. In central and southern Europe it is replaced by the closely related species *M. arvalis*, which, strangely enough, is found in England as a fossil.

On the other hand, some species of meadow mice are of very local distribution, a few being confined to the summit of a single mountain or isolated on a single small island. The beach mouse (*M. breweri*), for instance, is found only on Muskegat Island, Massachusetts, while the Gull Island mouse (*M. nesophilus*), of Great Gull Island in Long Island Sound, inhabited so small an area that the recent extensive excavations and grading operations for fortifications on the island resulted probably in the total extinction of the species.

The several species differ much in size. In length of body some are nearly as small as the common house mouse, while others are nearly as large as the common rat. While the tail is usually very short in proportion to the body, the various forms differ much in this particular.

HABITS OF MEADOW MICE.

Notwithstanding meadow mice are much alike in manner of feeding and nesting, in other respects marked differences in their habits have been observed. Some of them prefer high and dry ground, and others live in low, moist places. Some remain in forests, and others on the open prairies. Some, like moles, make long burrows under the surface of the soil, while others construct runways on top of the ground. Most of the species live where there is considerable moisture; and a few are almost as aquatic as the closely allied muskrat. Aquatic habits are the rule more especially with the larger kinds, such as the Florida species *M. alleni* and the European *M. amphibius*, both of which swim and dive habitually and with such freedom that they are commonly known as water rats. Some of the species emit a strong odor not unlike that of the muskrat.

BREEDING HABITS.

The nests of meadow mice are composed mostly of compact bunches or balls of grass blades, placed in depressions in the ground or shallow burrows; or, if the ground is very moist, supported on grass stems 5 or 6 inches above the wet surface. They are so light in structure that

after a storm a day's sunshine will dry them out; and yet they are so warm that the animals pass the coldest season snugly housed in them under the snow. In these nests the hairless young are produced and nursed. When the mother is suddenly disturbed, she slips away from the nest, often carrying the young mice attached to her mammæ, to return promptly when the premises are again clear.

The breeding season of meadow mice extends over most of the year, except midwinter of the coldest latitudes. The number of litters produced depends largely upon the character and length of the winter. It is certain, too, that the number of young at a birth varies with the character of the season. A few species produce habitually from two to four at a litter, but other species bring forth eight to eleven. Most of the species have four to six litters in a year. Precise knowledge on this point is wanting, and the period of gestation can only be guessed at as about twenty-one days. Members of the Biological Survey record the finding of pregnant females or young in the nest during every month from March to December.

The common meadow mouse (*M. pennsylvanicus*) is one of the most prolific of the American species. If six young, the average number, are produced at a birth, and four litters in a season, and if no enemy or disease check the multiplication, the increase would be appallingly great. A single pair and its progeny would in five seasons amount to over 2,000,000. This calculation is conservative, being based on the theory that the young of one season do not breed until the next year—an assumption that is likely to be incorrect; for the animals mature very quickly, and the young born in spring probably breed in the fall of the same season. If a thousand pairs of meadow mice survive a winter in any locality, it is easy to understand how, after two or more seasons of uninterrupted increase, they might become a menace to agricultural interests.

In Dr. A. E. Brehm's interesting account of the field mice of Germany (*M. arvalis*),[a] it is stated that in 1882, in the district of Zabern, 1,570,000 voles were caught in 14 days; in the district of Nidda, 590,427, and in that of Putzbach, 271,941. In the autumn of 1856 so much damage was done by voles in one district between Erfurt and Gotha that about 12,000 acres of land had to be replowed. On a single large estate near Breslau 200,000 were caught within seven weeks and sold to the Breslau fertilizer factory at a pfennig (one-fourth cent) per dozen. Some of the vole catchers were able to secure 1,400 to 1,500 per day. In the summer of 1861, 409,523 were caught and counted in the neighborhood of Alsheim in Rhenish Hesse. The local authorities paid 2,593 gulden (about $1,000) for them.

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[a] Brehm's Thierleben: Saugethiere, vol. 2, pp. 387–393, 1877.

Louis Figuier, the French naturalist, writing of the same species, states that the female gives birth to from eight to twelve little ones three or four times in a year, and that they multiply so rapidly that whole districts have been brought to destitution by this scourge. In 1816 and 1817 the losses in a single department of France, La Vendée, were estimated at $600,000, caused entirely by these animals.[a]

FOOD HABITS.

Investigation of the food of rodents is difficult because of the finely ground condition of the stomach contents, and usually the nature of the food can be determined only in a general way. In summer, the principal food of meadow mice is green vegetation and unripe seeds of grain and grasses. In winter, grain and bulbous and other roots are usually eaten, but sometimes the bark of various trees becomes a staple food. It is mainly in winter that apple orchards and young forest plantations suffer from the depredations of these animals. Such attacks are not always due to severe weather which deprives them of their ordinary food, for they often occur during mild, open winters. The depredations seem to result rather from the excessive numbers of the animals and the consequent scarcity of food, which renders them so voracious that they are ready to devour any vegetable substance.

Stomach examinations show that in addition to bark, green leaves, and seeds of grasses and sedges, field mice eat all kinds of bulbs, tubers, and roots, and occasionally animal food. The larger aquatic species are said to eat fish, mollusks, and crayfish. When a number of these mice are kept in confinement, the stronger animals usually devour the weaker, and our field naturalists have frequently noted that trapped field mice are devoured by their brethren.

Brehm's account of the food habits of European field mice agrees with the above; but he says further that they eat fruit, berries, beech mast, nuts, corn, turnips, and potatoes, carrying them to their burrows for winter stores. The habit of storing food, however, is not common with the American species. Brehm says also that the animals hibernate during the severest weather—a fact not true of our species, which are active in winter, even in the far North.

It has been calculated that each adult meadow mouse requires from 24 to 36 pounds of green vegetation per year. It is thus apparent that the total amount eaten by the hordes that ordinarily infest the meadows, swamps, and forests of our country is incalculable, and is a steady drain upon the resources of the farmer.

DAMAGES TO FIELD CROPS AND MEADOWS.

In recent years the Department of Agriculture has frequently received complaints of damages to meadows and pastures by field mice. The common meadow mouse (*M. pennsylvanicus* and its vari-

[a] Mammalia, Popularly Described by Typical Species, p. 445. London, n. d.

ous subspecies) is usually the offender in these cases, although the prairie meadow mouse (*M. austerus*) also causes considerable loss in the West. Both these mice work under the snow in winter, burrowing along the tops of the succulent roots of clover and other plants, and sometimes destroy entire meadows, which have to be plowed up and resowed. Such damage usually occurs where a thick growth of grass is left in the field in fall. Closely mowed or closely pastured fields are not usually badly injured by mice.

The meadow mice are destructive to market gardens. Strawberry fields are especially liable to attack, because of the mulch used to protect the plants and because of the animal's fondness for the succulent crowns of the plants themselves. These mice destroy seeds in the garden, hotbed, or cold-frame, potatoes in the ground, and many other growing vegetables. In the fall they destroy beets, turnips, carrots, parsnips, celery, apples, and potatoes, when piled on the ground or stored in pits. The depredations may to a great extent be prevented by the careful burning of weeds and other trash which harbor the pests.

The destruction of corn and wheat in the shock by meadow mice is common, and growing crops—wheat, oats, barley, rye, and buckwheat—are often cut down and eaten. The damage to standing grain is most noticeable when it is nearly ripe, but fully matured grain also is eaten. Short pieces of the stems of grains and of grasses scattered along the runways of the animals are conclusive evidences of the nature of their diet. In alfalfa and clover fields considerable loss is frequently caused by meadow mice. The ground is often littered with leaves cut from the plants. Stomach examinations of a dozen specimens of *Microtus austerus* captured in alfalfa fields during the summer of 1905 showed that their diet was almost exclusively leaves of alfalfa. When field mice occur in normal numbers, the losses are not serious; but when local conditions have favored an abnormal increase of the animals, the loss of crops is enormous.

DAMAGES TO TREES AND SHRUBS.

Meadow mice have been known to almost wholly destroy large nurseries of young apple trees. It was estimated that the losses sustained by nurserymen near Rochester, N. Y., during the winter of 1902 amounted to $100,000. The animals usually inflict the damage by burrowing under the snow and girdling the tree just at the surface of the ground. Some species burrow below ground, and, like the pocket gopher, eat the roots of trees, thus completing their destruction. (See fig. 89.)

In some cases older trees are attacked and ruined. The writer has seen many apple trees, eight to ten years transplanted, and 4 to 6 inches

in diameter, completely girdled by the prairie meadow mouse (*M. austerus*), sometimes to the height of a foot or more above the ground.

The list of cultivated trees and shrubs that are injured by these mice includes nearly all of those grown by the horticulturist. The Biological Survey has received complaints of the destruction of apple, pear, peach, plum, quince, cherry, and crab-apple trees; of blackberry, raspberry, rose, currant, and barberry bushes, and of grape vines; also of the injury of sugar maple, black locust, Osage orange, sassafras, pine, alder, white ash, mountain ash, oak, cottonwood, willow, wild cherry, and other forest trees. In the Arnold Arboretum, near Boston, Mass., during the winter of 1903–4, meadow mice destroyed thousands of trees and shrubs, including apple, maple, sumacs, barberry, buckthorn, dwarf cherry, snowball, bush honeysuckle, juniper, blueberry, dogwood, beech, and larch. Plants in nursery beds, and acorns and cuttings in boxes, were especial objects of attack and injury.[a]

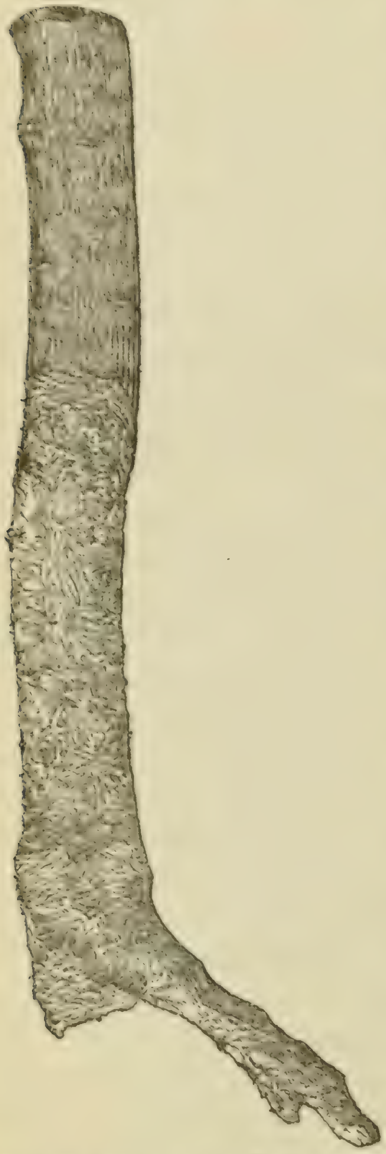

FIG. 89.—Root and trunk of apple tree from Laurel, Md., gnawed by pine mice.

The pine mice (*Microtus pinetorum*, Pl. XXXVIII, fig. 2, and several subspecies) are destructive also to trees, shrubs, and bulbs. They burrow in the soil after the manner of moles, and, unlike those insectivorous animals, attack plants in such a manner that their presence is not suspected until much injury is inflicted. Ordinarily pine mice live in woods, from which they make incursions into cultivated grounds through long underground tunnels. During the winter of 1904–5 pine mice invaded suburban grounds near Washington and did considerable damage. In one instance out of a bed of 50 bulbs of choice hyacinths only 4 escaped injury, and most of them were entirely consumed. (See Pl. XXXIX.)

NATURAL ENEMIES OF MEADOW MICE.

One of the chief causes of the recent great increase of the smaller rodent pests is the persistent destruction of the birds, mammals, and reptiles that habitually prey upon them. This is true not only in

[a] Boston Transcript, April 16, 1904.

FIG. 1.—MEADOW MOUSE (MICROTUS PENNSYLVANICUS).

FIG. 2.—PINE MOUSE (MICROTUS PINETORUM SCALAPSOIDES).

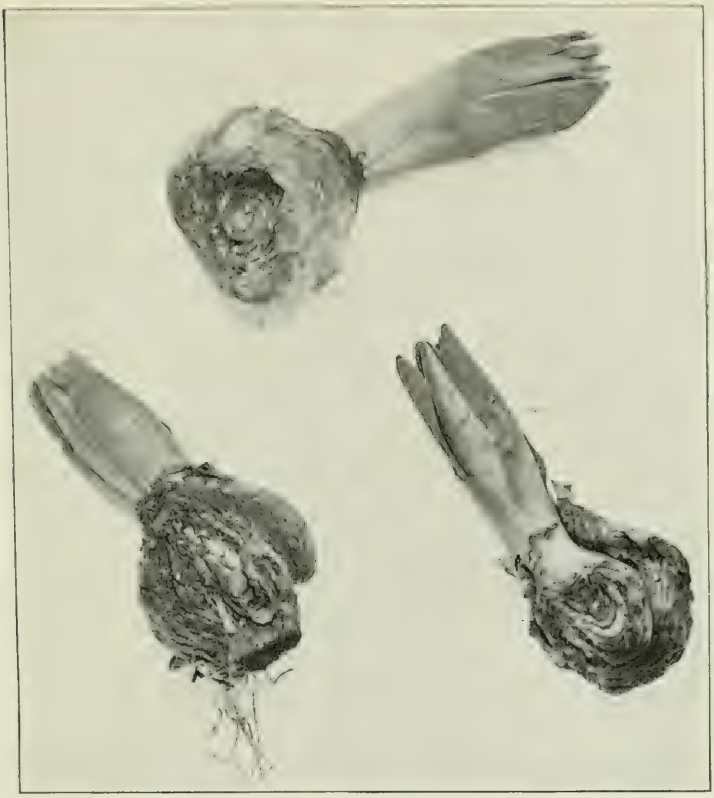

FIG. 1.—HYACINTH BULBS EATEN BY PINE MICE.

FIG. 2.—BEDS FROM WHICH THE BULBS WERE TAKEN, SHOWING BURROWS AND RUNWAYS OF MICE.

America but also in Great Britain and on the Continent, where for years gamekeepers and even farmers have destroyed foxes, weasels, stoats, hawks, and owls whenever possible on the plea that they prey upon and diminish the supply of game in the parks and preserves. In America the same opinion is widespread, and has led to some unfortunate legislation against species that are wholly beneficial to agriculture. In the investigations before the British Board of Agriculture relative to the vole plague in Scotland in 1892, the testimony as to a previous scarcity of carnivorous mammals and birds, in the districts affected, was almost unanimous. While the committee in its report regarded climatic conditions, not the scarcity of carnivorous birds and mammals, as the primary cause of the outbreak, they considered the latter as the most important contributory factor.

Among the wild mammals of the United States that are known to prey upon meadow mice are wolves, lynxes, foxes, badgers, raccoons, opossums, skunks, minks, weasels, and shrews. The majority of these animals destroy mice habitually; and this service, together with their well-known habit of destroying noxious insects, goes far to compensate for the damage they do in other directions.

Among birds that feed on meadow mice are hawks, owls, crows, shrikes, cranes, herons, and bitterns. Of hawks, the kites and the marsh, red-tailed, red-shouldered, broad-winged, rough-legged, pigeon, and sparrow hawks feed upon them, some destroying large numbers of the two most destructive species, *M. pennsylvanicus* and *M. austerus*. Pine mice live mostly below the ground and are less frequently caught by birds of prey.

The habit of shrikes of catching meadow mice is well known, and most farmers have seen these birds in the corn fields at husking time, as they hover in the air or sit poised upon a fence or hedge ready to pounce upon every mouse that escapes from the shocks.

Crows destroy many young mice in the nests and sometimes kill the adults, and, no doubt, investigations will show that meadow mice form a considerable part of the diet of bitterns and herons.

Owls are especially efficient as destroyers of field mice, and all the species whose food habits have been investigated by the Biological Survey were found to feed upon these animals. In Bulletin No. 3 of the Survey [a] it is recorded that of 39 barn-owl stomachs examined, 7 contained meadow mice; of 107 long-eared owl stomachs, 59 contained them; of 101 stomachs of the short-eared owl, 52 had meadow mice; 31 out of 109 stomachs of the barred owl, 6 out of 9 of the great gray owl, 4 out of 22 of the saw-whet owl, 18 out of 254 of the screech owl, 12 out of 127 of the great horned owl, 10 out of 38 of the snowy owl, and the stomach of the single hawk owl, contained meadow mice.

[a] Hawks and Owls of the United States, Dr. A. K. Fisher, 1893.

They were mostly the common meadow mouse (*Microtus pennsylvanicus*), as the birds were collected for the most part where this species is common.

The examination of owls' nests and of the curious pellets cast up by owls reveals much as to the nature of their food. Doctor Fisher has recorded the results of the examination of many pellets of the barn owl, and a few of those of the long-eared owl, with the following result: Six hundred and seventy-five barn-owl pellets contained 1,123 skulls of the meadow mouse; 50 pellets of the long-eared owl contained 114 meadow mouse skulls. This is an average of almost two to each pellet.

A writer in the London Field states[a] that on April 26, 1901, he found 21 dead mice in a nest of barn owls. Three were the common house mouse and 18 were the bank vole (*Evotomys glareolus*), a mouse of a closely allied genus.

The short-eared owl inhabits the temperate and subtropical parts of both continents, except West Africa, Australia, and Polynesia. In both continents it occurs beyond the Arctic Circle. Its range is thus even wider than that of the meadow mice, which form a great part of its food. In every invasion of the mouse pest of which careful records have been kept it is reported that these owls became extremely plentiful in the infested country, and that they were important aids in checking the evil.

Notwithstanding the unanimous testimony of careful students of bird life to the effect that almost all owls are wholly beneficial to the farmer, few laws for the protection of these birds have been enacted, and a widespread prejudice exists against them. They are destroyed as relentlessly as if they were enemies instead of friends of the farmer. It is to be hoped that an enlightened public will soon come to recognize the good offices of the owls, and extend to them the protection necessary to prevent the extinction of any American species.

Next to insects, mice form the most important item in the food of snakes. Meadow mice are most easily obtained, but other mice, and, indeed, most of the small rodents, including ground squirrels, wood rats, prairie dogs, and young pocket gophers and rabbits, are eaten. This important service of snakes in the interest of the farmer is not generally understood or appreciated, but an inherent and deeply rooted prejudice induces thoughtless people to destroy them whenever possible and for no other reason than because they are snakes.

The value of domestic cats and of dogs in destroying mice is well known, and many of these animals learn from experience to prefer the large meadow mice to the species found in houses and barns. Dogs that never eat the common mouse or rat will sometimes eat meadow mice greedily. The great objection to the utilization of cats to check

[a] The Field (London), May 4, 1901.

the inordinate increase of field mice is that when cats take to roaming the field and forest they soon learn that song birds are more toothsome than mice, and turn their attention largely to the pursuit of such birds. In thus destroying birds, cats much more than offset their value as mouse catchers.

DESTROYING MEADOW MICE.

The writer has given considerable attention to methods of dealing with prairie meadow mice (*M. austerus*). In December, 1903, he was called to Marion County, Kans., to investigate an outbreak of these animals in orchards and in a large nursery. One orchard of 480 acres, containing about 26,000 apple trees, eight to ten years planted, was found to be badly infested. About 5,000 of the trees, worth over $30,000, were badly damaged, many of them being completely girdled, and the bark eaten often as high as among the lower branches. Most of the damage was from mice, but in parts of the orchard rabbits also had been at work. As a means of prevention, a force of men and boys was engaged in applying to the trunks of the trees a wash composed of water, soap, and carbolic acid. Later it was found that the efficiency of this wash did not extend beyond forty-eight hours.

EXPERIMENT WITH POISONED GRAIN.

As an experiment, the writer placed some wheat poisoned with strychnine at the base of about 50 of the badly damaged trees. This was done late in the evening, and on the following morning a considerable number of dead meadow mice and white-footed mice were found. An examination of the stomachs of both species showed that only the meadow mice had eaten the bark of the trees. The poisoning experiment had proved so effective that the owner of the orchard set his men to distributing poisoned wheat throughout the orchard, with the result that within a few days nearly all the mice had been killed.

The ground in this orchard was literally covered by a network of runways made by the prairie meadow mouse, and many of the runways extended below the surface for long distances. Examination showed that many twigs, 4 to 8 inches in length, had been cut from the trees by the mice and dragged into the burrows, where they were found in little piles and entirely stripped of bark.

It is to be carefully noted that the damage to this and other orchards in Marion County was due largely to neglect. On the greater part of the 480 acres mentioned corn had been planted the preceding spring, by listing it between the rows of apple trees; but a wet summer had prevented its cultivation, and the crop was abandoned, with the result that crab grass, sunflowers, and other weeds had grown luxuriantly. The weeds made a complete cover for the mice, and the entire summer was moist and favorable to the increase of the latter. The fall and

early winter were very mild, and all the damage to the trees by mice had been done in this open period and not under stress of severe weather.

During the cold weather that followed the extermination of the mice, rabbits renewed their attacks upon the trees. Many were killed by distributing pieces of apple into which powdered strychnine had been inserted by means of a knife. As many as twenty dead rabbits were counted in a single morning. While they were not entirely exterminated, the experiment demonstrated the efficacy of the method, especially in winter.

An exceptional circumstance in connection with these poisoning operations was that no dead birds were found in the orchard during their progress. Remarkable as it may seem, short-eared owls, hawks, and crows fed freely upon the poisoned mice and rabbits without injury. Tree sparrows, juncos, and quail were common, and it is strange that all should have escaped the poisoned baits. In distributing poison too much care, however, can not be used to avoid the destruction of valuable birds.

REMEDY FOR INJURY TO TREES BY MICE.

The writer recommended, as a remedy for the injury done to the trees by mice, that soil should be heaped up about the trunks so as to entirely cover the wounds. This was done, with the result that many trees that had been almost completely girdled formed new bark and recovered. The orchard was again examined during the summer of 1905, and photographs of some of the trees obtained. (See Pls. XL and XLI.)

METHODS OF POISONING.

In the use of strychnine for poisoning field mice an ounce of strychnia sulphate is used to each half bushel of wheat. The strychnia is dissolved in a pint of hot water and a pint of heavy sugar sirup is added. The combined wheat and liquid are then stirred until every grain is wet, when the mass is allowed to stand in the mixing vessel for twelve or more hours before it is distributed.

To prevent all danger of poisoning grain-eating birds, twigs of apple trees as a bait may be substituted for wheat. The twigs or sprouts, cut 6 to 8 inches long, are dipped into the liquid poison, or the poison applied to them with a brush, and then sparingly scattered near the base of trees or at the mouth of mouse burrows, and along the paths frequented by rabbits. Both mice and rabbits eat the bark of the poisoned twigs freely.

Another excellent way of destroying mice with poison without endangering the lives of larger mammals and birds, is to introduce the poisoned bait into the middle of short pieces of drain pipe which have

FIG. 1.—APPLE TREE KILLED BY PRAIRIE MEADOW MICE.

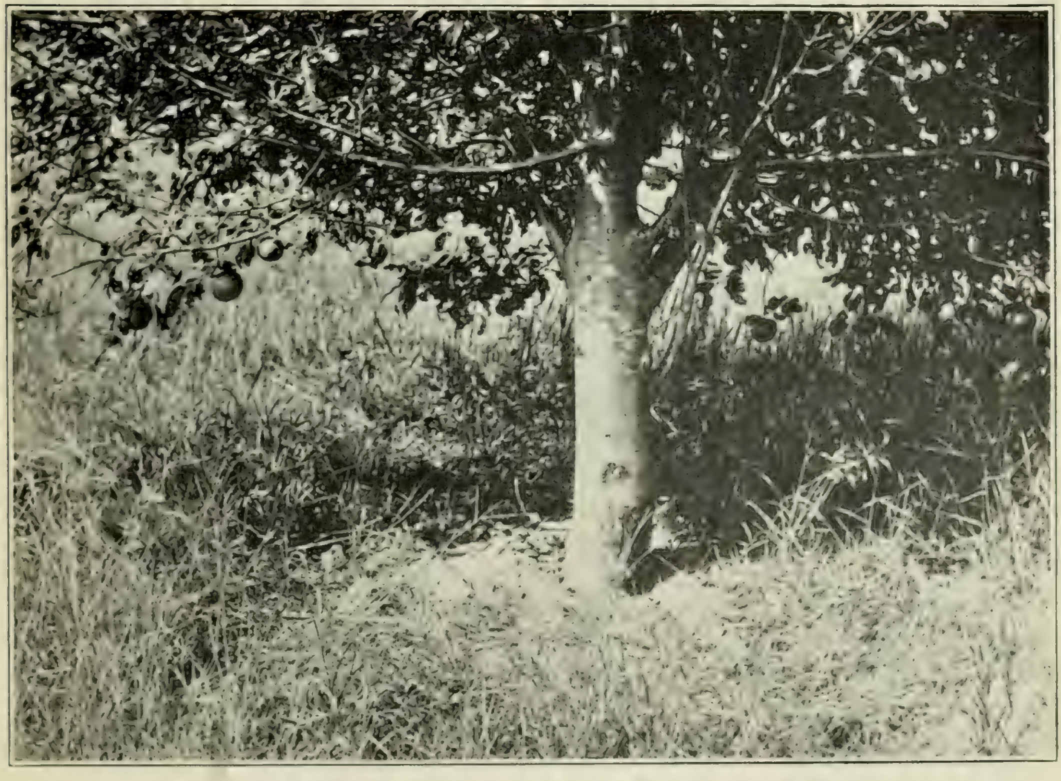

FIG. 2.—APPLE TREE SHOWING INJURY BY MICE. TREE RECOVERED.

APPLE TREES 5 INCHES IN DIAMETER, GIRDLED BY PRAIRIE MEADOW MICE (MICROTUS AUSTERUS).

[Trees saved by heaping up soil about the trunks to cover the injury.]

an internal diameter of about 1½ inches. The pipes are then laid on the ground near the burrows of the mice. To prevent displacement of the bait, it may be put into the pipes after they are in position. Meadow mice readily enter these drains and find the bait. Oatmeal made into a paste is the most convenient bait to use. This method of destroying mice is recommended by the French minister of agriculture, and is well worth trial.

EXPERIMENTS WITH INFECTIOUS DISEASES.

Much has been done abroad in recent years by way of experiment with infectious diseases for destroying rats and mice. When these animals multiply excessively and overpopulate a district, disease attacks them, and the greater number soon die. In several cases the bacillus affecting the animals has been isolated and cultures prepared which have been found to infect healthy animals through the digestive organs. Loeffler of Germany and Danysz of the Pasteur Institute, Paris, have each been reasonably successful in such experiments. Mereshkowsky succeeded in isolating organisms from the suslik (*Citellus musicus*), a ground squirrel, which were found to be fairly effective against rats and mice. Meadow mice were found to be most susceptible to several of the diseases.

Several reasons have prevented the adoption of these methods in America. The high price of the cultures and the somewhat uncertain results in their use have militated against their introduction. Moreover, the high temperature of our summers prevents the successful preservation of the cultures. Added to the above is the fear that under new conditions the organisms may prove infectious to game or domestic animals. In the case of the three organisms mentioned apprehension has been entirely dispelled in Europe, but in the case of other organisms experimented with, it proved to be well founded. Further investigations are necessary before bacterial cultures for destroying mice can be recommended for use in this country.

CONCLUSION.

There is no escaping the conclusion that meadow mice are injurious to agriculture. It has been argued that they are to a great extent inhabitants of waste lands, and therefore not very destructive to crops, but such assertions are wide of the truth. The value of these mice as tillers of the soil or as destroyers of weeds, while not to be overlooked, is very slight in comparison with their destructiveness to grass, fruit, vegetables, hay in the stack, and orchard trees. Testimony of their recent ravages in foreign countries, as before cited, is of itself conclusive as to their destructiveness, and their depredations in America, although less severe locally, have been nearly as great in the aggregate. The danger lurks in every swamp, copse, and waste corner,

and the continued destruction of hawks, owls, snakes, and small carnivorous mammals, together with climatic conditions favorable to multiplication of the mice, must inevitably result in an outbreak of the animals. An invasion of meadow mice in this country, where farming operations are on such an extensive scale, would be attended by ravages of crops such as have rarely, if ever, been experienced.

Timely preventive measures are much wiser than corrective measures following an invasion. Among the more important preventive measures are:

(1) The preservation, both by legislation and individual cooperation, of the natural enemies of mice.

(2) The curtailment of the range of meadow mice by the drainage of swamps and the periodic plowing of grass lands for the rotation of crops.

(3) The destruction of weeds, trash, and litter of all kinds about farm premises, gardens, and orchards, to prevent meadow mice from obtaining the winter shelter necessary to their survival.

(4) The burning of dead grass in meadows and pastures, to the same end. Care should be taken, however, not to burn the grass in late spring or early summer, when prairie chickens, quail, and other birds that build on the ground are nesting.

THE EFFECT OF INBREEDING IN PLANTS.

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INTRODUCTION.

The term "inbreeding" has commonly been used by plant breeders in a rather more restricted sense than it is used in animal breeding. It is common for plant breeders, in discussions, to restrict inbreeding to mean the fertilization of a flower with its own pollen or with pollen from a different flower on the same plant. This is a union of germ cells more closely related to each other than it is possible to obtain in any of the domestic animals. In animal breeding the term "inbreeding" is used to refer to the mating of closely related individuals, as, for instance, the mating of father and daughter, brother and sister, or cousins; and when this breeding together of closely related individuals is continued generation after generation it is designated as "in-and-in breeding." The writer believes that the use of the word "inbreeding" in plants should be extended to include the breeding together of closely related individuals, as in the case of animals. Inbreeding in plants may, then, be defined as the fertilization of a flower with its own pollen, with pollen from another flower on the same plant, or with pollen from a closely related plant.

Many of the most important crops, such as wheat, oats, barley, and tobacco, are produced from seed which is habitually self-fertilized—the closest possible degree of inbreeding—while others, as corn and hemp, are normally cross-fertilized.

If the cross-fertilization takes place between related plants of the same strain or race, their progeny may be said to be inbred, but in a more remote degree than that raised from self-fertilized seed. The crossing of distinct varieties may be termed crossbreeding, while the crossing of different strains of the same race should be designated as outbreeding.

The effect of inbreeding, in relation to the improvement of the cultivated varieties of plants by breeding, is a subject of the greatest possible importance to practical plant breeders. There is a lack of exact information upon the effect of inbreeding on the production and improvement of farm crops and cultivated plants; and, from the fact

that varieties and species differ in their response to varying degrees of inbreeding, there has accumulated a mass of seemingly contradictory evidence, from which many erroneous general conclusions have been drawn by breeders in special lines of investigation. Darwin's important and extensive experiments and observations on the effect of cross and self fertilization in the vegetable kingdom proved that cross-fertilization was beneficial and self-fertilization injurious in some cases, while in others the plants raised from self-fertilized seeds were equal in fertility, constitutional vigor, and other characters to those raised from the seed which resulted from a cross between two individuals of the same variety or race. It was found, however, that a cross between individuals of different races frequently produced better plants than the self-fertilized seed, and this effect was particularly marked where the two races had been grown under different conditions previous to the cross.

The benefits to be derived from crossbreeding in the production of new races or varieties of plants are well understood, while the use of inbreeding in the fixation of type and the propagation of desirable characters is not fully appreciated by plant breeders. The literature and practice of breeding have been largely devoted to methods for the production of new varieties of plants by crossing, and the immense practical importance of this work can not be overestimated; but an equally important field for investigation lies in the study of the maintenance of these varieties, which in many cases is effected by the closest possible inbreeding.

The object of this article is to discuss the effect of inbreeding in plants, with special reference to some important farm crops, and to call attention to the use, as well as the danger, of inbreeding in the production of varieties giving the maximum yield and value. The production of uniform races of crops adapted to special purposes is the most important problem for the practical consideration of the plant breeder. The lack of uniformity as regards the individual plants in the fields is responsible for a low yield of inferior quality, frequently requiring extra expense in sorting out the good from the poor grades. In the case of corn, if every stalk bore one well-developed ear of uniform size and weight, the present yield per acre would be more than doubled and the value of the crop as a whole would be greatly increased. If all of the tobacco plants in the fields were uniformly of the same type as the best plants, the yield and value of the tobacco crop would be greatly increased and the expense of handling the crop would be reduced, so that the profit to the grower would be at least double that obtained at the present time. The same facts hold true in the case of all the crops raised by farmers, and the most valuable and important lines of plant breeding are those which aim to assist the growers in

bringing up the average of the crop to that of the best individual plants. In the case of those crops which are partly or wholly naturally self-fertilized, this object can be more easily attained than with those crops which are naturally cross-fertilized. In the latter case, the prevention of too close inbreeding is of special importance, and the degree of inbreeding that can safely be practiced without injuriously affecting the fertility or vigor of growth of the plants, and methods of controlling the parentage of the offspring, are matters which must be carefully and systematically investigated for each crop.

THE USE OF INBREEDING IN THE IMPROVEMENT OF ANIMALS.

Inbreeding in animals—that is, the breeding together of closely related individuals in a single instance or at long-separated intervals—has been one of the most important means of improvement of our famous breeds of live stock. It has seldom or never resulted in evil effect, but continuous in-and-in breeding is claimed by some to result in a predisposition to disease, a lack of fecundity, and a delicacy of constitution. No matter what may be said regarding the evil effects of in-and-in breeding, the fact remains that all the great breeders have practiced it to a greater or less extent in the fixation of desirable characters in their herds and flocks and the rendering of these characters prepotent for the improvement of their breeds. Miles states:

> From the general examination of the practice of in-and-in breeding by the most celebrated breeders, it appears that they have made use of it to secure uniformity in their breeding stock, to fix slight variations that they have sought in the process of improvement and blend them with the best original characters, and to secure the important quality of prepotency in the males that they made use of to improve the average characters of their stock.

Many illustrations might be given of the fact that the majority of our various breeds of live stock have been brought up and improved by the use of close inbreeding. The pedigree of the famous Longhorn bull Shakespeare shows him to have been deeply inbred from animals that had been carefully selected for breeding purposes. The Shorthorn bull Favorite was not only an example of very close in-and-in breeding, but he was bred to his own mother, daughters, sisters, and descendants to a heretofore unheard-of degree, and many of the offspring became famous animals of acknowledged merit. In fact, his immediate descendants constitute, according to Sanders, a large proportion of the entire foundation stock upon which the Shorthorn herdbook records stand. A study of the history of the Shorthorn breed shows that the practice of inbreeding was followed by a most rigorous system of selection, and only the best animals were retained for breeding purposes. A recent illustration of the use of inbreeding in the development of a famous breed of live stock is found in the

breeding of Berkshire hogs as practiced by Mr. N. H. Gentry, who for twenty years has not infused fresh blood into his herd. In his herd the great boar Longfellow, 16835, was the result of close inbreeding, and his best sires, and in turn their best sires, have been at the head of the herd. One of the best individuals in the herd was produced by a sire of Longfellow, out of a daughter of Longfellow, sired by the sire of a Longfellow. Says Mr. Gentry:[a]

> Neither inbreeding nor the reverse will be a success unless matings are made with animals suited to each other, that is, having no weakness in common, if possible, and as much good in common as possible. This, in my opinion, is the key to success in all breeding operations, and success will come in no other way. In my opinion, inbreeding as a rule is very good or very bad. If you intensify the blood of animals that are good, you do good, but if they are bad, you go wrong as fast or faster than you go right in the other case. If it is true that inbreeding intensifies weakness of constitution, lack of vigor, or too great fineness of bone, as we all believe, is it not as reasonable and as certain that you can intensify strength of constitution, heavy bone, or vigor, if you have these traits well developed in the blood of animals you are inbreeding with? The latter is certainly my belief and my experience.

The Holstein-Friesian, the Jersey, and the Guernsey breeds of cattle were produced in communities where close breeding was practiced, and while it is true that the environment had more or less to do with the development of efficiency, the fixation of character was accomplished by inbreeding. With sheep there has often been long-continued interbreeding within the limits of the same flock. Darwin says that "although by the aid of careful selection the near interbreeding of sheep may be continued without any manifest evil, yet it has often been the practice with farmers to cross distinct breeds to obtain animals for the butcher, which plainly shows that good of some kind is derived from this practice." He further says that the evil effects of close interbreeding in large animals are most clearly shown in the case of pigs, which statement is not supported by Mr. Gentry's evidence in the case of his herd of Berkshires. In fact, a careful review of the evidence in favor of the belief that in-and-in breeding leads to sterility, loss of vigor, or other detrimental effects will leave the student in doubt as to the conclusion to be drawn.

In most cases inbreeding has been resorted to in order that some valuable character may be made prepotent and saved from being lost, and in most of the recorded instances of such practice such characters have been strengthened by inbreeding so as to become dominant in the offspring. As regards the loss of fecundity, while instances have been presented to show that inbreeding has led to sterility, other illustrations have shown that full fertility has been retained. The same thing may be said regarding vigor of constitution and tendency to disease, so that the facts seem to warrant the statement that close inbreeding is not in itself injurious, but that it may be made to perpetuate any

[a] Report of American Breeders' Association, 1905, p. 164.

constitutional defects which may have been caused by other agencies, as well as important and valuable characters which are known to be rendered prepotent and transmitted to the offspring.

In breeding, then, may be said to be a means of preserving in animals desirable characters which with crossbreeding would become swamped or lost and appear only infrequently; but it must be used with great care in the selection of individuals for mating. The history of the important breeds of live stock shows that in the beginning the breeder made a fortunate selection of parents, as in the case of the bull Shakespeare, and by judicious in-and-in breeding combined with most careful continued selection retained and intensified the valuable parental qualities in the herd. In some cases, after long-continued inbreeding, crossing may be necessary to remedy some constitutional defect which may not have appeared until after some years of inbreeding, as was done in the case of the cross of Galloway's with Colling's Shorthorn. The benefits of such crosses are particularly noticeable after an extended period of in-and-in breeding.

DEGREES OF INBREEDING IN PLANTS.

There are at least three degrees of relationship between parents found in cultivated plants: (1) Complete self-fertilization; (2) combined self and cross fertilization; and (3) complete cross-fertilization. Self-fertilization is the fertilization of the ovule of a flower by its own pollen, or by the pollen of a different flower on the same plant. Less complete forms of inbreeding may be grouped under two classes: (*a*) The crossing of flowers on different plants of the same stock grown under the same conditions, as the crossing of the flowers of two corn plants raised from kernels borne by the same parent ear or related parent ears; (*b*) the crossing of flowers on different plants of the same stock grown under different conditions.

Among the groups of plants that are normally self-fertilized we find many of the most important farm crops, as barley, wheat, and oats. In wheat and oats a few doubtful natural hybrids have been discovered and described, but it is the opinion of the authorities on these crops that cross-fertilization rarely takes place under natural conditions. The anthers usually burst open in oat flowers before the glumes open, at which time the pollen is thoroughly distributed over the receptive stigma, and it is probable that fecundation takes place several hours after the flowers open. In the case of barley the anthers burst and discharge their pollen long before the glumes open, so that self-fertilization is insured; and in the case of wheat, self-pollination takes place and self-fertilization probably occurs shortly before the flowers open.

The second kind of fertilization includes those plants which are highly self-fertile, but are cross-fertilized to a greater or less extent

by insect aid or other means. This group of plants may be divided into two classes, as (*a*) those which are almost wholly self-fertilized and only occasionally cross-fertilized, and (*b*) those which are usually cross-fertilized, but are also adapted for self-fertilization. One of the best examples of plants largely self-fertilized, but occasionally crossed, is the cotton plant. Dr. H. J. Webber states that the cotton flower sets seed normally when covered with a paper bag, but that ordinarily from 5 to 10 per cent of the seeds are cross-fecundated.[a] Plate XLII, figure 2, shows several cotton flowers in different stages of development, the pollination of the newly opened flower having taken place immediately preceding the opening. Webber gives the following description of the flower and its fertilization:

> The flowers open at daybreak, the anthers break immediately, and apparently the stigma becomes receptive at the same time. The flowers are visited very early by bees and other insects, which are usually dusted over with pollen. Pollen is produced in the cotton flowers in enormous quantities, and the stigmatic lobes of the pistil, three in number, are large and protrude slightly above the column of stamens. The bees light in the stamens and crawl down into the flowers, frequently crawling over the pistil, and in so doing, if their bodies are dusted with foreign pollen, they may leave some of the foreign pollen in the pistil. At the same time, however, they naturally brush over the pistil a large quantity of the flower's own pollen, so that self-fertilization almost certainly takes place about the time that cross-pollination occurs.

The tobacco flower is largely self-fertilized, but occasionally cross-fertilized. In Plate XLII, figure 1, the condition of the flower just before it opens is shown. It can be seen that, before the flowers open, the anthers have burst and a large quantity of their pollen has been distributed over the receptive portion of the stigma, so that self-fertilization usually takes place before there is an opportunity for the visits of insects. The tobacco flowers open early in the morning, and in an extensive series of observations made by the writer on this subject it was found that as a rule some of the anthers open and their pollen is distributed over the stigma before the opening of the flower. Shortly after the flowers open they are visited by bees, usually the common honeybees, which crawl down into the flowers, brushing against the stamens and pistil on their way to secure the secretion of honey-like substance in the lower portions of the flowers. The insects are covered with pollen in passing in and out of the flowers, so that there is an opportunity for cross-fertilization, provided that self-fertilization has not taken place previous to the visit of the insects. Abundant evidence is at hand to show that cross-fertilization does take place in tobacco, but in only a small percentage of the seeds. The tobacco flowers set seed normally when covered with paper bags to prevent the visits of insects, humming birds, or other agencies of cross-fertilization.

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[a] Improvement of cotton by seed selection, Yearbook of the U. S. Dept. of Agriculture for 1902, pp. 365–386.

FIG. 1.—TOBACCO FLOWERS, BEFORE OPENING, SHOWING SELF-POLLINATION.

FIG. 2.—COTTON FLOWER IMMEDIATELY AFTER OPENING.

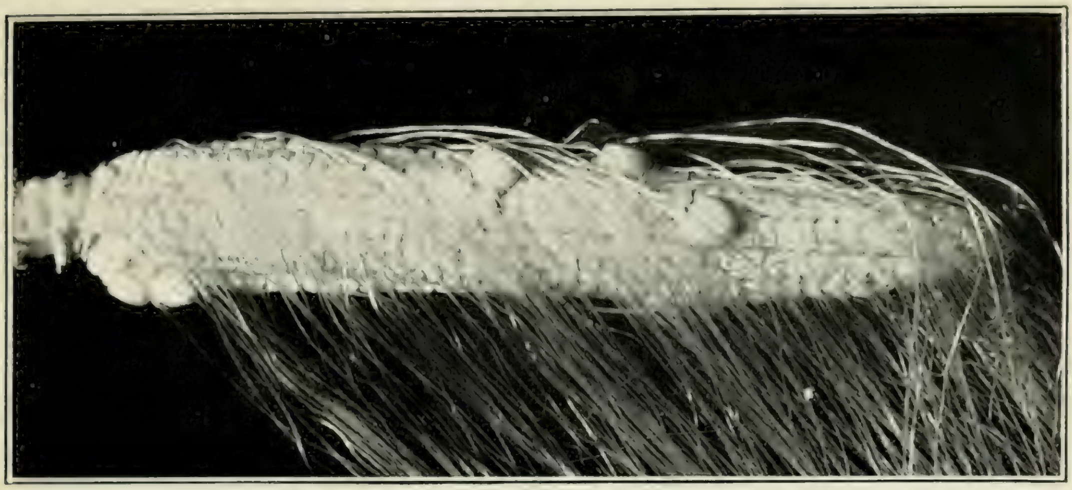

FIG. 1.—AN EAR OF CORN BORNE BY ISOLATED STALK, SHOWING LACK OF SELF-FERTILIZATION.

FIG. 2.—IMPROVED UNIFORMITY AND INCREASED VIGOR OF TOBACCO PLANTS RAISED FROM SELF-FERTILIZED SEED.

The third kind of fertilization naturally occurring among cultivated plants is cross-fertilization, or the union of the sexual elements belonging to two distinct flowers borne by separate plants. Cross-fertilization is accomplished through the agency of wind, water, insects, or birds, and the various devices to secure cross-fertilization exhibited by different plants are most wonderful and interesting, and furnish an almost inexhaustible field for study and observation. Corn, or maize, is a good illustration of this class of plants. Here the plant produces enormous quantities of pollen, which is very light and easily carried long distances by the wind. Frequent cases have been observed by the writer where the pollen of corn plants has been carried a half mile where there were no obstructions, but in the cornfield the pollen is usually carried only a short distance, owing to the plants catching the pollen grains as they drift about. The anthers borne by the tassels of the corn plants ripen and discharge their pollen in enormous quantities when the plants are shaken by the wind. The pollen of any one plant is usually discharged slightly before the silks, or stigmas, of the same plant are ready for fertilization, so that the corn plant is usually cross-fertilized. In Plate XLIII, figure 1, is shown an ear of corn which was borne by an isolated plant and on which only a few kernels were developed, owing to the fact that the silks were not in condition to receive the pollen from this plant at the time it was distributed by the opening of the anthers on the tassel. The long corn silks, or stigmas, are covered with numerous stigmatic hairs—a special adaptation to catch floating pollen and insure cross-fertilization. The imperfectly fertilized ear borne by the isolated plant shows that in order to secure complete fertilization it is necessary to grow large numbers of corn plants together, and that self-fertilization does not take place except in a small percentage of the seed.

In the case of certain hermaphrodite plants, in which the male and female reproductive organs are both borne in the same flower, where self-pollination takes place about the same time as cross-pollination, it has been found that the pollen of a different plant of the same race, or in some cases of a different race, is frequently prepotent over the plant's own pollen. Webber gives an instance where he pollinated a flower of Sea Island cotton (*Gossypium barbadense*) with its own pollen early in the morning. About four hours later the same stigma was dusted with the pollen of Upland cotton (*G. herbaceum*), a different but nearly related species. The seed of this Sea Island capsule gave five plants, three of which were hybrids.

Other plants are self-sterile, and produce seeds only when cross-fertilized. Mr. M. B. Waite found that many varieties of pears, such as Bartlett and Anjou, are largely self-sterile, producing few or no fruits when pollinated only with the pollen of the same variety. The orchards of pears had been found to be unfruitful for some unknown

cause. Waite found that by crossing these self-sterile varieties with a different horticultural variety they were rendered fertile. These, like most cultivated fruits, are clonal varieties which are propagated by budding, so that the individual trees of a variety are simply parts of the same individual. Therefore, the pollination of the flowers of one tree by the pollen of a different tree of the same variety is true self-fertilization.

The recent experiments of Waite, Waugh, Beach, and others have shown that the barrenness of many varieties of plums and apples is due to self-sterility, and that by placing among the trees of these varieties a few trees budded with varieties which have been determined by experiment to be good pollenizers for such varieties a simple remedy for this lack of fruitfulness is obtained. These discoveries have been of great practical value to fruit growers, as they have made it possible to produce profitable crops from naturally self-sterile and unproductive varieties by providing for proper cross-fertilization.

EFFECT OF INBREEDING ON VEGETATIVE VIGOR AND FERTILITY OF PLANTS.

The degree of relationship between parents in plants has a wide range of effect upon the vigor and fertility of the progeny, depending to a greater or less extent on the natural method of fertilization of the plants, so that it is impossible to draw general conclusions by a consideration of one phase of the subject. It is necessary to study the plants in each class separately, as determined by the natural habit of fertilization, in order to arrive at any satisfactory conclusion regarding the evil or beneficial effect of inbreeding.

Darwin, in his classical work on cross and self fertilization in the vegetable kingdom, recorded his extensive experiments and observations, which furnish the best known data on the effect of self-fertilization in plants. His general conclusion, after thirty years of the most careful study and observation on this subject, was that cross-fertilization is generally beneficial, and self-fertilization injurious. The beneficial results were not invariable, however, as is illustrated in the case of a highly self-fertilized individual of the common morning-glory (*Ipomœa purpurea*), which he named Hero. The flowers of the morning-glory are highly self-fertile, but when grown out of doors are freely crossed by insects, so that it is probable that the plant is largely cross-fertilized in nature. In Darwin's experiments with this plant he found that the average height of the cross-fertilized plants exceeded the height of the self-fertilized plants during ten generations in the ratio of 100 to 77.

In the sixth generation, Hero appeared among the plants raised from the self-fertilized seed, which grew more vigorously and finally reached a greater height than the cross-fertilized plants under similar conditions. Several of the flowers on this plant were self-fertilized, and

the plants produced from this seed were found to inherit the powers of growth of their parent, for they exceeded in height not only the self-fertilized offspring of other self-fertilized plants, but made a more vigorous growth than intercrossed plants of the same generation. The average height of the self-fertilized children of Hero to ordinary self-fertilized plants of the same generation was as 100 to 84, and the ratio of height to the intercrossed plants was 100 to 95. Similar results were obtained in succeeding generations, so that Darwin was led to observe that "it appeared, therefore, that Hero and its descendants have varied from the common type, not only in acquiring great power of growth and increased fertility when subjected to self-fertilization, but in not profiting from a cross with a distinct stock."

Among cultivated plants there are almost numberless illustrations of flowers becoming habitually self-fertilized, in the absence of insects specially adapted for crossing them, or by transportation from a warm to a cooler climate, or from other changed conditions, without injurious effect. The garden pea (*Pisum sativum*) is an interesting exception in Darwin's experiments to his many observations of the beneficial effect of cross-fertilization. The average height of the self-fertilized plants was 39.68 inches, while that of the cross-fertilized plants was only 34.62 inches, or in the proportion of 115 to 100. The garden pea is a plant which is normally self-fertilized, crosses rarely occurring, and has become adapted for self-fertilization. The lack of vigor shown by the cross-fertilized plants may have been due to an injurious effect of cross-fertilization, a fact which seems to hold true in the case of a large number of our normally self-fertilized plants. The experiments conducted by Prof. W. M. Hays at the Minnesota Agricultural Experiment Station showed that artificial crossing in wheat, of individuals of the same race or of different races, almost invariably resulted in decreased fertility, but in the crosses of distinct races certain individuals with increased fertility could be selected. The writer's experiments with tobacco have shown that the crossing of individuals of the same race results in decreased vigor of growth, loss of fertility, and a general deterioration of the qualities of the plants.

The effect of self and cross fertilization upon the vigor and fertility of leguminous plants, as well as the habit of fertilization of the different species, is somewhat in doubt, owing to the incompleteness of observations and experiments on this subject. The seed production in most of the clovers seems to depend largely on the visits of bees. In a series of experiments to determine the extent to which clover would set seed without the aid of bees, the writer found that in red clover (*Trifolium pratense*) bees were absolutely necessary for the production of seed. In these experiments each of the 51 heads was covered with a paper bag to exclude insects. In these heads not a single seed was

produced, while from 20 open heads freely visited by bumblebees, and harvested for comparison, 478 well-developed seeds were obtained. In white clover (*T. repens*) 27 covered heads did not produce a seed, while 11 unprotected heads yielded 874 seeds. Similar results were obtained with mammoth clover (*T. medium*) and Egyptian clover (*T. alexandrinum*), so that it is apparent that insect aid is necessary for seed production in these clovers as a rule. This condition has been generally assumed to be due to the necessity for cross-fertilization, although it has been recently suggested that the visits of insects may be beneficial to the fertilization of the flowers through stirring the anthers, so that self-pollination can take place.

Morrow and Gardner, of the Illinois experiment station, found that in crossing races of corn which had been grown under different conditions for a number of generations the crossbred sorts gave a larger yield and made a more vigorous growth than the ordinary corn of the parent varieties. Of 15 crossbred sorts tested, 12 gave an increase in yield over the parent varieties of from 2 to 86 per cent. In the three remaining cases the yield was decreased from 8 to 20 per cent, while in the 15 crosses, as a whole, an increase in yiel of about 16 per cent was secured. Similar experiments with corn by McCluer, of the same station, gave similar results.

In tobacco experiments the writer has found that the offspring of crosses of two varieties possesses increased vigor of growth, earlier germination of seed, and greater resistance to drought than either of the parent varieties. In Plate XLIV, figure 2, is an illustration of the increased vigor of growth of a cross between two varieties of tobacco. The taller and more vigorous plants in the row on the left were grown from a cross between Connecticut Broadleaf and Connecticut Havana varieties of tobacco. The smaller but more uniform plants in the row on the right were grown from self-fertilized seed of the Connecticut Broadleaf variety, the mother parent of the crossbred plants. All of the plants were grown under uniform conditions, both in the seed bed and the field. During a severe and prolonged drought in the growing season it was noticed that the hybrids had a better and more healthy appearance and made a decidedly more vigorous growth than the inbred plants. In the hybrids, however, there was great variation in the height of the individual plants, in the size of plants, size and shape of leaves, time of flowering, and other qualities, while in the self-fertilized strains there was a remarkable uniformity of all characters.

BENEFICIAL EFFECTS OF INBREEDING IN TOBACCO.

Self-fertilized tobacco seed produces more vigorous and uniform plants than seed which has been cross-fertilized within the variety. In the course of tobacco-breeding investigations conducted by the writer, it has been found that by protecting the flowers from cross-fertilization

FIG. 1.—SAVING TOBACCO SEED UNDER BAG.

FIG. 2.—INBRED COMPARED WITH CROSSBRED TOBACCO.

larger and heavier seed are developed than where the seed is allowed to set ordinarily, without protection from the visits of bees and other cross-fertilizing agents. The tobacco flowers on the selected seed plants are covered with a light manila-paper bag inclosing the entire seed head. In this way bees are excluded and the flowers are fertilized by their own pollen.

Extensive tests have been made of the productiveness and quality of the tobacco raised from such self-fertilized seed in comparison with plants raised from seed grown under normal conditions. An illustration of the comparative height, uniformity of plants and leaves, and other characters of two strains of Connecticut Sumatra tobacco grown from carefully selected seed plants of the same type is given in Plate XLIII, figure 2. The row on the left was raised from self-fertilized seed, and the smaller row on the right from open-fertilized seed subject to cross-fertilization. The original seed plants were of the same variety, selected from the same field, and were as uniform in height, number, size and shape of leaves, time of flowering, and other characters as it is possible to find in two plants. The conditions of soil, fertilization, and culture were the same in both cases, particular care having been taken to secure the greatest possible uniformity of treatment, in order to make the comparisons fair and trustworthy. As can be seen from the illustration, the plants grown from the self-fertilized seed are larger and the leaves more fully developed than in the plants grown from the open-fertilized seed. A similar result was observed in the case of other tests of this character.

The great uniformity of the leaves and plants from the self-fertilized seed is of great practical importance to tobacco growers, as it decreases the cost of sorting the various sizes and kinds of leaves into different grades and greatly increases the yield of the most valuable grades. The total yield from the self-fertilized seed is greater than that from the open-fertilized seed, and the rate of growth is correspondingly increased, so that the self-fertilized plants are earlier, as well as more productive, than the partially cross-fertilized strains.

The practical benefits derived from using self-fertilized tobacco seed have been so marked that tobacco growers have adopted the plan of bagging the seed heads of their selected plants. A field of Connecticut Broadleaf tobacco in which a large number of bagged plants have been saved for seed is shown in Plate XLIV, figure 1. In this illustration the two rows of plants on the right were grown from self-fertilized seed saved from plants having comparatively small leaves, with an upright habit of growth. The two rows of plants on the left were grown from self-fertilized seed, the parent plants having very large leaves, borne in a drooping position. The original seed plants were selected in the same field, of the same variety, and their progeny illustrates the possibility of securing uniform races of tobacco adapted for special

uses by the practice of saving self-fertilized seed from plants possessing the desired characteristics.

The effect of inbreeding in tobacco is beneficial and offers an effective means of maintaining desirable characteristics in the established varieties, while cross-fertilization within the variety results in a lack of uniformity and decreased vigor of growth.

DETRIMENTAL EFFECT OF INBREEDING IN CORN.

The effect of inbreeding in corn is shown in weakened germinative power of the seed, loss of vigor of growth of the plants, and great reduction in yield in both ears and stalks. The inbred plants lack constitutional strength, and also fertility; and they lose the power of resistance to drought or other conditions unfavorable for growth. This loss of vigor is particularly noticeable where the practice of inbreeding has been carried on for several generations, although the decrease in size and weight of the inbred plants, as well as the small size of the ears borne by these plants, can easily be detected in the first generation.

In observations made by the writer upon the effect of self-fertilization in corn—that is, where the pollen produced by the male flowers borne by the tassel of a plant is used to pollinate the silks or stigmas of an ear borne by the same plant—it was found that in four generations of continuous self-fertilization the vitality had become so weakened that the seed failed to germinate. The plants in the third generation of inbreeding were small of stature and almost sterile. The seed produced by inbreeding with pollen of the same stalk yielded the next year at the rate per 100 stalks of 55 ears, weighing $6\frac{1}{5}$ pounds. The seed of the same race, in every way comparable but produced by crossing different seedlings, yielded under the same conditions at the rate per 100 stalks of 128 ears, weighing $50\frac{1}{2}$ pounds.

Figure 90 shows the comparative height of plants raised from self-fertilized and cross-fertilized seed in the first generation, the inbred plants being shorter and bearing less foliage than the crossbred individuals, while in succeeding generations the evil effects of inbreeding were proportionately more marked. It has been found that the crossing of plants produced from kernels borne by the same ear results in similar deterioration, but in a less violent degree than in the case of the self-fertilized seed. It is probable, also, that the long-continued crossing of nearly related plants, further removed in degree of relationship than sister kernels on the same ear, is injurious to the constitutional vigor and fertility of the plants, which may account for the "running out" of varieties when grown on the same farm for many generations without the introduction of new strains.

The most important problem for the corn breeder to solve in the production of pure varieties of corn is the prevention of the injurious

effect of cross-fertilization between nearly related plants, or inbreeding. Nature has provided means for avoiding self-fertilization, but in systematic corn breeding, where rows or plats are planted from individual ears, it is probable that the seed in the rows or plats is partly fertilized by the pollen of nearly related plants.

In order to avoid the detrimental effects of inbreeding in systematic corn breeding, and to secure the improved constitutional vigor and productiveness obtained by the crossing of strains of the same race of corn which have been grown under different conditions for several generations, the following plan is proposed for the use of corn breeders. The plan is, in part, the one used by Mr. C. G. Williams, of the Ohio experiment station, and offers a practical method for the produc-

FIG. 90.—Inbred corn plants, showing lessened vigor of growth.

tion of pedigreed strains of corn, by which the record of performance of both male and female parents can be secured and a reliable pedigree established by breeders.

As explained in the accompanying diagram (fig. 91), the first year's work consists in selecting the ears to be tested for future breeding work. These ears can be selected from the general field and should come as near as possible to fulfilling the breeder's ideal of the most desirable type of corn, as regards characteristics of both stalk and ear. The second year at least 100 of the selected ears should be tested in a test plat, using one-half the kernels from each ear for this purpose, planting this seed in individual rows, and so labeling the rows and the remnants of the ears from which they were planted that the parent ears can be readily traced to their progeny in the test plat. The remaining seed of each parent ear should be kept separate and

saved for the next season's use. The third year 2 breeding blocks are planted with the remnants of the ears producing the 4 best rows, as regards both yield and quality of corn, of the preceding year's test plat. These breeding blocks must be isolated to prevent accidental crossing with foreign pollen. In each breeding block 2 of the ears are planted in alternate rows, a convenient arrangement being 10 rows 15 hills long from each ear. The plants in the rows grown from the ear selected for the female parent are carefully detasseled at the proper time, so that the seed borne by these plants must be fertilized by the pollen of the plants in the adjoining rows grown from the ear selected for the male parent. The ears on the detasseled rows are certainly cross-fertilized, and as the performance of both the parents

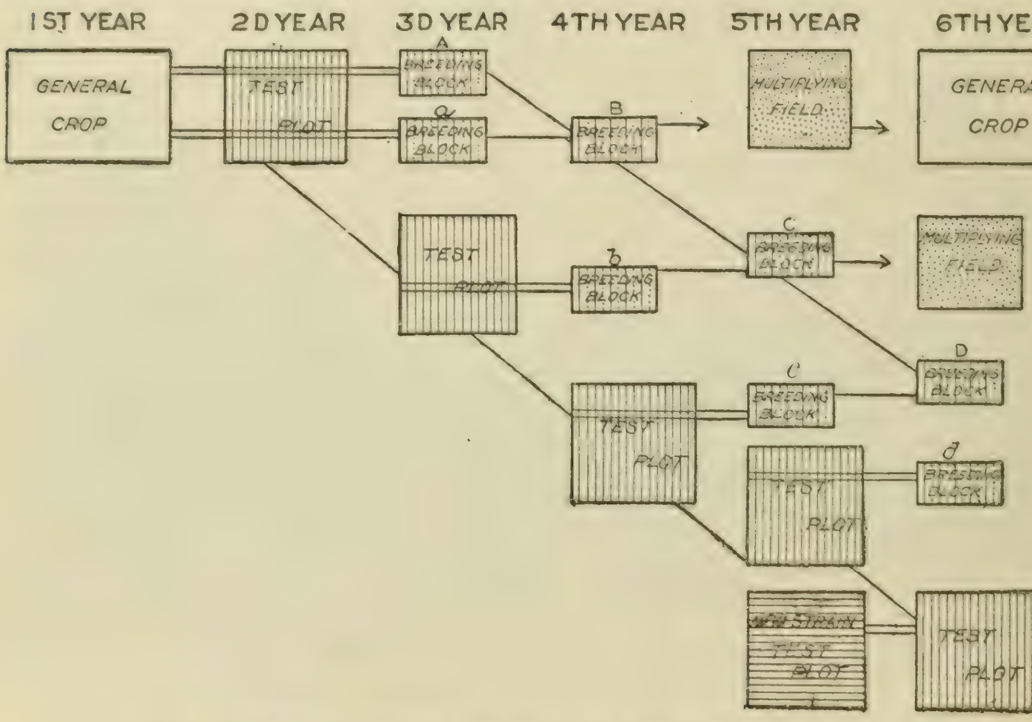

FIG. 91.—Diagram illustrating method of corn breeding to avoid inbreeding.

is known, by referring to the record of the test plat a definite pedigree of these ears is obtained.

The test plat can be planted the third year from selected ears from the best rows of the preceding year's test plat, or from selected ears from the general field, or both, as may be found most desirable. The fourth year one of the breeding blocks, *B*, is planted with one ear from breeding block *A* and one from *a*, thus bringing together and crossing the best individuals from each of the preceding year's breeding blocks. The other breeding block, *b*, is planted from the remnant of the two ears producing the two best rows in the preceding year's test plat. The work the fifth year consists of planting a general multiplying field from selected ears borne by the detasseled plants in the breeding block *B*, in order to secure enough seed to plant a large field the next or sixth

year. In this multiplying field, which on small farms may be the general crop, the seed of the select ears is mixed together, care being taken in the summer to detassel all inferior plants in order to prevent the possible fertilization of the seed by the pollen of undesirable plants. The breeding block *C* should be planted from one ear selected from breeding block *B* and one ear from *b*. The breeding block *c* should be planted from the remnants of the two ears producing the best two rows in the preceding year's test plat.

The sixth year a general crop can be grown for distribution from the seed selected from the multiplying plat of the preceding year. This corn can be sold as pedigreed seed corn, and the record of the parents, both male and female, as shown by their performance in the test plats, can be given to the purchaser. In the sixth year the multiplying field, the two breeding blocks, and the test plat should be arranged as before. This plan can be continued each year, and after the fifth year a general crop can be grown every season from highly bred seed of known ancestry. At this time, or at any future time, it may become desirable to introduce other strains grown by breeders in other localities, so as to get the beneficial effect of outbreeding in added constitutional vigor and productiveness. If so, a special test plat should be planted, using one-half the kernels from the ears of the new strain for the rows. This test plat enables the grower to determine the desirability of the new strain and its adaptation to the conditions under which it is to be grown. The following season part of the rows in the regular test plat should be planted from the remnants of the ears which produced the best rows in the test plat of the new strain the preceding year. In this way the introduction of the new strain is made slowly, with the assurance that only desirable strains are used, and without danger of swamping the important characters of the original strain with possible undesirable results.

The necessity for the use of this and other more complicated means of preventing inbreeding and securing definite cross-fertilization, at least occasionally, with fresh stock is sufficient evidence of the injurious effects of self-fertilization and close inbreeding in corn. However, the corn breeder and the leaders of experiments in this field should keep in mind Darwin's experience with the naturally cross-fertilized morning-glory, where after several generations of self-fertilization the plant Hero appeared. This plant and its offspring during the succeeding generations of the experiment surpassed the plants raised from cross-fertilized seed. In the case of corn, as well as other cross-fertilized crops, it is not beyond the limits of possibility that by continuous inbreeding an individual plant adapted for self-fertilization might be found, which would revolutionize and greatly simplify the work of corn breeding.

CONCLUSION.

The writer has attempted to describe a few cases of self-fertilized, cross-fertilized, and open-fertilized plants and the effect of such methods of fertilization on the vigor of constitution and the productiveness of our most important cultivated plants. It is impossible to overestimate the practical importance of a more careful study of this subject as applied to the improvement of our crops. The effect of inbreeding in plants, both as regards its use in propagating important and valuable characters and its effect in the different degrees of relationship of parents on the constitutional vigor and fertility of the plants, should receive the most careful attention of plant breeders and others interested in this subject.

In general, in the light of the experience of plant breeders up to the present time, it would seem that the improvement of our crops can be most rapidly effected with permanently beneficial results by following the practice of inbreeding, or crossing, to the degree in which these methods of fertilization are found to exist naturally in the kind of plant under consideration.

RENOVATED BUTTER: ITS ORIGIN AND HISTORY.

By Levi Wells,

Inspector, Dairy Division, Bureau of Animal Industry.

SURPLUS COUNTRY BUTTER

Great quantities of butter are made annually on the farm. The quality of this farm-made butter is as varied as the number of individuals who make it. The greater part of it finds its way to the consumer within a short time after it is made. Usually the better grades are in demand and bring a fair price as dairy butter, but there is a considerable quantity that is unsalable because it is not good butter.

Owing to increased production in the summer months, most of the surplus accumulates during that season. Formerly this surplus of country butter was a drug on the market, and it was of such indifferent quality that to store it was a doubtful expedient. After it came out of the storage houses it had developed, in addition to its other defects, the storage flavors, and was unsalable as butter.

The only method formerly known of profitably handling the surplus was to rework it, adding coloring matter and salt. This reworking brought the butter to a uniform shade of color and a uniform degree of saltiness. If it was salted heavily, this helped to conceal some of the undesirable flavors. Such butter was called, commercially, "ladles."

Along in the early eighties several persons began to experiment with the surplus country butter to determine, if possible, whether there was not some way to bring it to uniform color and saltiness and at the same time free it from bad or disagreeable flavors.

The first thought of the manipulator was to devise some way to rid the butter of the curd and coarse salt it often contained. Melting was the only practicable method.

WORK OF EARLY MANUFACTURERS.

Melting butter and separating the fat from the other ingredients, then canning the fat and shipping it to tropical countries to be used as a substitute for butter was practiced in some sections of Europe many years ago, but restoring the ingredients extracted and again converting the substance into butter is an American invention.

Several persons in different sections of the country were working independently on the same idea. The earliest experiments along this line of which there seems to be any data were made in Missouri. The account is given in the words of the experimenter:

I began melting butter in 1883 at Memphis, Mo., at first washing the oil and churning it in cold water, salting and working it like other butter. A little later I used cold milk.

In 1888, at Monmouth, Ill., I conceived the idea of converting the butter oil back to cream by feeding the milk and oil into a centrifugal separator and forming an emulsion by plugging the skim-milk outlet. This proved intensely interesting and in a measure successful, but the grain of the butter was still short and sandy.

In 1893, at Scottville, Mich., I substituted steam pressure for this work of emulsion, with much the same results as with centrifugal force, a large percentage of the fat rising to the top of the cream while ripening over night, and the grain of the butter was imperfect.

At Cleveland, Ohio, in 1898, I switched back to the granular emulsion until 1903, when the idea occurred to me that I had overlooked an important point on liquid emulsion. I have now perfected this work. The grain and body of the butter are perfect.

The cream can be used for several purposes outside of being churned into butter, and can be shipped like ordinary cream. I make it with the percentage of oil as heavy as 50 per cent for renovated butter. I have thought enough of the process to take out a patent.

This covers my twenty-two years' experience in this butter proposition.

In 1885, at Baltimore, Md., another experimenter manufactured what is now known as renovated butter. It was then nameless, and the manufacturer came to be known to the trade as the "butter wizard." He bought inferior grades of all shades of color and sold a uniform article, much improved in quality and appearance.

The melting was done in a tin milk can surrounded with hot water. After melting, the butter was transferred to a barrel, with spigots to draw off the milky portion and the sediment. The fat was separated by gravity, and cleansed and purified with warm water. An attempt was made to clarify with air, by using a hand bellows, but it proved unsuccessful. After getting the melted fat in as good condition as possible with the crude appliances at his command, an emulsion with milk was made, and granulation was secured by suddenly cooling the mixture in cold water.

This man had had experience in manufacturing oleomargarin, which experience he no doubt employed in his experiments with renovated butter, as, after separating the butter fat from other material, the processes were much the same.

Another man, in Detroit, Mich., in 1884, began experimenting in separating the fat from butter and mixing it with milk, thus forming an artificial cream. On August 9, 1887, he was granted letters patent on the process of purifying and preserving butter. The declaration reads as follows:

This invention relates to certain improvements in a process for the preservation of freshly made butter and the remanufacturing of old butter, by which such old butter is renovated and made to resemble in every way that which is freshly made.

The process consists of melting, securing the fat, then granulating by the use of ice-cold water; then the fat is solidly packed, there being added to the butter fat 5 per cent salt and 1 per cent glycerin.

When wanted to make into butter, it is again melted, separating the salt and glycerin. The fat is then mixed with three times its volume of fresh milk. The mixture is then placed in an emulsifier, the action of which is to produce an emulsion of the

butter and milk which resembles natural cream. This cream is then treated like natural cream in manufacturing butter.

Numerous other persons have done a great deal of experimental work. One firm in Chicago discontinued the manufacture of oleomargarin soon after the act of 1885 placing a tax of 2 cents a pound on that substitute for butter went into effect, and took up the manufacture of renovated butter. This firm has been very successful in bringing to a high degree of perfection the system under which it operates.

WHAT CONSTITUTES RENOVATED BUTTER.

What constitutes process or renovated butter can not be better explained than in the definition given by the Department of Agriculture in accordance with the act of Congress approved May 9, 1902:

This grade or kind of butter may be made from one or more lots or parcels of butter which has been or have been "subjected to any process by which it is melted, clarified, or refined and made to resemble genuine butter, always excepting 'adulterated butter' as defined by this act."

The butter, to be subject to this definition, must have been melted—that is, so affected by heat as to become of sufficient fluidity to move in a continuous stream of even consistency from one vessel to another by pouring or pumping, because butter can not be "clarified or refined" unless it be melted to that degree.

The butter must, besides melting, have been subjected to some process by which it is "clarified or refined." Butter, or melted butter, may be clarified or refined by skimming, aerating, washing, and other processes, through the action of heat, cold, agitation or motion, or rest.

Butter thus melted and clarified or refined becomes an oil or fat almost free from taste and odor. To be again "made to resemble genuine butter" it must have restored to it the butter characteristics or similitude of texture, granulation, and flavor. For this purpose the processed or renovated butter is usually mixed with milk or skim milk, or buttermilk, or cream, sweet or sour, and granulated by cooling. It may or may not have common salt or artificial coloring added. To "resemble genuine butter" the article must have passed through these or other processes subsequent to melting, so that it looks, smells, and tastes like "butter," having a similar appearance, consistency, texture, and flavor.

FIRST APPEARANCE ON THE MARKETS.

It was not until the early nineties that renovated butter began to appear in any considerable quantities on the markets of this country. It was generally quoted and sold as creamery seconds, its quality preventing its securing any higher rating. Its source and mode of preparation were unknown to the general public, though in some localities it had a distinctive name. In Philadelphia it was called "boiled" butter, in Boston "sterilized" butter; then "process" was substituted as its prefix by those interested in its manufacture and sale. The consuming public, however, knew little or nothing of its origin or make-up, supposing that it was an inferior quality of ordinary butter. Its keeping qualities were very poor; and while attractive in appearance and to the casual observer of fairly good quality when it left the manufacturer's hands, yet when it reached the consumer it was in most cases vile, and in its last estate worse than its first.

ORIGIN OF NAME.

The first attempt to control the sale of renovated butter in a legal way was made by the dairy and food commissioner of Pennsylvania in 1897 under that clause of the food law prohibiting the sale of any article of food under the name of another article, the commissioner claiming that this butter was not genuine and should be sold under a distinctive name that was in a sense indicative of its nature.

A case was brought against a manufacturing firm in Philadelphia which made and sold the goods for creamery butter. At the preliminary hearing the defendants were held to court, but the case was finally settled by their agreeing to discontinue selling their product as creamery butter and to print on the wrappers a name satisfactory to the commissioner. The word "renovated" was selected as being appropriate, and one that conveyed to the consumer an idea of its nature.

The name "renovated butter" was unpopular with those engaged in its manufacture and sale, but the public looked upon it with favor as a step in the right direction to compel dealers in articles of food to sell them for what they were. In 1899 the legislatures of several States enacted laws requiring this product to be labeled and sold as renovated butter. The prejudice against this name has in a great measure worn away, and the business probably now stands on a firm basis and with good prospects for its continuance as a legitimate dairy industry. To improve the quality of an inferior article is certainly commendable and advantageous in many ways.

With improved methods and greater care taken by manufacturers in selecting their packing stock before it has deteriorated and become rancid, a wholesome and palatable article is produced, one that is very acceptable to those who wish to save a portion of the cost of high-priced butter.

LEGISLATION GOVERNING MANUFACTURE AND SALE.

To sell articles of food for something which they are not is a fraud and imposition on the consumer. The public had become disgusted at the extent of the manufacture and sale of spurious butter as the genuine article. Before National and State legislation became effective, as high as 150,000,000 pounds of renovated butter and oleomargarin were produced and sold in this country annually, the greater part of it being sold for genuine butter. While these products did not come into direct competition with high-grade butter, they seriously affected the price and caused dull markets and an apparent overproduction of dairy products, as the inferior quality greatly reduced consumption. The manufacturers of genuine dairy products became aroused and alarmed at the danger threatening the dairy interests of the country, and asked protection against an unjust competition with

counterfeit goods masquerading as genuine, demanding remedial legislation—not to prevent their manufacture, but to prevent fraud.

As the result of an aroused public opinion, the sale of oleomargarin colored in imitation of yellow butter was prohibited in a large majority of the dairy States, and laws requiring renovated butter to be marked and sold as such were passed. National legislation was also sought, and what is familiarly known as the Grout bill, covering both the manufacture and sale of oleomargarin and renovated butter, finally became a law May 9, 1902.

This act classes all butter under one of three grades, and legally defines the same as (1) butter, (2) renovated or process butter, and (3) adulterated butter. Adulterated butter also includes that which carries an abnormal quantity of water, milk, or cream. The tax on adulterated butter is 10 cents a pound, the same as on colored oleomargarin, and the license to manufacture is also the same. There are no factories in the United States that have taken a license to make adulterated butter, or that are ostensibly engaged in the business, but some have been obliged to qualify and pay for a license with penalties, and also pay the tax of 10 cents a pound, because their goods were found to contain more than 16 per cent of moisture. This law applies to all butter, whether renovated, dairy, or creamery, so that loading any butter with an abnormal quantity of milk, brine, or water is liable to entail on the manufacturer a heavy expense if the same is detected by any Government inspector. Any butter carrying less than 80 per cent of fat is almost sure to come under the ban as adulterated butter.

GOVERNMENT INSPECTION OF FACTORIES.

The law as applied to renovated butter requires rigid and frequent inspection to be made of the plants where it is manufactured, and of the materials used in its composition, as well as the sanitary conditions within and around the factories, including proper drainage, ventilation, etc., so that nothing unwholesome or detrimental to health shall exist in the finished product when it leaves the factory.

While the sanitary conditions of some factories were very good at the beginning of this inspection, others were in a most deplorable condition. The writer, on one of his first tours of inspection, came to the melting room of a factory so bad that it seemed difficult to know where to begin a reformation. Floors and stairways apparently were seldom cleaned; vats and tanks were used time and again without cleaning.

Such methods and conditions fortunately were the exception, and better still, the factory from which this picture is drawn was closed very soon after the present law became operative.

FACTORS IN IMPROVEMENT OF PRODUCT.

At the present time many creamery men who consider their product gilt-edged could with profit, so far as cleanliness and sanitary conditions are concerned, advantageously examine and adopt methods practiced in some of the best renovating plants.

But the marked improvement in the quality of renovated butter is only partially due to the improved conditions of recent years. The most important factor in this improvement is in securing the packing stock while it is fresh and giving it proper care until it is needed for use, so that instead of lying around in the basements of country stores absorbing the odors of fish and kerosene oil it is put in cold storage at a temperature below zero, where it remains, without deteriorating in quality, until it is needed to make over.

Manufacturers generally have abandoned the idea that they can produce a merchantable article of butter from old rancid stock, and as a rule if any such is received they reject it. Some of it goes to the cheap bakeries and the rest is used for soap grease.

EXTENT AND PROSPECTS OF THE INDUSTRY.

There are 78 factories now running, no two working under precisely the same system, but all striving to produce as good a quality of renovated butter as possible.

The total product of renovated butter the last fiscal year was fully 60,000,000 pounds, the product of 78 factories. There is nearly $1,000,000 invested in the plants, which give employment at good wages to a considerable number of men and women.

The markets here and abroad seem to take readily at remunerative prices all the better grades of renovated butter that can be produced, and the quantity is only limited by the amount of packing stock that the country provides. The facilities of factories now in operation are ample for working up all there is. The business, so far as the quantity produced is concerned, has undoubtedly reached its limit, not from lack of profit in manufacturing, or of demand for the finished product, but from lack of material from which to make the goods.

The amount of packing stock to be produced each year will gradually decline, principally because it will be diverted into more profitable channels by improved methods and the introduction of hand separators.

A man in Indiana who operates both a creamery and a renovating plant stated recently that within the last year he had placed among his patrons two carloads of cream separators, taking their cream instead of packing stock manufactured by the farmers themselves, and benefiting the farmer nearly the amount of the increased value of the product made by the change.

OSTRICH FARMING IN ARIZONA.

By WATSON PICKRELL, *Tempe, Arizona.*

INTRODUCTION.

Ostrich farming in the United States is really only in its infancy. It has been only twenty-three years since the first American ostrich farm was started. The early attempts met with varying degrees of success. The pioneer breeders in this country had to get most of their knowledge from their own experience. In fact, more than half the ostriches now in the United States are the progeny of a single pair owned in Arizona in 1891. Great progress has been made in the last five years, and there are now (October, 1905) 2,200 ostriches on farms in the United States. Of these, 1,540 (including chicks of 1905) are in Arizona, and the remainder in California, Florida, and Arkansas.

Where good alfalfa pasture has been available the birds bred in America have grown larger than those first imported. A full-grown fat ostrich will weigh from 375 to 450 pounds. He will stand 8 feet high, but can easily reach to a height of 10 or 11 feet.

Ostriches thrive best in a warm, dry climate, but can be grown in any of the Southern States and Territories in this country. In a moist climate they should have protection from cold and rain.

Salt River Valley, Arizona, is thought by many to be the best location in the United States for ostrich farming. Climatic conditions are favorable to the health of the birds, yield and quality of feathers, and the production of alfalfa for green feed the year round.

HISTORICAL SKETCH OF THE OSTRICH IN ARIZONA.

The first ostriches brought to Arizona came from the Cawston importation, and were shipped from California in 1888 by M. E. Clanton & Co. There were 13 in the troop, 2 old ones and 11 young ones. While the ostriches were being transported from the railroad station to the ranch 10 of the young birds were smothered. The men, knowing nothing of ostriches, took double precautions to prevent their escaping from the wagon—they put hoods over their heads and a canvas over the wagon. The weather being extremely hot, 10 of the young birds died before they were transported 4 miles. Before the old pair made a nest the female ostrich died from an accident, which left only the old male and a young female. In 1891 the first ostrich was hatched in Arizona. The birds had then passed into the possession of Josiah Harbert, and the Arizona ostriches remained under his control until

1896, when they were sold to the Arizona Ostrich Company. At that time there were 123 ostriches in the troop. W. S. Pickrell, of Phoenix, was the manager of the ostriches for two years. Under Mr. Pickrell's management the ostriches increased at the rate of 11 to a pair of breeding birds, which was the largest increase ever made on an Arizona ostrich farm, or even in America. Over 75 per cent of the birds were hatched in incubators.

In 1898 the Arizona Ostrich Company sold its entire troop of over 300 ostriches to Messrs. A. Y. Pearson and M. J. Taylor. These gentlemen purchased 300 ostriches from the Fullerton, Cal., farm, which birds they brought to Arizona.

The next year (1899) Mr. Pearson bought Mr. Taylor's interest. In 1903 Mr. Pearson sold to W. S. Pickrell & Co., of Phoenix, 21 pairs of breeding birds for $16,800. Within two years W. S. Pickrell & Co. had sold $30,000 worth of young ostriches, the produce of the 21 pairs.

There are six ostrich farms in the Salt River Valley, Arizona, and on these are all the ostriches in Arizona. They are all owned by the following incorporated companies: The Arizona Ostrich Company, the National Ostrich Company, the Phoenix-American Ostrich Company, the Big Five Company, and the McNeil-Wiley Company, all of Phoenix, Ariz.; and the Tempe Ostrich Company, of Tempe, Ariz.

The description of methods which follows is based almost entirely on the experience and observation of the writer, and applies especially to ostrich farming as practiced in Arizona.

EGG LAYING AND INCUBATION.

Ostriches come to maturity when about 4 years of age. The female matures from six months to a year before the male, but she will seldom lay a fertile egg until she is 3½ years old. The nest is a round hole in the ground which the male scoops out with his feet. At first the female may not take to the nest, but may lay her first eggs on the ground, whereupon the male will roll them into the nest. Generally, after the male has put 3 or 4 eggs into the nest, the female will lay there. In about thirty days she will lay 12 to 16 eggs, and will be ready to commence incubation.

Incubation under domestication is carried on in two ways—by natural and by artificial means. Some growers prefer the former method, others the latter. Either has been found to yield satisfactory results with fertile eggs. About forty-two days of very careful attention are required for good results.

In natural incubation the male takes a prominent part, covering the eggs fifteen or sixteen hours out of the twenty-four. He will usually go on the nest about 5 o'clock in the evening and remain there till 8 or 8.30 the next morning, the female taking her turn during the day. It is thought that the color of the sexes has had something to do with

developing these instincts. The male, being black, is not so easily seen at night, and the female, being drab or nearly the color of sand, can not be so readily seen in daylight. The male usually begins sitting three or four days before the hen stops laying. If the weather is cold during the laying period the male may often be found covering the eggs at intervals during the night to prevent them from becoming chilled. The birds are also very watchful in the warmest season to prevent the eggs from becoming overheated by the sun. Often, in the heat of the day, one or the other of the old birds may be found sitting on its ankle joints with both wings extended to shade the eggs from the sun. The careful ostrich farmer should make this work unnecessary by providing artificial shade during the hot season. The birds sit very much closer to the nest during the first half of the incubation period, the internal heat of the eggs making this less necessary during the last half. As is usually the case with all eggs in a dry climate, the shell of the ostrich egg becomes dry and hard, and very difficult for the chick to break. When the time arrives for the liberation of the young, they will be heard to chirp and to move in the shell. The parent bird seems to understand the situation, and will often crack the shell with its breastbone, sometimes taking the young bird by the head and drawing it out of the shell. Sometimes three or four days elapse between the hatching of the first and the last eggs in the nest. During this time one or the other parent bird takes care of the chicks while the other is attentive to the nest. Owing to liability of injury to the young birds by reason of the anxiety of the parent birds, it is a good plan after the first eggs have hatched to remove the remaining eggs to an incubator.

Artificial incubation can be successfully carried on with any good, well-regulated machine that will hatch eggs of common fowls, provided, of course, it is constructed on a large enough scale to accommodate ostrich eggs, which are 5 inches in diameter and 7 inches long. It has been found best to use an incubator which will hold only 30 to 35 eggs, as in case of a blunder or an accident to the incubator the loss will be comparatively small. The incubator should be heated for two or three days before the eggs are put in, to see that everything is in proper working order. The incubation should be started at a temperature of 101° F. In three weeks this temperature will be slightly increased by the heat generated in the eggs themselves. Every egg should be turned at least once or twice a day. To be on the safe side it is well to adopt the rule of turning the eggs three times daily.

The regulation of the temperature is not the only thing to be considered in hatching eggs in an incubator. The matter of moisture presents quite a serious problem. Inside the shell of the egg are two fibrous coats, of which one adheres closely to the shell and the other incloses the contents, there being a small air space between them.

This air space should be closely watched by the attendant, as its size indicates the moisture condition of the egg. If this space becomes abnormally large, small pans of warm water should be placed in the incubator; if it becomes too small the moisture should be reduced. An intelligent and watchful attendant will experience no difficulty in this matter. Moisture pans are seldom required before the fourth week.

In a warm climate the incubator house should be so constructed as to be as cool as possible and at the same time free from drafts and not subject to sudden changes. During the period of incubation the attendant should observe the growth of the embryo at least once every two days. This he can do by shading the egg with the open hand and holding it to a lighted candle. Careful observation will enable him to detect and remove the infertile eggs by the end of the second week; but whenever there is room for doubt, the egg should be allowed to remain longer, perhaps to the end of the third week, when the internal heat of the eggs will be sufficient to unmistakably indicate the live eggs. Near the end of the sixth week the eggs should be watched more closely. By placing an egg to the ear one can hear the unhatched chick scratch the inside of the shell and chirp; also the air space will be observed to become filled up. It is then time to crack the shell and thus aid the chick in liberating itself.

CARE AND FEEDING OF THE CHICKS.

It is not well to suddenly transfer a newly hatched chick from the incubator temperature of 101° to that of the open air. A well-ventilated brooder kept at 90° F. is the proper thing for the first twenty-four hours, after which the temperature may be gradually brought to that of the outside air. The chicks should never be allowed to become damp or cold, and they should not be fed for the first three or four days, but they may be allowed to pick up sand and gravel. Dry feed is preferable for the first week. Cracked wheat and moistened bran are excellent, but the chicks should never be given feed which has begun to sour. The inclosure should always be kept clean. At the end of the first week green alfalfa cut very fine may be fed, but not too freely at first. It should not be allowed to become dry, as fresh feed should be the ostrich farmer's watchword at all times.

Young ostriches, like young chickens, should be housed and protected from cool drafts until they are two or three months old, the length of time depending somewhat on the climatic conditions.

PLUCKING AND SORTING THE FEATHERS.

The ostrich is plucked the first time when six months old, and should be plucked about every eight months thereafter during its lifetime. The only feathers removed are those of the wing and the tail. The process of plucking consists in cutting the tail feathers and one row of the largest quill feathers in the wing with pruning shears, and

drawing by hand those of the remaining two or three rows in the wing. Two months later the quills of the cut feathers may be removed.

At plucking time the ostriches are driven in from the pasture and placed in a small pen surrounded by a tight board fence 5 or 6 feet high. The plucking box is about 4 feet high, 20 inches wide, and 3½ feet long, open at one end and closed with a door at the other. An ostrich is caught and a hood placed over its head. An old black stocking makes a very satisfactory hood. The hooded bird is very easily handled. It is placed in the plucking box with its head next to the closed door. The plucker stands behind the bird while removing the feathers (Pl. XLV, fig. 2). This is necessary, because the ostrich can kick or strike very hard, but it always strikes out in front and never behind, so that the plucker is perfectly safe if he stands in the rear.

When removing the feathers from the ostrich, the pluckers usually tie in a bunch the feathers of each length as they are taken from each bird. When through plucking, they have a grading table with enough compartments in it to hold all the grades and lengths of feathers, which are many. The size of each compartment is about 4 inches wide and 4 inches deep, and the length varies from 4 to 30 inches. In sorting, the feathers of the male are kept separate from those of the female. The former are the more valuable. Manufacturers in this country usually request that the feathers be graded as nearly as possible as they are in the London market, where nearly all the feathers of the world are marketed. A London report shows the following classification: White, femina, bayocks, black, drabs, floss, spadones, and boos, with numerous subdivisions or grades.

The value of the American feathers depends on the London market. In an American factory they will bring 15 per cent more than the London price, plus the freight charges. In October, 1905, "white primes" and "blood feathers"—the most valuable—sold in London for £30 sterling ($146) per pound. It takes about 90 of these feathers to weigh a pound. The "white primes" and "blood feathers" are taken from the males, as well as most of the "white firsts," though occasionally a female bird will have what the feather men call a "first white." The black feathers are plucked from the male birds and the drab from the females. "Spadones" are chick feathers, the first plucking. "Boos" are tail feathers. "Bayocks" come mostly from the male birds. The shortest drab feathers, which are frequently used in making feather dusters, are worth about $4 per pound. An average ostrich will yield 1½ pounds of feathers annually.

The United States is one of the largest consumers of ostrich feathers in the world. During the fiscal year 1903–4 there was imported into this country $2,292,515 worth of "raw" or "unmanufactured" feathers. The feathers produced in America are fully as good as those coming from Africa, and it is claimed that they are broader and finer looking,

though some manufacturers contend that they are not as strong and tough as the wild feathers. There seems to be no reason why ostrich farming may not be developed sufficiently in Arizona and California alone to supply all the feathers consumed in America.

PERIODS OF LIFE AND MARKINGS.

Ostriches are called "chicks" until 6 months old, or as long as they have their first crop of feathers. From then until 1 year old they are called "young birds," and from 1 to 4 years old they are known as "plucking" or "feather" birds. It is difficult to determine the age of an ostrich when it is more than 3 years old. Illustrations of ostriches at various ages are given in Plates XLV to XLVII. Douglas, in Ostrich Farming in South Africa, says:

The distinguishing marks of the different ages are somewhat as follows, though it must be borne in mind that a very forward bird of one age will have many of the marks of the age above him, whilst a backward bird will have many of the marks of the age below:

At six and a half months old the quill feathers will be ready to cut; some of the body feathers will have begun to change; some of the cocks will show yellow in front of the legs.

At twelve months old the second growth of quill feathers should be showing; some of the cocks should begin to show black feathers; all cocks should show white on legs and bill.

At two years old all the "chicken" feathers should have gone from the back, and the cocks should show quite black or nearly so. Most of the little white belly feathers should have been replaced by blacks or drabs, according to sex.

At three years old there should not be a single "chicken" feather to be found on the body; the last place from which they disappear is where the neck joins the body. Every vestige of the white belly feathers has gone. The bird's plumage has reached perfection. Some of the cocks will be red in front of the leg and on the bill.

At four years old the birds have reached maturity; the breeding organs are fully developed; the cocks in season will have the back sinews of the leg pink, the front of the leg and the bill scarlet; and much of the fineness of the feet, the leg, and the lines of the body will have gone.

At five years old and upwards the only distinguishing marks we know are a generally coarser look of the limbs and body and an increased coarseness of the scaling in front of the legs and feet.

HANDLING AND FEEDING OSTRICHES.

Lands used for ostrich farms in Arizona are worth from $40 to $125 per acre. As irrigation is absolutely necessary for farming here, the land value depends mainly on location and water rights. The annual cost of water is from 50 cents to $2.50 per acre, depending partly on the cost of bringing the water from the river to the land and partly on whether the canals are owned by a corporation or by the owners of the land. The land used for growing alfalfa is usually a sandy loam.

Young ostriches are usually kept in troops of 25 to 50. When they are 1 year old the males should be separated from the females. When they are 3½ years old the birds should be paired off, each pair being placed in a separate inclosure, which, in case the birds are to graze on

FIG. 1.—OSTRICH 26 MONTHS OLD.

FIG. 2.—PLUCKING AN OSTRICH.

FIG. 1.—OSTRICHES 5 DAYS OLD.

FIG. 2.—OSTRICHES 5 MONTHS OLD.

OSTRICHES 5 YEARS OLD.

alfalfa or other green feed, should be large enough to furnish them sufficient food. If they are fed on dry feed the inclosure need only be large enough to allow plenty of exercise.

The usual way to fence an ostrich farm is to use a woven wire for the outside fences about 5½ feet high and with meshes small enough to keep out wolves and dogs. The fences used to divide the farm into small paddocks may be made about 5 feet high and need not extend nearer than 18 inches to the ground. Paddocks for chicks should be inclosed with woven wire, which should extend to the ground, but need not be so high.

Ostriches are easily moved from one field to another by one person going ahead, calling them, and toling them on with grain, while another follows on a horse. The birds are very timid and do not like to be driven unless someone goes ahead of them.

After ostriches are over 1 year old no one should go among them without a brush or stick in the hand, as at times they will want to fight, and a person going among them is liable to injury unless he has something with which to drive or frighten them away.

One of the very best feeds for ostriches is alfalfa. One acre of good alfalfa in Arizona will maintain 4 ostriches without their receiving any additional feed. When pastured or fed on green alfalfa they are always healthy. The writer has known troops of more than 100 to be kept on alfalfa for three or four years without a death. Ostriches thrive well on any tender green forage, and they prefer the kind they have been taught to eat. Birds fed on hay, when turned out, often refuse to eat grass until they become very hungry.

For dry feed, alfalfa or clover hay cut up, mixed with bran, and moistened is excellent. An ostrich will consume about 3 pounds of hay and 1 pound of bran daily. They should have gravel and broken bone at all times. Occasionally an ostrich will get a piece of bone lodged in its throat. In such case, if the bone can not be worked up or down by external manipulation, the throat may be cut, the bone removed, and the incision sewed up. It will heal very quickly.

Ostriches may be fed any kind of grain—corn, wheat, barley, oats, or peas. Some farmers feed a little grain while the birds are nesting. Ordinarily, however, if ostriches are in good flesh and have plenty of good green feed they need no grain. Besides, if fed much grain they are liable to become cross and hard to manage.

Although African writers assert that ostriches will live for years without water, Arizona farmers find that they drink water freely every day if it is supplied to them.

THE FLESH AND EGGS AS FOOD.

The value of the ostrich as a domestic animal depends on its production of feathers for ornamental purposes. It is hardly probable that the relations between supply and demand will so change as to make the

ostrich more valuable as a source of food in the form of meat and eggs. The flesh of the domestic ostrich, however, is said to be much relished by those who have eaten it. The eggs are fine for making omelets and are good scrambled. One egg will make as much omelet as 2½ dozen hen's eggs. An ostrich has been known to produce over 300 pounds of egg food in a year.

AGE OF THE OSTRICH.

Nothing is positively known as to how long an ostrich will live. Some writers claim that it will live one hundred years. Ostriches which are known to have been in captivity for forty years are still breeding and producing feathers. It is the experience of Arizona farmers that among birds having good nutritious green feed deaths seldom occur except as the result of accident. A dog or other small animal will sometimes frighten ostriches and cause them to run into the fence, which may result in a broken leg. When this happens the bird may as well be killed, as few if any ever recover from such an injury.

THE VALUE OF OSTRICHES.

The question most frequently asked by visitors to an ostrich farm is, "What is an ostrich worth?" The somewhat curt reply usually given is, "The birds are not for sale at any price." The day has not yet arrived when the American grower is ready to part with his birds as the grower of other animals does. The value of the ostrich has only begun to be appreciated. Practically the only inducement that will bring an ostrich farmer to the point where he will sell birds is lack of available pasture for them. Ostrich farmers may name the estimated value of their birds, but there are few who will sell the birds at the prices named. Chicks 6 months old may be set down as worth $100 each; 1-year-old birds, $150; 2-year-olds, $200 to $250; birds 3 years of age, $300 to $350, and birds 4 years old, the age at which they pair, $800 or more per pair.

IS OSTRICH FARMING PROFITABLE?

"Does ostrich farming pay?" This question is asked by almost everyone who visits an ostrich farm. When an acre of alfalfa will furnish a home for 4 birds, with food enough to maintain them; when an ostrich will yield annually 1½ pounds of feathers, with an average value of $20 a pound, and from 36 to 90 eggs, which may be used for incubation, or may furnish egg food at the rate of 3½ pounds to the egg if the owner does not wish to increase his troop, readers may be left to decide for themselves as to the profitableness of the industry.

ILLUSTRATIONS OF THE INFLUENCE OF EXPERIMENT STATION WORK ON CULTURE OF FIELD CROPS.

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INTRODUCTION.

Improvement in the culture of field crops is manifested by a greater efficiency in methods of soil preparation and cultivation; by more nearly perfect stands of all kinds of crops, whether sown broadcast, drilled, or planted; by varieties better adapted to soil and climate, while at the same time meeting the requirements for the market and for use on the farm, and by scientific systems of crop rotation followed not merely for the diversification of the crops produced, but largely for the improvement and maintenance of soil fertility. Great progress in the production of field crops has been made during the last fifteen or twenty years, and the object of this article is to point out some specific examples indicative of the influence of experiment station work on these different phases of crop production.

In many instances work carried on by the stations was inaugurated by the Department of Agriculture, and the particular lines of investigation were carried on in cooperation with the stations. As a notable example of this kind of work the introduction and distribution of new crops and new varieties, as, for instance, Kafir corn, durum wheats, numerous varieties of other cereal and forage crops, varieties of sugar beets, etc., may be mentioned. To-day we find a number of these introduced crops grown as staples in many States, and a large number of the new varieties outranking the common sorts in distribution and production. While the experiment stations and the Department of Agriculture have done much in the way of bettering field-crop culture in different lines, they have not been alone in the work, and such helpful factors as the agricultural press, farmers' institutes, agricultural schools and colleges, cooperative demonstration work, agricultural shows, such as State and county fairs, improved farm implements, and other valuable aids of a similar nature must also be given credit for helping to bring about the general result.

Owing to the multiplicity of forces and the relation they bear to one another it is impossible to say with accuracy how much credit is due to each one, and estimates as to definite results, such as the actual increase

in crop production or in financial returns, are necessarily unreliable. The results of experiment station work are largely used by the different educational agencies which make for progress in cultural methods, and thus they exert a very strong although indirect influence in various ways. The nature of the case makes it futile to attempt to show in terms of bushels or in dollars and cents the advantages that have accrued to American agriculture through the results of experiments in field-crop culture secured in station work and the recommendations and suggestions based upon the same. In very few of the examples here given can it be claimed that the progress made is due exclusively to experiment station activity, but in all cases the stations have been important factors in bringing about the results achieved. The purpose of the writer is therefore to outline in a general way how these results and recommendations have borne fruit and to what extent the interest of the farming public in the matter has been aroused.

In the following discussion of individual crops the work of certain stations is mentioned to indicate the lines along which the influence of the stations in general is exerting itself.

THE INFLUENCE OF THE WORK ON THE CULTURE OF INDIVIDUAL CROPS.

CORN.

Experiments in the different phases of corn culture carried on by nearly all the stations have shown the advantages of frequent and shallow cultivation and have given rise to the more general adoption of this method by farmers, who are finding that their results confirm the station recommendations. By actual test the stations demonstrated that cultivating about 3 inches deep is likely to give better results than allowing the cultivator to go to a depth of 5 or 6 inches; and by a series of studies on the development of the root system of the corn plant they have shown the relation of the depth of cultivation to the location of the roots under the surface soil stirred by the cultivator. The advocacy of shallow cultivation by the stations, based on these results, is doubtless responsible to a very considerable extent for the more or less general substitution of this practice for the deep cultivation and root pruning so common some years ago.

When the stations were established deep cultivation of corn was commonly practiced, and the idea prevailed that culture was merely for the destruction of grass and weeds growing in the crop; but carefully conducted experiments extending over a series of years indicated plainly that frequent shallow cultivation, especially during the latter part of the cultivating season, is likely to give better yields than deep cultivation because, in addition to a more efficient destruction of the weeds, it forms a dust mulch which conserves the soil moisture, so necessary to the plants at this period of their growth. Since then the manufacturers of implements for corn cultivation have made such

improvements in this line of machinery that shallow cultivation is much more easily and effectually accomplished than it was with the old style of cultivators. Some authorities estimate that in the corn belt to-day 75 per cent of the farmers practice shallow cultivation.

In the way of improving the yield and quality of corn, together with the growing of seed corn as a special crop, the stations in the great corn States are doing valuable work. Corn-breeding investigations have been pursued by the Illinois station for some ten years. After several years of experimentation it was shown beyond a doubt that improvements in the quality as well as the yield of corn could be made. These results were largely instrumental in the organization five years ago of the Illinois Seed Corn Breeders' Association, the first association of its kind in the world. To-day seed corn breeders' associations have been organized in all the principal corn-growing States, and in general the method of corn breeding as worked out by the stations, and their recommendations in the management of the special breeding plats or fields, are followed in detail. In Illinois this work has induced a group of farmers to form a company for producing agricultural seeds and to fit up a chemical laboratory in which numerous analyses are made to determine the protein and oil content of sample ears, and to base upon these results the selection of seed corn for improvement in quality. Many members of these associations have taken up corn breeding commercially, but there are also many farmers who, through the advice of the stations, maintain a breeding plat for the production of seed corn for their own farms. The Illinois station has devised a method of determining approximately the chemical composition of the corn kernel by a simple mechanical examination which may be made with a pocketknife, and which enables every farmer to make an intelligent selection of his seed corn according to scientific principles of plant breeding. Methods of registration showing the pedigree of each ear produced have also been devised by this institution. The growing interest in the production of field crop seeds and the improvement of the crops, as well as the maintenance of their good qualities, may justly be ascribed to the initiative of the experiment stations.

The Iowa Experiment Station has been prominent for the last two years in impressing upon the farmers of the State the necessity of a proper selection of seed corn and of testing every ear before it is shelled and used. The method of bringing the subject before the people was both unique and effective, and the efforts of the station were assisted in a great measure by the railroads and supported by the agricultural press and agricultural associations. A brief review of what was accomplished during the two years will best illustrate the extent and the success of the work and the general interest it awakened. Special trains, known as "seed corn specials," were run for the purpose of giving instruction in selecting, testing, and planting seed corn.

The lectures on these subjects were delivered by the agronomist and other officials of the station. In 1904 a special train covered 1,480 miles in eight days on three different roads. During this time 100 stops were made in 37 of the 99 counties of the State and 150 short lectures delivered, with a total attendance of 17,600. In 1905 the movement assumed much larger proportions. Six railroads were interested. The special train covered 7,855 miles and made 570 stops in fifty-seven days, while 1,085 lectures were delivered to 127,763 hearers. During the two years 96 counties were traversed, and the information given out in the lectures was further disseminated by 312 newspapers and by 25,000 bulletins of instruction issued by the railroads themselves. (See fig. 92.) The average attendance at each meeting was over 190. Similar work is being done in other States.

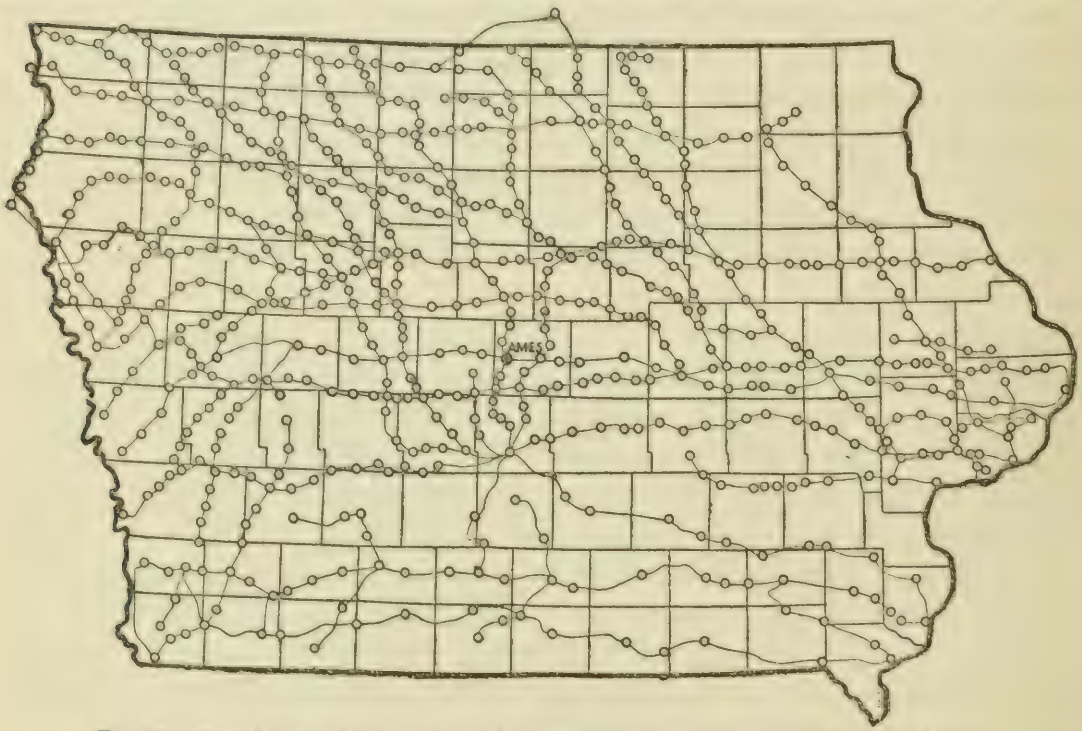

FIG. 92.—How Iowa was covered by the "seed corn specials" during 1904 and 1905.

The Iowa station also found that the grading of seed corn for the planter is an important factor in securing an even stand. When the corn is shelled the kernels from each ear are kept separate. Three grades are established—large, medium, and small. By examination of several kernels from each ear it is determined to which grade the kernels from that ear belong, and all the kernels of a single grade are then put together in one receptacle. Then the different plates of the planter are tested with kernels from a single grade. The plate should drop the required number 90 to 95 times out of 100. If it fails to do this it is ground or filed until it will drop with the desired uniformity. It is then used in planting seed of that particular grade. This station has also recently begun to utilize the county poor farms of the State for testing varieties with a view to determining those best adapted

to different localities. This is another efficient way of bringing experiment station influence to bear upon the agriculture of the State.

The varieties of corn now grown in the different States have in many cases been distributed by the stations or their culture recommended by them. In Alabama, for instance, Cocke Prolific and Mosby Prolific have become quite well known in this way, and in Illinois the experiment station has published bulletins in which the standard varieties for the State, as determined by trial and observation, are accurately described and figured. Some years ago the Minnesota station originated a new variety known as Minnesota No. 13, and, when satisfied of its merits, began its distribution. This variety is now one of the standard varieties of the southern part of Minnesota, the region for which it was originally intended. The reports received indicate that it yields from 4 to 5 bushels more per acre than the varieties for which it was substituted. As another evidence of its value the fact may be cited that the South Dakota station is now distributing the variety among the farmers of that State. Some of the first work done by the New Hampshire station was to demonstrate to the farmers of the State the value of varieties of corn for silage purposes, and as a result a variety known as the Sanford came very prominently into use throughout the State; and a number of years later, when the station, pursuing this same line of investigation, found that Leaming corn was of pronounced value in the southern part of the State and recommended the same, this variety largely supplanted the former in the section to which it was adapted, and its value by farmers generally is now well recognized.

The Georgia experiment station, among other southern institutions of this class, has been quite successful in testing and introducing the method of cutting and shocking corn, curing it in the field, and then husking and cribbing the ears and shredding the stalks for forage, in place of gathering the blades some time before the corn is ripe and curing the same for fodder, while the ears remain on the stripped stalks to be broken off, with more or less of the husks, and stored in the crib when they have become sufficiently dry.

WHEAT.

Experiment station work with wheat includes culture, variety, and fertilizer tests, together with other lines of work for the improvement of the crop in both yield and quality. The Montana station has shown that fall plowing, followed by thorough preparation and cultivation of the soil the next spring, gives a considerable increase in yield, due to the possibility of early seeding and to the benefits derived from a firmer seed bed. These practices are now largely followed.

The Oklahoma experiment station has impressed upon the farmers of the Territory the necessity of early plowing and thorough preparation of the seed bed for wheat, and it is estimated that 20 per cent of

the wheat growers have improved their methods of soil preparation. Late seeding is necessarily the consequence of late plowing, and with the change in the time of plowing has come a change in the date of seeding, much to the advantage of the crop, it having been shown by station work that seeding in October, as a rule, gives better yields than seeding in November. The lessons taught by experiments showing that pasturing winter wheat when the soil is not in suitable condition or when the pasturing is continued much later than March 1 is likely to reduce the yield more than is gained by the grazing, have been quite thoroughly followed by Oklahoma wheat growers. On the other hand, although the station tests show an increase of 60 per cent during six years on land treated with stable manure, little progress has been made in getting the farmers to follow the station practice. This station, like all others in the wheat-growing States, has been instrumental in testing and distributing the varieties best suited to its territory. The institution has been unable to supply the demand for seed, which was furnished the farmers at market prices. Weissenberg, one of these varieties, is fast becoming a favorite.

In Maryland, Currell Prolific, a variety of wheat well adapted to all the tide-water sections of the State, was introduced into the State by the experiment station. To the credit of the Michigan station belongs the introduction into that State of Dawson Golden Chaff wheat, which has to a considerable extent replaced some of the older varieties with an estimated increase in yield of about 10 per cent. In Ohio no part of the station work has attracted more attention among the farmers than its variety tests with wheat, which have been in progress since the institution was first organized, and the results of which have been made public in many bulletins and by annual exhibits at the State fairs. The surplus produced of the better varieties is sold to the farmers for seed. The increasing yield of wheat per acre in the State is in part due to the more intelligent use of fertilizers, upon which subject the station has also disseminated much valuable information, but that it likewise largely results from the more general distribution of the better varieties can not reasonably be doubted.

New varieties of wheat originated by the Minnesota station, especially Minnesota No. 163 and Minnesota No. 169, have spread over large areas in the State of Minnesota, and have already found their way to neighboring States. They are now successfully grown on about a half million acres, and are estimated to yield from 1 to 2 bushels more per acre than the varieties they are replacing. In quality these new varieties rank with the best Minnesota hard wheat.

In Kansas and other wheat-growing States the stations have also achieved notable success. In North Dakota a newly bred Fife wheat originated at the station, known as Experiment Station No. 66, together

with Minnesota No. 163, has been widely distributed and the two sorts have come into more general use than any other variety.

In the distribution of durum wheats, introduced by this Department, the Nebraska, North Dakota, and South Dakota stations, and others whose territory includes wheat lands with scanty rainfall, have met with good success, and thousands of acres of this class of wheat are now grown by the farmers of those States, the total annual production for the entire country having now reached about 20,000,000 bushels. It is estimated that in North Dakota good strains of durum wheats are now grown on nearly one-half of the fields in a third of the wheat-growing portion of the State. The Idaho station reports good results with durum wheat in the high altitudes of the State, which is in part a solution of the problems connected with high-altitude agriculture.

Some of the principal advantages in growing winter wheat are a better distribution of farm work; generally higher yields, largely due to the ripening of the crop before the extreme heat of midsummer, which prevents proper development; a conservation of soil fertility by the crop during winter; and in some localities and under certain conditions, an increase in pasturage. Through experiment station work the culture of winter wheat is being extended. As a particular instance, the work of the Nebraska station may be cited. This station, beginning its work with winter wheat when very little was grown in the State, has contributed largely to bringing Nebraska to its present rank in winter-wheat production. Some of the more recent efforts include the distribution, in 1900, of seed of hardy strains of Turkey Red and Big Frame wheat to 400 farmers throughout the northern and the western part of the State. Since that time the winter-wheat production of the State has been increased by about 10,000,000 bushels, and while this can not be credited solely to this particular effort of the station, it must be acknowledged as a great factor in bringing about this result. The results obtained generally have indicated that the best success may be expected from the selection of hardy strains of Turkey Red, a well-known domestic variety.

OATS.

Important results have been obtained by several stations with the oat crop, and its culture has been measurably benefited. The Georgia station originated and developed a method of sowing oats which has proven to be effective in protecting the plants against winterkilling. This method of sowing consists in leaving the drill furrows open after drilling the seed instead of filling them up by means of the harrow, clod crusher, or smoother. The plants thus come up an inch or two below the general surface, which affords them protection. This station has also done valuable work in improving and maintaining the quality

of Appler rust-proof oats and has distributed several thousand bushels of seed of this variety through the South. In Nebraska it has been shown by cooperative experiments conducted by several hundred farmers during the last four years that Kherson oats, imported eight years ago by the State experiment station from the Province of Kherson, in Russia, is a valuable variety for Nebraska. Its distribution has already become quite general in the State. Another striking instance of the far-reaching influence of experiment station work is the introduction of Swedish Select oats into Wisconsin. In 1899 the experiment station secured 6 pounds of seed of this variety from this Department, compared it with 40 different sorts, and improved it by selection. Seed was sent for trial to practically every county in the State, and good returns were obtained. It is estimated that in 1904 no less than 5,000,000 bushels of this variety was grown by Wisconsin farmers. This same variety has also been tested and distributed by the Montana station and has proven to be one of the best sorts for that State. In Idaho the station has distributed early varieties in high altitudes, where the seasons are too short to mature the varieties now grown.

BARLEY.

Comparatively few stations have worked with barley, because of its lesser importance. The Colorado station in testing the best varieties of barley obtainable in Europe and America found a type of special value on account of a high protein content in the grain, and with this as a basis is now working on the development of a superior feeding barley for Colorado. The Wisconsin station began the dissemination of Manshury barley about twenty years ago, and this variety has become the standard barley of the State and has proven of the greatest practical value for the Northwest. In Montana the station has demonstrated the excellence of New Zealand barley, and the distribution of seed of this variety throughout the State is now in progress.

COTTON.

Much useful information regarding the culture of cotton and the use of fertilizers in that connection has been given by the stations in the cotton-growing States, and their work along the line of improving varieties in yield, earliness, and staple by breeding and selection is of the greatest value to the cotton grower. Early varieties and early planting have recently been recommended as a means of reducing the ravages of the boll-weevil, the late-maturing varieties and crops being the more subject to its depredations. In Louisiana the recommendations of the experiment stations regarding the use of the cultivator, the practice of thorough preparation of the soil, and frequent shallow cultivation have been the most potent factors in decreasing the cost of

producing the crop. An improved method of cultivating cotton, originated by the director of the Georgia experiment station, has been adopted with very satisfactory results by many farmers of that State. The extensive work of this station in testing the more prominent and popular varieties of cotton now grown in the South Atlantic and Eastern Gulf States has brought them to the more general notice of the Georgia cotton growers, and has been of great assistance in protecting them against fraud and imposition regarding varieties. The Alabama station has been very influential in extending the culture of the Culpepper and other valuable varieties of cotton in Alabama. These lines of work are pursued by all experiment stations in the cotton belt.

FLAX.

Experiments with flax have been limited to a few stations. Improved strains of flax have been originated in the plant-breeding nurseries of the Minnesota experiment station. The most promising strain has been named Premost, and pedigreed seed of this new variety, which is much superior in seed production to the varieties generally grown, is being distributed. The farmers and seed growers cooperating with the station in this work guarantee to grow for seed the several bushels of seed allotted to them. This plan of distributing new varieties has proven most successful. The North Dakota station is giving special attention to combating the wilt disease of flax by treating the seed and by developing resistant or immune strains. The formaldehyde treatment for the prevention of the disease is almost universally used in that region as the direct result of the station's efforts.

POTATOES.

Potato growing has received considerable attention at the Oklahoma station and the varieties and cultural methods most likely to give the average best results were determined. A few farmers who, according to station advice, have followed the plan of growing cowpeas as a renovating crop after early potatoes have reported it as being very profitable, but the greater number of growers are still making the mistake of producing a second crop of potatoes the same year on the same land. The New York Cornell station has shown that for certain soils of New York State very thorough preparation, deep planting, and thorough, level, and late-continued cultivation are decidedly more profitable in growing potatoes than the practices in vogue, and these ideas are being spread by means of cooperative tests carried on by the farmers under the direction of the station. The Geneva station demonstrated to Long Island potato growers that, on the average, the largest profit is realized from the use of 1,000 pounds per acre of commercial fertilizers containing 4 per cent of nitrogen, 8 per cent of available phosphoric acid, and 10 per cent of potash, and that the large quantities of potash used by many Long Island farmers are not economical.

In the matter of treating seed potatoes for the prevention of scab the farmers in many States have quite generally and promptly followed the advice of the stations whenever the crop has become badly infected; and while spraying with Bordeaux mixture to prevent blight has not been of such wide adoption, a large proportion of farmers in localities where blight prevails are treating the potato crop as recommended, and where the disease is generally prevalent the spraying of potato fields is becoming as common as the spraying of orchards. It may further be stated that in the section of Maine in which potatoes are a great commercial crop practically all of the thousands of acres are treated with Bordeaux mixture, and the leading farmers in that region attribute the rapid introduction of the practice to the results of the demonstration experiments carried on by the station in 1900 in cooperation with practical growers. It is considered that in 1903 spraying potatoes saved the growers of Aroostook County many times the cost of maintenance of the station. In the potato region about Greenville, Mich., farmers have practically eradicated the scab from potatoes by following the advice of the State experiment station.

In the potato-growing districts of New Jersey the experiments of the New Jersey stations have very materially changed the practice in the growing of this crop by a substitution of commercial fertilizers for barnyard manure, and this has resulted not only in heavier yields but also in a lower cost of production.

TOBACCO.

In 1893, the first year of the State system of farmers' institutes in Maryland, the officers of the State experiment station advocated the use of crimson clover as a preparatory crop for tobacco, and the general opinion held with regard to such a practice was that it was ruinous to the crop. The station teaching, however, took root, and in addition to crimson clover, which is now quite frequently grown in this connection, cowpeas are also used as a preparatory crop for tobacco. In Connecticut the growers have generally adopted the methods of fertilization for tobacco which the station tested and advocated, and in consequence carbonate of potash and cotton-seed meal are extensively used on the tobacco fields of Connecticut, while large quantities of sulphates are generally avoided. A movement has recently been started by the station in cooperation with this Department to induce growers to select their tobacco seed and to sow only the heavy grains. This station has also done much to introduce the method of fermenting tobacco in bulk instead of in case.

Investigations upon the manuring of tobacco by the Pennsylvania station have distinctly modified the practice in the Lancaster County tobacco district. It was found that larger yields and a better quality were secured from the use of commercial fertilizers than from the application of barnyard manure alone. This work has also led to a more intelligent use of fertilizer ingredients with reference to their

effect upon the yield, and especially upon the quality of the crop. Experiments in curing tobacco have thrown more light on the nature of the process and have materially aided in reducing the loss from pole burn. Tests of growing Sumatra leaf under shade by the station have discouraged the investment of large sums of money in such an enterprise before the practical local requirements of this method of tobacco culture have been ascertained and its feasibility demonstrated.

SUGAR BEETS.

A striking illustration of the value of experiment station work through a series of years may be found in the extensive culture and variety tests of sugar beets conducted by these institutions in a number of States in which the beet-sugar industry has been established. The progress made in the past ten to fifteen years in the culture of this crop has assured not only the permanency of this industry, but also its further healthful development. In pointing out the possibilities and in determining the sections of the country in which the industry could be profitably established, this work has been a most important factor. Early in its organization the Nebraska station, in cooperation with this Department, experimented with sugar beets and demonstrated, before any factories were built in the State, the adaptability of the soil and climate to beet growing. More recent experiments have demonstrated the possibility of producing beets on alkali soils. In Michigan, as in several other States, the growing of sugar beets was first urged by the experiment station. Seed secured from this Department and imported from Europe was distributed throughout the State and the beets grown from it were analyzed. The results reported in a bulletin were widely circulated. The third year of the work nearly 100 acres of beets were grown near Saginaw, and after this several wealthy citizens cooperated with the station by furnishing the capital for the erection of the first beet-sugar factory in the State. The farmers in nearly all cases have been and are now guided in the culture of the beet by the work of the station. To-day Michigan has 16 beet-sugar factories, being the leading State in this regard.

These examples illustrate the course of the movement in general. In many instances the stations were the first to demonstrate what could be done in the production of beets and of sugar per acre in certain localities, and thus gave confidence to the investor and the manufacturer as well as to the farmer.

SUGAR CANE.

Experiment station work with sugar cane is practically limited to the Louisiana station. When this station was established the crop was almost entirely cultivated with the turning plow, but at present it is estimated that not more than 10 per cent of the crop grown in the

State is cultivated by this method. The station was the first to demonstrate to the planter the value of the cultivator in the more economical production of the cane crop, and this implement is now quite generally used. This result was achieved by the station inducing certain planters to give the cultivator a trial, and when these had proved its value others followed their example. In addition, the manufacturers of cultivators used this testimony in selling their implements and thus became an important factor in extending their use. The cultivator as compared with the turning plow not only saves labor but is also more efficient in the eradication of weeds, especially in rainy seasons. The work of the station has also been the greatest factor in reducing the width of the cane rows, and at present very few planters are still using the 7-foot rows, while practically none are using 7½-foot rows.

Among the new varieties of sugar cane introduced by this station, seedling canes D. 74 and D. 95 are giving most promising results. These canes were sent out about nine years ago and have now been so thoroughly tested that some of the planters are at present growing from one-half to two-thirds of their crop of the D. 74. The mill and field tests of this cane during the past few years have established a good record, and if the results continue to be as satisfactory as they have been it is fair to assume that in a few years much the greater proportion, if not the entire crop of the State, will be of D. 74.

FORAGE CROPS.

In the introduction and distribution of forage crops in the different States the experiment stations have been most prominent, and through their work new crops have come into use and the culture of others has been widely extended. A special effort has been made to impress upon every community the value of growing leguminous crops for forage and for soil improvement. Alfalfa, which has received the attention of every station, is fast becoming a staple forage crop throughout the country. In every State containing dry land areas grasses and other forage plants have been tested on such lands, and the species and varieties making the most successful growths have been adopted.

The Wyoming station demonstrated the successful culture of alfalfa in that latitude at altitudes of 6,000 to 7,000 feet above sea level. Four years were devoted to working out the problems of successful alfalfa culture under the prevailing conditions, and the suggestions of the station, closely followed by many farmers, have resulted in the use of the press drill as a sure method of securing proper germination and in a much larger acreage of the crop for hay in the State. Turkestan and an acclimated strain of alfalfa distributed by the North Dakota station are being largely tried by the farmers of that State, and the results secured indicate their more general adoption. In addition to establishing the use of different leguminous forage crops in the crop rotations for the State, the Oregon station has shown that alfalfa can

be grown with reasonable success on either naturally or artificially drained soils of western Oregon, and through cooperative work during the season of 1905 about 100 farmers in that part of the State have been induced to grow the crop for the first time. Through cooperative work started by the Maryland station a few years ago this crop has been introduced into every county of the State. It is successfully grown on many different kinds of soil, the two most important requisites under Maryland conditions being proper drainage and the liberal use of lime. Many of the stations have given more or less attention to the inoculation of soils for alfalfa, and some—as, for instance, the Illinois station—report that alfalfa inoculation has become quite general. The Illinois station also made the discovery that infected sweet-clover soil can be used for inoculating alfalfa fields.

The culture of the Canadian field pea as a feed for lambs by turning them on to the crop without harvesting it was recently introduced into Wyoming by the Wyoming station, and during the year 1905 about 1,000 acres were grown with this object in view. The value of cowpeas has of course long been recognized in Maryland, but the station was the first to demonstrate the practicability of growing this crop in conjunction with corn for silage, and this method is being put into practice on a number of leading dairy farms in the State. The Mississippi station has done good work in the introduction of vetch into the South, and many farmers of Mississippi are now growing this crop for soil restoration and for early pasturage, and also in connection with wheat, oats, rye, or barley for early spring grazing.

Varieties of grasses and grains have been introduced into various parts of Wyoming through the seed distribution carried on by the station, and in certain parts of the State where the ranchmen had no cultivated grasses producing heavy crops of hay, large areas of brome grass have been planted. This grass has also been widely distributed by the Nebraska station and thousands of acres are now grown in that State. In North Dakota many of the details of growing and handling this crop were worked out and established by the State experiment station. Farmers have followed the plan of brome-grass culture outlined by the station, and as a result this grass has already become the principal cultivated grass of half of the State. This station has also been successful in originating a strain of slender wheat grass by selecting native seed grown on the prairies. A hardy variety of Bermuda grass growing on the Oklahoma station grounds was distributed with good results. The grass grown from roots which were sent out instead of seed withstood unfavorable winter weather in localities where the seed-grown grass did not survive.

In demonstrating the value of sorghum and Kafir corn for forage, in cooperation with the Department of Agriculture, the stations in California and the States of the Plains have shown great activity and have been specially successful in establishing these crops in sections

with insufficient rainfall for profitable corn culture. In Kansas, where the station has been a leader in this work, over one-half million acres are now grown annually. The Oklahoma station is now working with the selection of seed of black-capped white Kafir corn for large heads and uniformity in height of stalks, so that the heads may be harvested by machinery, and the results thus far secured are already being put to use in western Oklahoma.

In North Dakota, a State which is out of the corn belt proper, the results of rotation trials, field experiments, corn breeding, and seed distribution by the experiment station have led to the quite general adoption of growing corn for fodder, and similar work has been inaugurated by the Oregon station.

CROP ROTATIONS.

Crop rotations in a country like ours, in which large areas of new lands have come under cultivation during a comparatively short period of time and where the virgin soil yields abundantly of a certain crop, there is a tendency to disregard largely the principles of crop rotation. In the older sections of the country the further advanced depletion of soil fertility brought the attention of the farmer to the necessity of a varied soil management before the experiment stations were established and their study of this important phase of agriculture was begun. Soil-management investigations, in progress in many cases for a series of years, are showing results more definite in their indications as the work is carried on. The general object of rotating crops is the improvement and maintenance of soil fertility and the diversification of agricultural products, but in some of the Eastern States the stations have worked out rotations with a view to securing green forage in succession from spring until fall, and this practice is coming more and more into use among dairymen.

The culture of corn for fodder has been quite generally adopted in North Dakota, partly as a result of rotation trials by the station; and in connection with this work it was also shown that the wheat and flax crops are largely benefited when following corn in the rotation. The Oregon, Idaho, and Montana stations have been very successful in demonstrating the advisability of substituting the culture of leguminous crops in rotation for the pioneer system of growing cereals one year after another. As a result the acreage in leguminous crops has been materially increased during recent years, and the cereals following these crops have given better yields. Before these rotations were begun the farmers practiced fallowing every third year, while under proper rotation a crop is produced every year.

The Georgia station has persistently practiced and advocated a three-year rotation in which small grain, liberally fertilized and followed by a crop of cowpeas for hay, is grown the first year; cotton, highly fer-

tilized, the second year; and corn, with cowpeas as a catch crop, the third year. This rotation is followed by a great many farmers in the State, but it has not become general as yet.

ARID FARMING.

Several years ago the Utah station began a systematic study of arid farming, or agriculture carried on in dry regions without irrigation, and the value of the results secured has been recognized to the extent that the State has established and maintains six experimental arid farms of 40 acres each, upon which the actual work of experimentation and demonstration is under the direction of the experiment station. Although this work is new, notable results have already been obtained, and each one of these farms serves as a demonstration station to the surrounding country, and its influence is favorable to the extension of dry farming on a safe and profitable basis.

COOPERATIVE EXPERIMENT AND DEMONSTRATION WORK.

The foregoing is a brief statement regarding some of the principal lines of field-crop work conducted by the experiment stations and the influence the results obtained, as estimated largely by the station officers themselves, are exerting on the culture of field crops throughout the country. It has been the endeavor to call attention to the fund of agricultural facts which the stations are creating through constant research work and how these facts are of benefit to the people.

The experiment stations are primarily institutions of research, created as such by law, and their duty is really performed when the results of their investigations have been published. The station publications, aggregating about 7,000,000 copies annually, are distributed to those requesting them, and in this way only about 700,000 of the 5,000,000 to 6,000,000 farmers of the country are regularly supplied with information in this form. A further dissemination of station results takes place through the press, and especially through agricultural journals, but not all who read the advices are sufficiently influenced thereby to follow them, and such persons are often more readily reached by the farmers' institutes and other similar agencies. Moreover, many farmers are much more ready to take up a new variety or a new method of culture upon learning by observation than by reading or being told about it, and these must be influenced mainly by being shown how they may benefit themselves. Farmers are often slow in adopting new methods so long as fairly good results may be obtained in the old accustomed ways, and more than mere publications are necessary to induce them to try the newly recommended practice. Cooperative experiments have been a great help to the stations in forcing upon the farmer the advantages to be derived from the application of the new methods. Each experiment is an object lesson and forms a center from which progressive agriculture is sent

onward. In these cooperative tests no new facts are brought out, but they are of value in confirming the results obtained by the station and in getting the farmer to try the method, which is one of the best ways of teaching him.

How cooperation and demonstration popularize experiment station results may best be shown by giving a few illustrations. In 1886, when the Ontario Agricultural and Experimental Union of the Province of Ontario, Canada, began its work, twelve parties made fertilizer and culture tests, and in 1904, 4,050 farmers conducted experimental work on their own farms along 35 different lines of field agriculture, including all the various crops grown in the Province. These data at once point out the great value of the work in distributing the best varieties of farm crops, in bringing into use the best methods of culture, and in creating a desire to solve the problems which every day confront the farmer. In addition to these advantages, the farmer remains in close contact with the experiment station, and the influence of the institution is therefore more effective. Similar organizations have been formed recently in California, Illinois, Iowa, Kansas, Nebraska, New York, Ohio, Texas, and Wisconsin. As our agricultural colleges are getting older the number of farmers who have followed either the long or the short courses is fast increasing, and this association movement is an inducement to continue the study begun at the college, applying its principles in practice, and to keep in touch with the institution naturally advocating the application of methods tested and in some instances devised by the experiment station.

The Minnesota station inaugurated in a most efficient manner the introduction of a certain line of cooperative experiments in crop rotations throughout the State by inducing the students of the Minnesota Agricultural High School to plan the reorganization of their home farms and to project crop rotations for ten years ahead. As these principles are studied and applied by the students the difficulties of reorganizing a farm which has never been brought under a rotation, or of changing from one good cropping system to another, practically disappear, and many facts not now obtainable are brought out and serve as a guide for all future rotation work.

In Wisconsin the experiment association is composed of 700 students of the College of Agriculture conducting cooperative tests under the direction of the experiment station, and in Ohio over 1,000 farmers have taken up similar work.

There is urgent need of extending demonstration work in order that experiment station recommendations may be more generally and more uniformly applied, and it is encouraging to observe that, while the National funds given to the stations are being applied more strictly to research work, the States are providing more largely for the demonstration of the results through the stations, agricultural colleges, experiment associations, and other agencies.

THE RELATION OF IRRIGATION TO DRY FARMING.

By Elwood Mead,
Chief of Irrigation and Drainage Investigations.

A GREAT SEMIARID STRIP.

Between the line of 20 inches average annual rainfall and the Rocky Mountains there is a strip of land reaching from Canada to the Gulf of Mexico, embracing about 300,000,000 acres, which for agriculture is debatable ground. This semiarid belt and other separated semiarid areas farther west are shown in figure 93.[a] Together they present one of the greatest problems of American agriculture. The area is great, the soil is deep and exceedingly fertile, and the climate healthful and agreeable aside from lack of moisture. Men need it for homes. All interests are eager to see these areas settled, provided the settlers can be self-supporting, or to avert this if settlement is to mean disaster. From all classes come the questions: What methods will make the most of these lands? How can they be made to support the largest number of people and give them the greatest measure of human comfort?

There is a variety of causes tempting men to plow up the native sod. The stockman realizes the need of a reserve food supply and seeks to provide it by growing Kafir corn, sorghum, rye, hay, and other drought-resistant forage crops. The eastern farmer finds these broad, rolling plains, with their fertile soil and freedom from rocks or stumps, attractive. Hopeful, enterprising men are prone to believe that settlement and cultivation will change the climate, and a few wet years are almost certain to create a wave of settlement.

EARLY FAILURE AND ITS LESSONS.

The first general attempt of this kind began in 1883. Western Kansas and Nebraska were dotted with farmhouses. Eastern Colorado was largely settled up between 1886 and 1889. A few wet years, in which fine crops were grown, were followed by a succession of dry seasons. On millions of acres crops shriveled and died, men lost hope and energy through repeated bitter failures, and women and children endured dreary years of poverty and hardship. Homes which represented the savings of a lifetime had to be abandoned. Whole counties were almost depopulated. What had been thriving towns were deserted.

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[a] Taken from Chart 1, Part VII, Annual Report of Weather Bureau, 1896–97.

The bitter lessons of this failure lasted for years, but its scars at length healed. Other influences were meanwhile at work to restore confidence in ability to farm this region. As a result, another wave of settlement is sweeping over these plains. Other settlers are buying the abandoned farms. Deserted towns are being rebuilt and new ones laid out. This latest attempt is not, however, a repetition of the first. New methods are being tried. Much has been learned in the past twenty years. Practically every settler who has remained in the semiarid belt has been an experimenter in developing a kind of agri-

FIG. 93.—Map showing annual rainfall west of the ninety-fifth meridian.

culture suited to this climate. The Department of Agriculture has searched the world for drought-resistant crops, and it and the State experiment stations have conducted extended experiments to determine their value in this country. Independent investigators, like Robert Gauss, of Denver, have been working many years to adapt old varieties to semiarid conditions. Tools have been invented for cultivating the soil so as to check evaporation, and investigations are now being made to perfect these tools and methods. To this combination of special tools, special methods of cultivation, and drought-resistant

crops as means of overcoming drought has been given the name "dry farming."

The successful working out of agricultural methods adapted to the semiarid region will open up to permanent settlement hundreds of millions of acres of land which under ordinary methods of cultivation could be used for pasturage only.

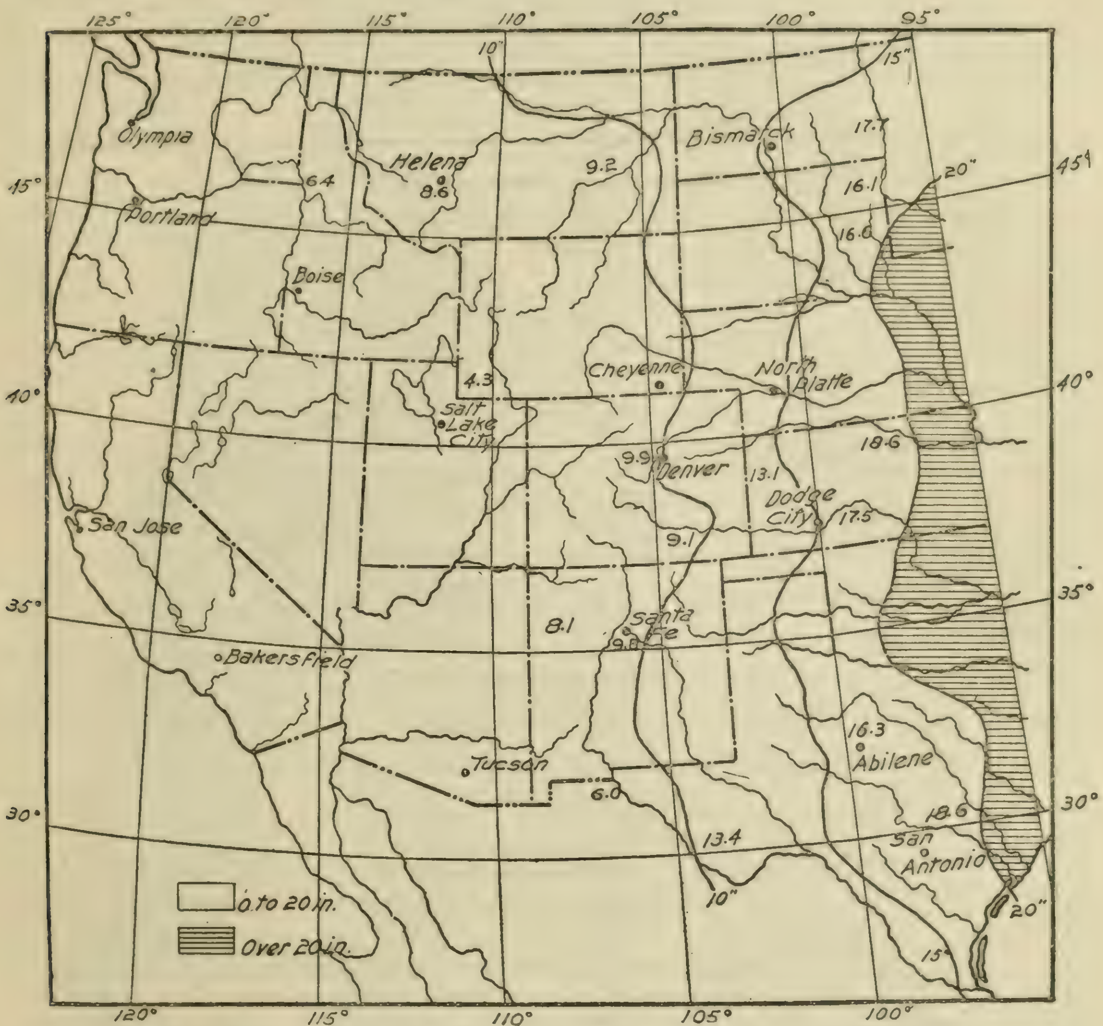

FIG. 94.—Annual rainfall, April to September, west of the ninety-fifth meridian.

THE HAZARDS OF DRY FARMING.

The agricultural problems of the semiarid region relate to heat and moisture. There is no lack of fertility. The average rainfall, which varies from 20 inches on the eastern margin of the semiarid district to 10 inches on the western, is not simply scanty, it is irregular. Figure 94 shows the normal rainfall from April to September west of the ninety-fifth meridian, and figure 95 shows the least rainfall for the same section from April to December. There are years when the average is almost cut in two, and there are months without a cloud and days, especially in the Southwest, when the winds are like a blast from a

furnace—so hot and dry that they change green fields of corn into dry and rattling stalks in twenty-four hours.

In order to show the wide variation in annual and monthly rainfall a set of diagrams has been made from the rainfall records of the Weather Bureau for a number of points along the eastern or humid border of the debatable ground. A study of these diagrams (figs. 96–100) shows that at every place there were at least two dry years in the ten years covered and many months when there was less than 1 inch of rainfall. The failure of one crop in five years would not

FIG. 95.—Least recorded rainfall, April to September, west of the ninety-fifth meridian.

render dry farming unprofitable, but the killing of all trees every five years or the destruction of vines and perennial crops like alfalfa would take from the dry farm many of its attractions and greatly reduce the range and value of its products.

In order to lessen the losses in dry years and to extend farming beyond the point where the rainfall of a single year is sufficient to grow crops, summer fallowing is employed. The ground is plowed, pulverized, and kept free from crops or weeds, the main purpose being to lessen evaporation and save the moisture falling on the soil from one

year to the next. Thus when a crop is planted on this land the following year, two seasons' rainfall is utilized to grow one crop. Special tools and methods of cultivation have been devised to lessen the losses by evaporation from the summer-fallowed fields and remarkable results have been achieved, but a summer-fallowing will answer for annual

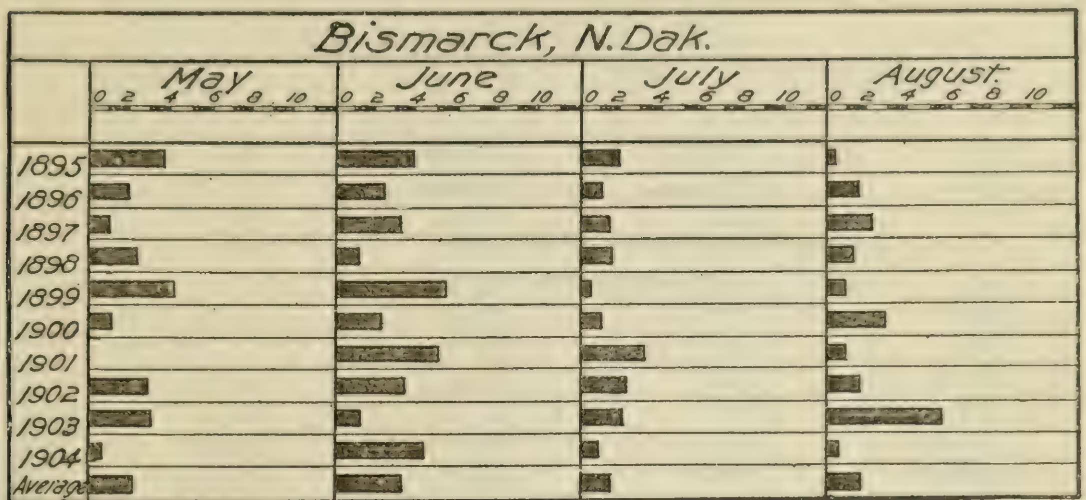

FIG. 96.—Monthly rainfall, in inches, for the growing season, at Bismarck, N. Dak., showing the occurrence of months with deficient rainfall.

crops only. It will serve to grow wheat and many of the drought-resistant crops that are now a feature of the dry farm, but will not answer for trees, and in many cases it will not answer for alfalfa. Trees, small fruits, or alfalfa can not be moved each year from the summer-fallowed to the nonsummer-fallowed field. For these the

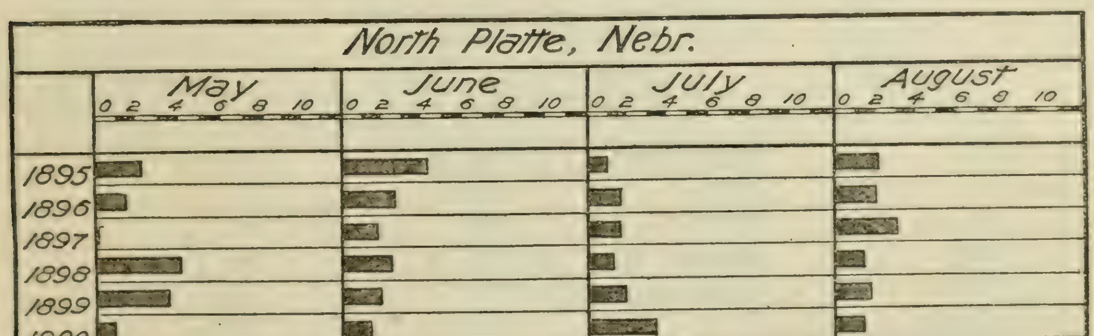

FIG. 97.—Monthly rainfall, in inches, for the growing season, at North Platte, Nebr., showing the occurrence of months of deficient rainfall.

dry farm provides no method of tiding over the seasons when a dry winter is followed by a dry spring and when the soil moisture falls below the needs of plant life. If these are to be features of the dry farm, the additional water supply which is necessary to maintain continuous growth must be furnished by irrigation. Nor do the most

sanguine expectations of the effectiveness of dry-farming methods justify belief in immunity from drought, even with the best methods or safest crops. The studies of soil moisture made at the State experiment stations of California, Kansas, Utah, South Dakota, and Oklahoma all show that plants need more water in a dry atmosphere than

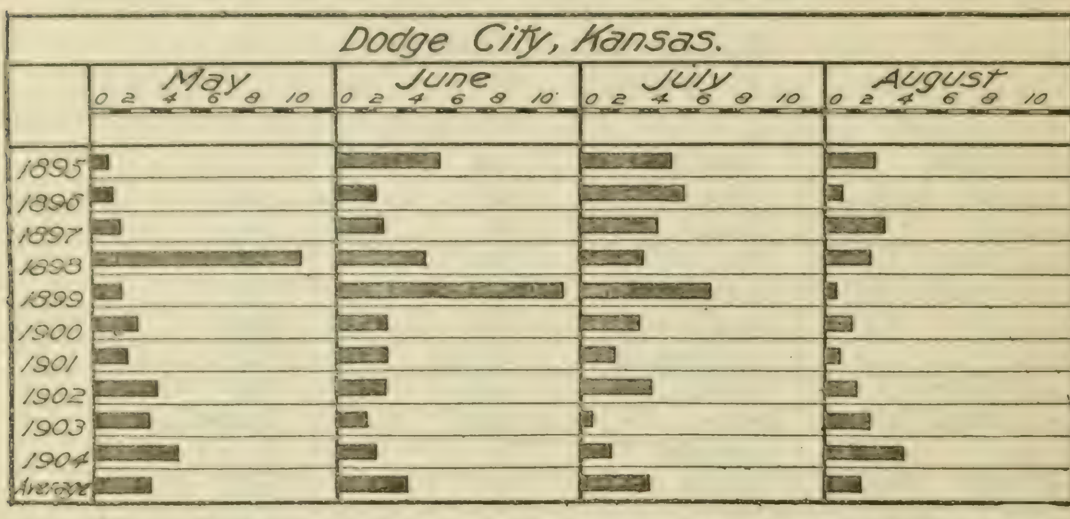

FIG. 98.—Monthly rainfall, in inches, for the growing season, at Dodge City, Kans., showing the occurrence of months of deficient rainfall.

in a humid one—325 to 550 pounds of water will produce a pound of dry matter in the humid atmosphere of Wisconsin; an average of 750 pounds of water is required to produce the same results in the arid climate of Utah.[a] These amounts do not represent the total moisture needed to keep crops growing. The roots of plants do not reach all

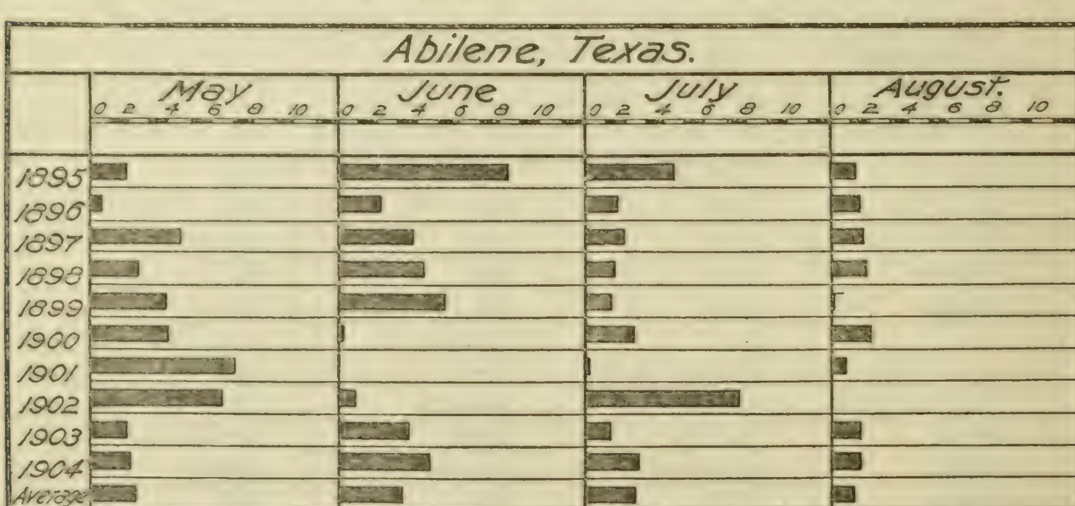

FIG. 99.—Monthly rainfall, in inches, for the growing season, at Abilene, Tex., showing the occurrence of months of deficient rainfall.

parts of the soil. Much water is lost by evaporation, the amount of this loss being greatly influenced by the heat and humidity of the air and the velocity of the wind. In the hot, dry climate of the Hawaiian Islands 285 to 450 pounds of water is required to grow 1 pound of

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[a] Bulletin 91, Utah Experiment Station.

sugar cane, while in Utah, under irrigation, over 4,000 pounds of water has been absorbed by the crops and the air in growing 1 pound of wheat.

For a number of years the State Agricultural College of Colorado made a systematic and continuous study of the efforts to grow crops without irrigation in the eastern part of that State. The results are summarized in bulletins 59 and 77 of that station. In these Mr. J. E. Payne, the observer, shows that there were years of large yields and large profits from small grain, and other years when failure was complete; that all attempts on adobe soils were failures; that alfalfa on the dry farm can not endure the drain on its vitality. It flourishes in wet years, but makes little growth in dry seasons, and the plants continue to die until practically all disappear. Of thousands of orchards planted only a few trees have lived. Fruit growing without irrigation has not proved successful. Orchards may grow well for years, but an

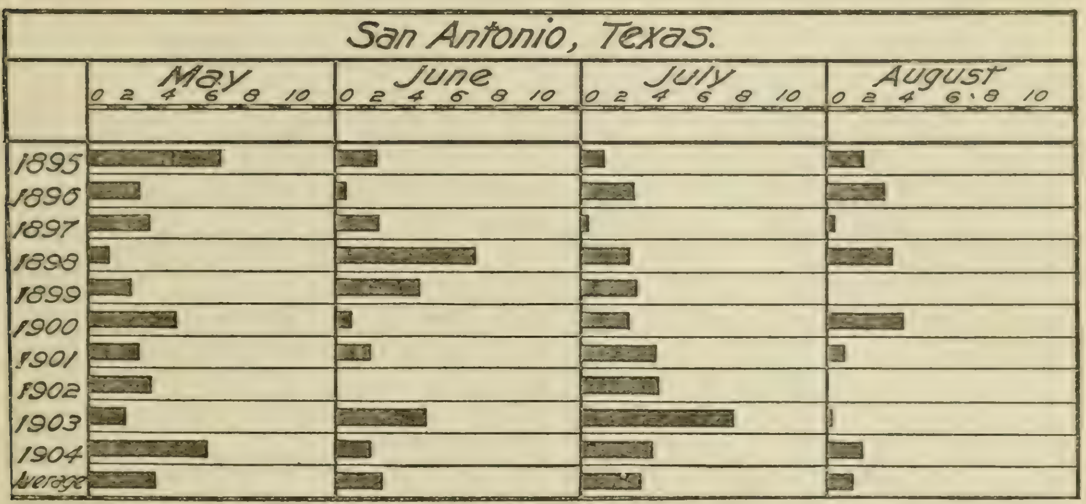

FIG. 100.—Monthly rainfall, in inches, for the growing season, at San Antonio, Tex., showing the occurrence of months of deficient rainfall.

unusually severe drought kills them. The same is true of attempts to grow shade trees. The failure of the timber-culture law is too generally admitted to require discussion. Even where the trees survive they are stunted and ill-shaped. As a result nearly all settlers have been compelled to combine stock raising with farming, depending on the native grasses for summer pasturage and growing forage for winter feeding. In good years they grow abundant crops of wheat and small grain; in poor ones, only forage.

From 1883 to 1888 the writer was a resident of Colorado and often visited the sections where dry farming was being tried. From 1888 to 1898, inclusive, he was a resident of Wyoming, and as State engineer was in official and sympathetic relations with the men farming by rainfall alone in the eastern part of the State. During these years hundreds of dry farms were visited and an intimate knowledge reached of the hard conditions of home life which the vicissitudes of the dry

farm impose on the farmer's wife and family. Since 1898 the progress of agriculture in the western half of this region has been carefully watched in connection with studies of the economical use of water in irrigation. In that time dry farming in certain areas has become a demonstrated success. Among these may be mentioned the divide country south of Denver, Colo.; the high bench lands near Newcastle, Wyo., and the slopes of the mountain foothills along the Big Horn and Rocky Mountains in Utah, Idaho, and Montana, as well as the States first named, where seepage from the higher lands above or local summer rains bring about a sensible increase in the average amount of moisture in the soil. There is no doubt that other areas will be discovered where dry farms will be successful. It is also believed that through summer fallowing drought-resistant crops can be grown alternate years with a fair degree of success over those portions of the semiarid region where the soil is sandy or a sandy loam, but not in the clay or adobe soils.

But when all this has been said the fact must be recognized that the dry farm taken alone has not the attraction or the security of farming under irrigation, or of farming in Iowa and Illinois, where the rainfall is ample. Nothing can be more dreary or discouraging than the aspect of the dry farmer's home in midsummer. Without shade trees, without green grass, without fruit, the dead, dusty, and lifeless appearance of the landscape is monotonous beyond measure. It makes one realize that "a world without turf is, indeed, a desert." The fact that many of these farmers are prosperous does not remove the need for trees, fruit, grass, and gardens, nor lessen the value of these features of a home as seen on irrigated farms in the same region. The dry farm needs enough irrigation to provide these things. It needs it for the comfort of the family. It needs it for the opportunities it will give to make a living in dry years, as well as larger profits in wet ones, and it is only by supplemental irrigation that the limits of settlement can be pushed westward across the driest part of the semiarid belt. The present situation requires that the chances of failure be clearly faced, and it is the writer's conviction that there are hundreds of settlers in the western half of the semiarid belt who must supplement the dry farm by irrigation; and unless they do, the next period of drought will witness a greater exodus and more hardship and privation than the first.

It is one thing to recognize the advantages of irrigation; another to provide for it. It is believed, however, that it is possible to control enough water to irrigate from 1 to 10 acres of land on each of thousands of farms where complete irrigation is not possible, and that this can be done by one of the three following plans: (1) Pumping from soil water or underground streams; (2) storage in small surface reservoirs of storm waters or the irregular flow of streams; (3) irrigation with flood water whenever it can be had, usually in the winter and spring, generally spoken of as winter irrigation.

PUMPING FOR IRRIGATION.

Where an ample supply of underground water can be reached at depths of 100 feet or less in the North and 200 feet or less in the South the farmer can afford to pump water for irrigation. Enough is already known to make it sure that thousands of farmers can have such supplemental water supply at lifts of 10 to 50 feet. A large percentage of the water which flows from the mountains or in plains streams sinks in the sands.

That underground water supplies can be utilized for the irrigation of large areas and that they are destined to be so utilized is foreshadowed by the experience of India, where 13,000,000 acres of land, or more than is irrigated in the United States, are irrigated from wells. The recent report of the famine commission of India says that during the years of drought the greatest saving of life from starvation was made in the districts irrigated from underground supplies. They recommend, therefore, the fullest possible extension of irrigation by pumping in every famine district in India.

The recent developments of irrigation by pumping in the United States are significant of what is to come. There are 200,000 acres irrigated from wells in California, the lift in many instances being over 200 feet. Including rice irrigation, about 750,000 acres of land are now irrigated in the United States by means of pumps. In the arid region the greatest development of pumping is where the water supplies are ample, and the experience there will not serve for the semiarid district where the limited underground supplies must restrict both the capacity of the pump and the kind of power used. In India the average area irrigated from a well is less than an acre. In this country we are likely to be equally restricted. For the lifting of small quantities of water the windmill has many advantages, and with improvements in construction calculated to give it greater strength and endurance the windmill promises to have a great development as a power agent. Gasoline and steam engines for large areas are more satisfactory, but the places where there is enough water in the soil to make the operation of a gasoline engine profitable are limited in number and extent, and those where steam can be used still more so.

What the windmill can be made to do in providing the dry farm with an orchard, a garden, and trees for shade and wind-breaks is illustrated at Garden City, Kans. Records were obtained by the Office of Experiment Stations in 1904 of the performance of 72 windmills. These irrigate from a quarter of an acre to 7 acres each, at a cost of 75 cents to $6 an acre. The crops were worth $12 to $500 an acre, and included alfalfa, garden vegetables, fruit trees, sugar beets, corn, cane, and sweet potatoes.[a] In the last ten years there has not been a single crop failure where the windmill provided moisture; there were

[a] Office of Experiment Stations Bulletin 158, Separate No. 8.

several years when the failure on adjoining dry farms was complete. In that region there is not a single fruit tree growing on unirrigated land, the lands watered by the windmills being oases in a desert so far as fruits and foliage are concerned. This does not mean that dry farming has proven unprofitable, but that it is unattractive and less profitable than it would be with irrigation. Plate XLVIII, figure 1, shows the method of providing a supplemental water supply for 5 acres near Cheyenne, Wyo.

Willows, Cal., is situated above existing ditches and is the center of a large district devoted almost entirely to growing wheat. The yield of wheat has been falling off for years and the average the present season (1905) was less than 15 bushels per acre. Recently small areas on dry farms have been brought under irrigation from wells. The following is a report of Mr. B. F. Calvert of the sales of products from 1 acre of land irrigated by means of a 2-horsepower gasoline engine:

Watermelons	$300
Strawberries	200
Blackberries	250
Logan berries	200
Tomatoes	150
Cabbage	100
Total	1,200

The cost of fuel for the gasoline engine was 50 cents a day. Irrigation began the 1st of June and continued to September.

California is not, however, a fair illustration of the average possibilities of irrigation, but the value of the products of small irrigated areas in other parts of the district we are considering is surprisingly large. At San Antonio, Tex., land irrigated from wells rents for $25 an acre, and the renter pays the cost of pumping. Many of these areas planted in sweet potatoes bring returns of $100 to $200 a year per acre. At Wenatchee, Wash., an acre of apple trees yielded, in 1901, 1,000 boxes, which sold for $1.75 to $2.25 a box. One-sixth of an acre of sweet potatoes yielded 35 sacks of 100 pounds each, which sold for $3 per sack, or at the rate of $630 per acre.

In the past three years a large number of pumps have been put in to irrigate portions of dry farms in eastern Colorado.[a] One of these pumps irrigated 50 acres this year (1905)—20 acres for the four men who own it and 30 acres for others, the charge to the others being 75 cents an hour for water and use of pump, provided it shall run continuously for at least one day. Of this 75 cents, 10 cents represents profit and 65 cents interest on investment, cost of running, and deterioration and assuring life of plant for five years. One of the owners starts the engine in the morning, and after getting speed regulated lets it run

[a] See Office of Experiment Stations Bulletin 158, Report of Irrigation and Drainage Investigations for 1904, pp. 595–608.

itself, visiting it only every two or three hours for oiling, etc. The crops grown on this land were as follows:

Crops on 50 acres irrigated by means of a single pump in 1905.

Crop.	Area.	Weight.	Value.
	Acres.		
Potatoes	20	3,680 cwt	$2,576
Beets	25	375 tons	1,875
Young orchard	5	No yield	
Total	50		4,451
Average for 45 acres			98.91

SMALL RESERVOIRS.

Next to the well comes the small surface reservoir, storing storm water as a means of irrigating a few acres of the dry farm. To irrigate land in the southern half of the semiarid region will, on an average, require 3 acre-feet of water for each acre, and 5 acres would require the storage of 15 acre-feet for irrigation and an additional amount for losses by seepage and evaporation. Estimating that half the water is so lost, a reservoir covering 5 acres and having an average depth of 6 feet, or covering 3 acres to an average depth of 10 feet, will provide for the irrigation of 5 acres of land. Plate XLVIII, figure 2, shows such a reservoir and the simple character of its construction. The Chicago and Northwestern Railway built 32 of these as watering places for range cattle along the line of its road in Wyoming and South Dakota.

One reservoir of this character, built in 1897, covers 15 acres and holds, when full, 100 acre-feet. It irrigated this year (1905) 80 acres of land, which produced the following crops:

Crops on 80 acres irrigated from a 15-acre reservoir.

Crop.	Area.	Yield.	Value.
	Acres.		
Alfalfa hay	20	30 tons	$150
Wild hay	54	60 tons	600
Wheat hay	2	10 tons	100
Oats hay	2.5	7 tons	84
Potatoes[a]	1	51 sacks	41
Garden truck	.5		100
Total	80		1,075

[a] Also 25 sacks small potatoes used for feeding hogs.

This reservoir is west of Cheyenne, Wyo., and is over 6,000 feet above sea level, where only the hardiest crops can be grown. It alone would insure a good income for a family.

The entire cost of the reservoir was $1,500, from which it is easily seen that it has paid for itself many times over during its existence.

WINTER AND SPRING IRRIGATION.

There are hundreds of water courses which are dry nearly all the year, but which carry large quantities of water in spring and after heavy rains. If this water should be diverted and allowed to soak into the subsoil, it would serve the same purpose as summer fallowing, with the added advantage of the production of a crop every year. This kind of irrigation is commonly designated as winter irrigation because the most land can be watered then, but it is here intended to include irrigation whenever water can be had.

The value of winter irrigation has been demonstrated in Arizona. Farmers in Salt River Valley provide against shortage of water in midsummer by filling the subsoil with water in the winter and spring. This reserve of moisture, while not as effective as abundant irrigation at the right time, brings yields and profits equal to those of many humid sections of the East.

Winter irrigation is assuming large importance in California. It is now recognized that wheat farming in that State must give way to rotation of crops. This can be accomplished in many sections by winter irrigation where it is not possible without, and where water for summer irrigation can not be had. Figure 101 shows how little summer rain occurs at Bakersfield, Cal. Yet even here soil thoroughly saturated in the winter will grow alfalfa and support trees.

For many years farming without irrigation was the prevailing practice in the Santa Clara Valley in California, but as fruit trees grew older the lack of rain in summer became a more and more severe drain on their vitality. While the average rainfall of this section is 16 inches, an average of 10.9 inches of this falls from December to March. Figure 102 shows how small and irregular is the rainfall in summer. Many vineyards which flourished when the vines were young weakened and died as they grew older. Irrigation, at first unpopular, began to be practiced and the practice of filling the subsoil in winter, making it a covered reservoir, has had large development.

The winter flow of the creeks in the valley, which possessed little if any value ten or twelve years ago, being then permitted to flow unused to the bay, is now eagerly sought for and is yearly increasing in value. Of late years a large number of new ditches have been dug and existing gravity plants extended, so that now almost the entire winter flow of these various creeks is utilized.[a]

Winter irrigation has also proved a boon to the Salinas Valley in California, where several thousand acres are treated in this manner.

[a] U. S. Dept. Agr., Office of Experiment Stations Bulletin 158.

The Salinas River is a typical stream of the Coast Range Mountains, and for two-thirds of its course through the Salinas Valley is dry for nine months of the year and a raging torrent for the other three months, which for the most part is the period of irrigation. These three months lie usually between November and February.

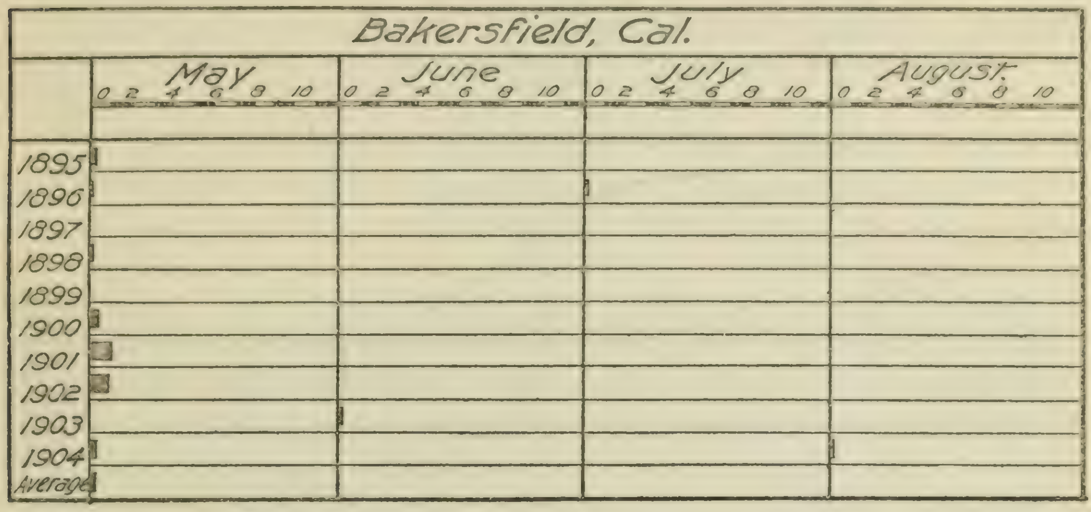

FIG. 101.—Monthly rainfall at Bakersfield, Cal., in inches.

The lands in this valley contribute a large share of the sugar beets for the largest beet-sugar factory in the world, at Spreckles (capacity, 3,000 tons of beets per day).

The method used is as follows: First, the land is prepared to receive the water by means of temporary checks running first at right angles

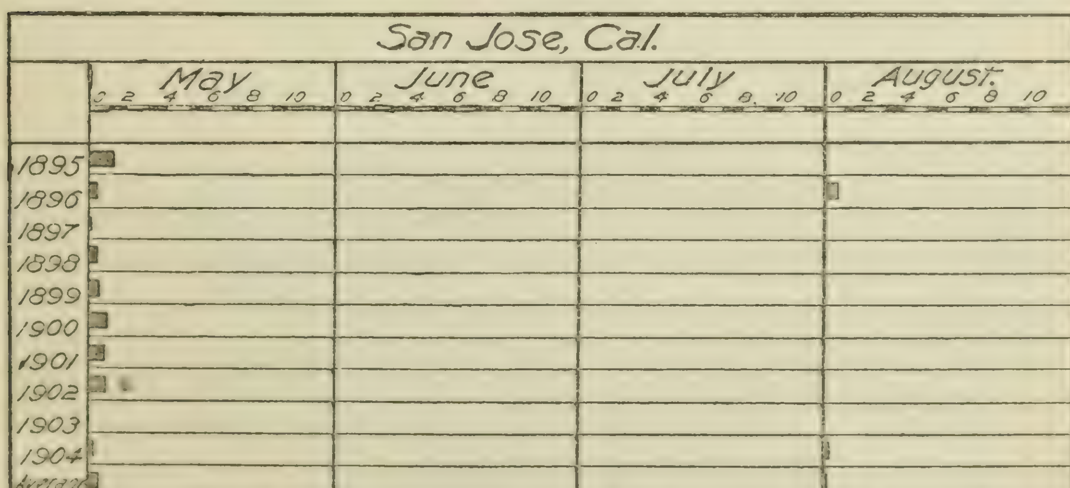

FIG. 102.—Monthly rainfall at San Jose, Cal., in inches.

to the contours and then following same, thereby cutting the land into approximate rectangles 25 feet square. These checks are made with a plow whose moldboard is unusually high, with which two furrows are plowed in opposite directions. After the land has been so checked

and during the flood stage of the river the land is thoroughly soaked. Then, as soon thereafter as the condition of the land will permit, the temporary checks are plowed out and the entire tract of land plowed to a depth of about 12 inches, after which the sugar-beet seeds are planted, usually in February or March. From this time until the crop is harvested no further water is received from irrigation and very little from rain. The soil is constantly cultivated during the growing season. The average yield is 10 to 15 tons per acre. The same course is pursued for raising wheat, barley, potatoes, and beans. The price paid to water companies for this irrigation is $1.50 per acre.

Another district where winter irrigation has had an extended test is in the valley of Butter Creek, Oregon. During the months of January, February, and March the flood flow of this creek is spread over the land, thoroughly saturating the soil to a depth of 8 to 30 feet. During this irrigation from 6 to 8 acre-feet of water is applied to each acre of land. This early application of water is all the land receives during the year. The annual rainfall is only about 10 inches. Crops are grown almost entirely from the water stored in the soil by the winter irrigation. The usual practice is to harvest three crops of alfalfa, and the average annual yield is 7 tons per acre. In addition to the alfalfa, there are a number of orchards which produce abundantly. Apples, peaches, apricots, pears, and prunes attain fine development. The trees surrounding the house shown in Plate XLIX, figure 1, were grown entirely by winter irrigation.

On the farm of O. F. Thompson, 350 acres are cultivated by winter irrigation. One field of alfalfa was seeded twenty-five years ago and, although too old to be in best bearing, it yields good crops of hay. Some of the apple trees were planted in 1861 and are still in a thrifty, healthy condition. The pear orchard shown in Plate XLIX, figure 2, is 25 years old and produces a fine quality of fruit each year, provided it receives an adequate irrigation in the spring.

The irrigation occurs whenever the creek carries water. Alfalfa is usually irrigated in February or March, sometimes as late as April. The orchard is irrigated as late as possible, usually in March or April. The ordinary methods of irrigation are applied. Water is kept flowing on the land for a period of eight to ten days, or until the soil will absorb no more. In average years alfalfa yields two good crops and pasturage for two or three months. The yield of hay is 5 to 7 tons per acre, which at current prices brings a return of $30 to $40 an acre. The pasturage is worth $1.50 an acre.

CONCLUSIONS.

Leaving out of account fruit-growing sections like the Santa Clara Valley in California, the foundation of the dry farm should be mixed husbandry in which stock raising is the leading feature. Many of the

FIG. 1.—WINDMILL IN USE AT CHEYENNE, WYO., AT STATION FOR EXPERIMENTING WITH IRRIGATION AS A SUPPLEMENT TO DRY FARMING.

FIG. 2.—RESERVOIR IN USE NEAR CHEYENNE, WYO.

FIG. 1.—FARM HOME IN EASTERN OREGON, SHOWING TREES GROWN BY WINTER IRRIGATION ONLY.

FIG. 2.—PEAR ORCHARD 25 YEARS OLD, RAISED BY WINTER IRRIGATION.

FIG. 1.—FARM HOME IN EASTERN OREGON, SHOWING TREES GROWN BY WINTER IRRIGATION ONLY.

FIG. 2.—PEAR ORCHARD 25 YEARS OLD, RAISED BY WINTER IRRIGATION.

drought-resistant crops are for forage. The experience of the Sacramento Valley has demonstrated that grain can not be grown continuously. There must be some provision for restoring fertility to the soil. Furthermore, many of these farms will always be remote from markets, and live stock can be shipped to better advantage than grain or hay. Poultry is one of the most profitable products of the western farm, and chickens and turkeys will pay as well in dry years as in wet ones.

The dry farm should have a larger acreage than either the irrigated or humid farm. There should be land enough to provide summer pasturage for stock, and, as it takes from 10 to 100 acres of native grass to support an animal, this summer pasture must of itself be larger than the cultivated farm in many sections. With live stock as a foundation and with alfalfa, vegetables, and fruit grown by irrigation, the dry-farmed portion will insure large crops in wet years and render the farmer largely immune from losses in years of drought.

The dry farm must have a relatively large area if irrigation is to be a feature. The reservoir near Cheyenne, Wyo. (Pl. XLVIII, fig. 2), draws the water from six sections of land. The wells used in the irrigation of the tracts reported on would not continue to furnish adequate water for these areas if an attempt should be made to irrigate all the land in that vicinity, but they will maintain it perpetually if these wells are widely separated.

It is believed that there are few localities in the arid region where enough water can not be had for the irrigation of 1 to 10 acres on each section. It is remarkable how much can be done with a little water where rightly used.

The irrigation of 1 acre on a dry farm will make it possible to grow a wind-break of trees around the farmer's house and barns, which will serve as a shade in summer and one of the best of protections against winds and storms in winter. No range stockman needs argument to convince him of the value of these wind-breaks, and everyone who has seen the shimmering waves of heat which rise from these gray and dusty plains in summer appreciates the value of shade and foliage in midsummer. It will insure a green lawn for the house, the growing of a wide range of fruits, and a still larger list of the best vegetables which can be produced anywhere. This will do one of two things for the farmer: It will save him from an excessive bill for canned goods or from living on a monotonous diet. If 5 acres of land are irrigated and 1 given to trees, orchards, and garden, 4 will be left for field crops. Planted to alfalfa this will produce 15 to 20 tons of hay—enough to support the farmer's milch cows and work horses. What can be done in the irrigation of 4 acres under intensive cultivation is shown by the returns of pumping plants. That much land will support a farmer in dry years if he grows nothing on the rest of his farm.

These returns are not exceptional. They are a few of many similar ones gathered by the engineers of the Office of Experiment Stations in all parts of the semiarid region.

In considering the relation of irrigation to the dry farm we have thus far dealt only with its value in the complete irrigation of a small part of the farm, but this alone leaves out of account a kind of irrigation which is possible wherever a storage reservoir can be built and water held for emergency use on the dry-farmed fields. Everyone familiar with irrigation knows what can be accomplished by a little stored water to be applied in times of excessive drought. It often happens that a single and scanty irrigation will result in an abundant yield, where there would otherwise be a complete failure. The experiment station at Stillwater, Okla., is building a reservoir for this kind of emergency use. The station is carrying on experiments in the breeding of drought-resistant varieties of corn. It always has to face the possibility of a year of such excessive drought that without a supplemental water supply the entire crop might be killed. The reservoir which is being built will not be used unless necessity arises to save the crop, but it will always be on hand for that purpose. Supplemental irrigation is the insurance of the dry farm, whether the water is confined to intensive cultivation of a small tract or used in emergencies on larger areas. Used in either way, its value is so great that farmers need only an understanding of methods to secure its general adoption.

The Office of Experiment Stations is now studying two phases of this question: (1) Cost and methods of providing a water supply, and (2) the tools and methods for the distribution of the water and the cultivation of the soil to secure its economical use. Bulletins giving practical advice along these lines will be published from time to time as experiments and investigations bring definite results.

NEW OPPORTUNITIES IN SUBTROPICAL FRUIT GROWING.

By P. H. Rolfs,

Pathologist in Charge of the Subtropical Laboratory, Bureau of Plant Industry.[a]

INTRODUCTION.

Agricultural problems in the Tropics and Subtropics until recently have been confined principally to products which will not deteriorate by being carried long distances in slow sailing vessels. The chief productions hitherto have been rubber, tobacco, fibers, and similar materials. The principal reason for this has been that ocean transportation has been slow and irregular. With the advent of new steamship lines and better railway facilities, together with an increased demand for food supplies, it has become possible to transport quickly and without loss large quantities of such perishable products as fruits.

The possibility of making the production of fruits a thorough financial success has been sufficiently tested to make it no longer open to question. Business men of means are now planting orchards as rapidly as the necessary nursery stock can be supplied. For persons of smaller capital there is a most excellent opening in growing the plants to supply such stock. The demand is considerably in advance of the supply, especially for grafted and budded trees. The difficulties in the way of providing this line of nursery stock are somewhat greater than in the case of citrus and deciduous fruit trees, but the selling price is from six to ten times as great, and the margin of profit is much greater. The direct personal attention of a most capable worker is, however, required.

AVOCADO.

The avocado, known by many names in the various tropical countries of America, is a salad fruit, occupying a place more nearly comparable with the olive than any other fruit. In the markets of the United States it is sometimes called "avocado pear" and "alligator pear," but the name "avocado" is now more generally used than either of the others. There is no good reason for continuing such a barbarism of language as "alligator pear," since the term "avocado"

[a] Since this paper was prepared Mr. Rolfs has become the Director of the Florida Agricultural Experiment Station at Lake City, Fla.

is sufficiently distinctive, and the word "pear" is altogether a misnomer. Mr. G. N. Collins,[a] in his paper on this fruit, shows that no less than 43 common names are applied to it, though it is almost unknown outside of the American Tropics. This speaks volumes for its popularity.

Chemical analysis brings out the fact that the ripe fruit contains from 10 to 15 per cent of fat, clearly indicating its value as a food. As a breakfast food it is of superior excellence. Adding pepper and salt as condiments and a teaspoonful of lime juice makes it a dish to please an epicure. However much it may fail to please on first trial, one is almost certain to become extravagantly fond of it if he continues to live in the Tropics. It is, indeed, the rare exception to find a person living in the section where good ripe fruit may be obtained in quantity who is not extremely fond of the avocado. Fruits picked green and ripened in a crate are as far from the real thing as are green tomatoes from ripe ones. Then, too, there are as great varietal variations as in other cultivated fruits. The tree is easily budded and readily transplanted,[b] so there is no need of planting and growing seedling orchards. A variety lately imported from Mexico by the Bureau of Plant Industry has passed through a freeze of 15.5° F. with a loss of only the smaller limbs. This hardiness greatly increases the possibilities of extending the range of this fruit.

USES OF THE FRUIT.

The most primitive way of using the avocado is to cut it into halves, remove the seed, and dip out the meat with a teaspoon; it should cut readily, and yet should come out neither oily nor mushy. A rancid avocado is simply nauseating, and a green one not edible. The addition of salt and pepper in no wise detracts from its flavor, and the novice may prefer to add a teaspoonful of lime juice, lemon juice, or vinegar to give it piquancy. A very small quantity of sugar may be used to reduce the sharpness of the acid. Mayonnaise, or even oil, is sometimes added, but this would seem entirely superfluous, since the fruit already contains so large a percentage of fatty matter. People accustomed to the use of sugar and cream with fruits sometimes add these. In hotels and restaurants the avocado is often cut into small cubes or thin slices and served in small dishes. This is done to economize the fruit, as a single avocado will fill six such dishes, while if served in the "half shell" it would suffice for only two people. The dressing or condiments used when sliced are the same as when served in the half shell. The ripe fruit, cut into cubes a half or a third of an

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[a] The Avocado, a Salad Fruit from the Tropics, Bul. 77, Bureau of Plant Industry, U. S. Dept. of Agriculture, 1905.

[b] Rolfs, P. H., The Avocado in Florida, Bul. 61, Bureau of Plant Industry, U. S. Dept. of Agriculture, 1904, p. 17.

inch in size, is frequently mixed with minced salads. At times it is added to lobster and shellfish salad, to which it imparts a pleasing nutty flavor. In Mexico and other Central American countries small cubes of avocado are added to soup as it is served. This imparts to the soup an agreeable nutty flavor that is pleasing to the novice.

A mixed sweet pickle made up largely of avocado cubes has been prepared. Thoroughly ripened fruit was chosen and prepared before it had softened, as otherwise it would have become mushy in cooking.

PROPAGATION.

Until very recently the propagation of avocado trees as a commercial enterprise was not undertaken, and the only method employed to extend the culture was to plant the seed where the tree was expected to fruit. Under this method no extensive plantings were made, since the resulting crop proved too variable and uncertain. All species of plants grown from seed are subject to variation. Our principal fruit trees, without exception, must be propagated by asexual means to obtain even an approximately uniform product. It has been asserted frequently that the avocado comes true to seed, and until the growing of it was taken up for commercial purposes this view was generally accepted. In fact, only a few years ago it was generally believed that avocados could not be budded, and it has been but recently demonstrated that budding and grafting are practicable.

Mr. Henry Davis,[a] speaking before the Farmers' Institute of Hawaii, February 4, 1905, said: "I can positively state that I have planted seed from selected fruit, both as to size and quality, and the resulting tree upon bearing produced fruit entirely different from the original." The experience in Florida[b] with seedling avocados is quite the same as in the Hawaiian Islands.

The budded orchard has so many advantages over one consisting of seedlings that it is not at all probable that any grower would plant seeds in order to establish an orchard. A few good varieties can now be obtained in limited quantity from nurserymen. The present high prices indicate a strong demand for the stock rather than a difficulty in the operation of budding. There are now thousands of seedlings that are producing fruit; among these will be found a few of such superior excellence that buds ought to be taken from them for propagation.

BUDDING.

The simplest form, known as shield budding, is the best one to employ for the avocado. This not only proves very successful, but admits of being done most rapidly. The operation is very simple and

[a] Tropical Agriculturist, XXV, 256.

[b] Rolfs, P. H., The Avocado in Florida, Bul. 61, Bureau of Plant Industry, U. S. Dept. of Agriculture, 1904, pp. 21–23.

readily learned. A longitudinal cut is made in the stock 1½ or 2 inches long, followed by a transverse cut either at the upper or lower end of the longitudinal one. This makes a cut shaped like a T or an inverted ⊥ (fig. 104). The blade of the budding knife or the ivory end is then inserted into the longitudinal cut and the bark lifted so as to permit the bud to be slipped into place. A bud on the bud stick (fig. 106) is then chosen. Here care must be exercised not to get a

Fig. 103.—Shield bud cut out preparatory to insertion.

Fig. 104.—Seedling avocado stock with shield bud inserted.

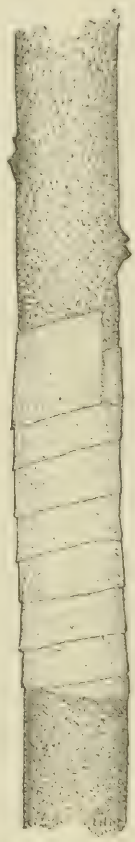

Fig. 105.—Shield bud wrapped with waxed cloth.

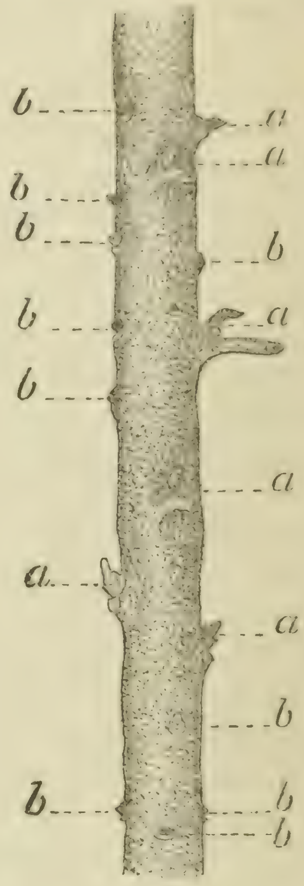

Fig. 106.—Bud stick; *a*, *a*, etc., "live" buds in various stages of development; *b*, *b*, etc., blind buds which should not be used.

"blind" bud (fig. 106, *b b*), but a live one (fig. 106, *a a*, and fig. 103). In cutting a bud the knife should be forced deep enough into the bud stick to cut out a small portion of wood. The bud is then inserted in the most convenient way, either right end up or the reverse. When the bud has been inserted firmly, if a portion should project beyond the crosscut, it can be cut off and the bud fitted into place. The bud may then be wrapped with the waxed tape commonly used in budding or grafting (fig. 105). In a dry climate or during a dry season waxed tape is better than twine or raffia for wrapping, as it prevents the bud from drying out before it has had time to "take." The time required for a bud to "take" depends entirely upon the condition of the stock; if it is growing vigorously, as is usually the case in a nursery, twelve to

twenty days will be sufficient. After the twelfth day a few buds should be examined; if they show a plumpness indicating that they have increased in size, it proves that they have taken. After a little practice, even the novice in the work will be able to judge whether the buds have taken or not.

When the buds have taken, the wrapping should be removed, and a week or two weeks later the stock should be lopped. Here is where considerable difficulty will be experienced, as a vigorous-growing avocado stem will snap off rather than be lopped. If the entire top is taken off it is apt to prove fatal to the bud. Where the stock happens to be very brittle it becomes necessary to resort to ringing; this should be done 2 or more inches above the bud. Where ringing has to be practiced it should be followed by cutting back the growing tips of the stock so as to force the bud along, and any buds of the stock that have been forced into growth as a result of the ringing should be removed.

As soon as the buds have grown to the desired size and the wood has matured, the trees must be taken from the nursery and set out in the places they are to occupy in the orchard. In transplanting, a considerable portion of the top should be cut off; otherwise the amount of evaporation from the leaves will be too great for the plant and the death of the tree will result. The extent to which the top must be cut back will depend upon the proportion of the roots that has been lost in the digging. When the trees have been set out, some kind of shade should be provided to protect them from the direct rays of the sun. This can be most readily accomplished by employing palm leaves, which are easily procured throughout the region where avocados grow.

MARKETING.

At the present time avocados are shipped in tomato crates, eggplant crates, barrels, and even in other kinds of packages; consequently there can be no uniformity in quotations. In the local markets they are sold by the dozen, the prices varying according to size and appearance—the largest ones bringing the highest price. In size they range from a few ounces to 3½ pounds, both extremes being somewhat unusual. Avocados ranging in size from a pound to a pound and a half seem the most desirable to meet the conditions of the grower and the seller. As the bulk of the crop is at present borne by seedlings, there are as many varieties of fruit as there were trees to produce it, which makes grading and sorting according to size impracticable and good packing difficult.

In the matter of ripening there is also great variation. Some trees will mature nearly all their fruit so that the whole crop may be gathered at one time, while others have to be picked over several times, and a few trees extend their ripening period over three months.

EXTENT OF ORCHARDS.

The orchards that are now producing fruit are rarely more than 2 acres in extent, but the budded orchards recently set out range in size up to 15 acres, having been limited by the number of trees procurable. The trees are usually planted at the rate of 80 to 100 per acre and cost about $1.50 apiece. This price tends to deter the man of very small means from planting avocados, since it is possible for him to buy three to five times as many citrus trees for an equal amount of money. It is possible, however, to secure an orchard of considerable size with no great outlay, since by his own labor the grower can secure the seed, plant his nursery, and set out his own orchard, costing him not more than 10 to 25 cents per tree in addition to his labor.

MANGO.

The mango (Pl. L) is one of the most beautiful fruits placed on the American markets. The varieties range in color from light lemon to dark scarlet, and also various shades of green. In form the fruits vary considerably, but in general they may be described as unsymmetrically heart-shaped. Some sorts, like the variety called "Bishop," are very long and narrow, while others, notably those belonging to the apricot mango group, are short and thick. The skin is smooth and usually covered with a slight waxy bloom. Since the mango is one of the fruits that have come to us from the Orient, it has had the advantage of hundreds of years' cultivation and selection. It is one with which the traveler in eastern countries becomes acquainted and which he always recalls with much pleasure.

It should not be supposed for an instant that all mangoes are good mangoes, any more than that all peaches are good. Some seedling mango trees, the descendants of a fine parental variety, are simply abominable, but a fine specimen of a well-ripened Mulgoba mango is luscious and fragrant. The aromatic principle is decidedly pleasant and has a quality peculiarly its own, and the fruit is not to be compared with any other known to the writer.

There is nothing that confuses a novice so much as his first experience in using the fruit. Of course, it can be pared and sliced before serving, but in this way the aromatic principle escapes, so that one enjoys merely a sweet, subacid, slippery something that hints at a mango. In some cases the fruit is served accompanied with a three-tined fork,[a] the side prongs being only a fraction of an inch long, while the middle one is stronger and longer than those usually found on table forks. This middle prong is thrust deeply into the fruit at the stem end, enabling one to hold the fruit firmly, remove the skin,

[a] Collins, G. N., The Mango in Porto Rico, Bul. 28, Bureau of Plant Industry, U. S. Dept. of Agriculture, 1903, Pl. VI, fig. 3.

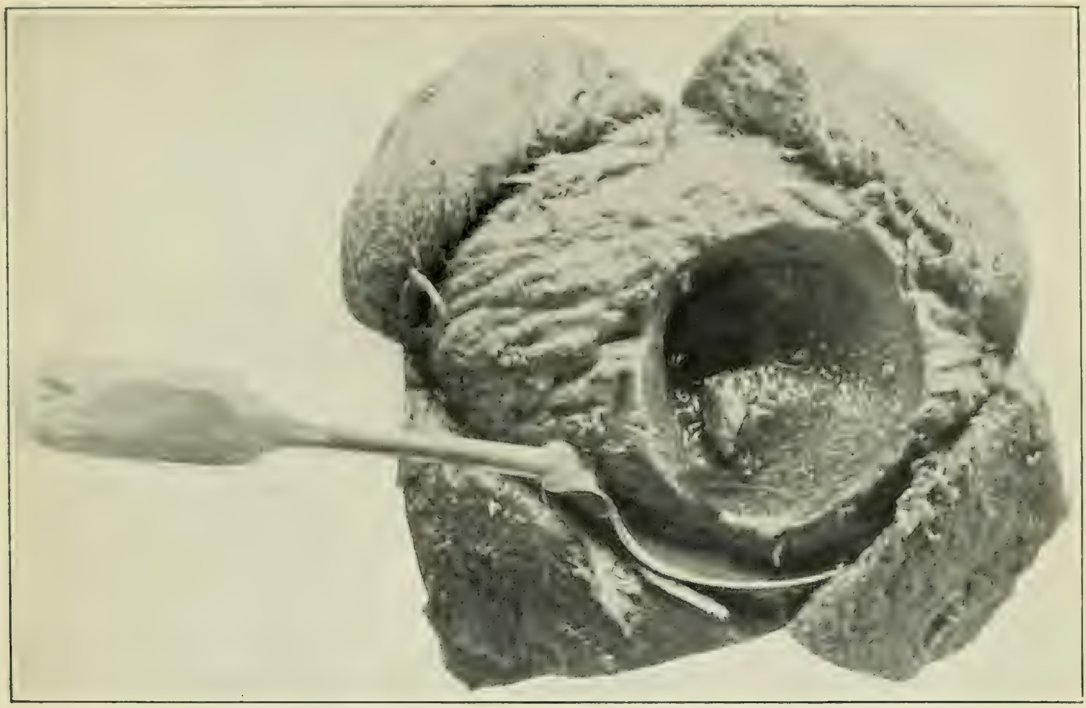

FIG. 1.—METHOD OF EATING THE MULGOBA MANGO.

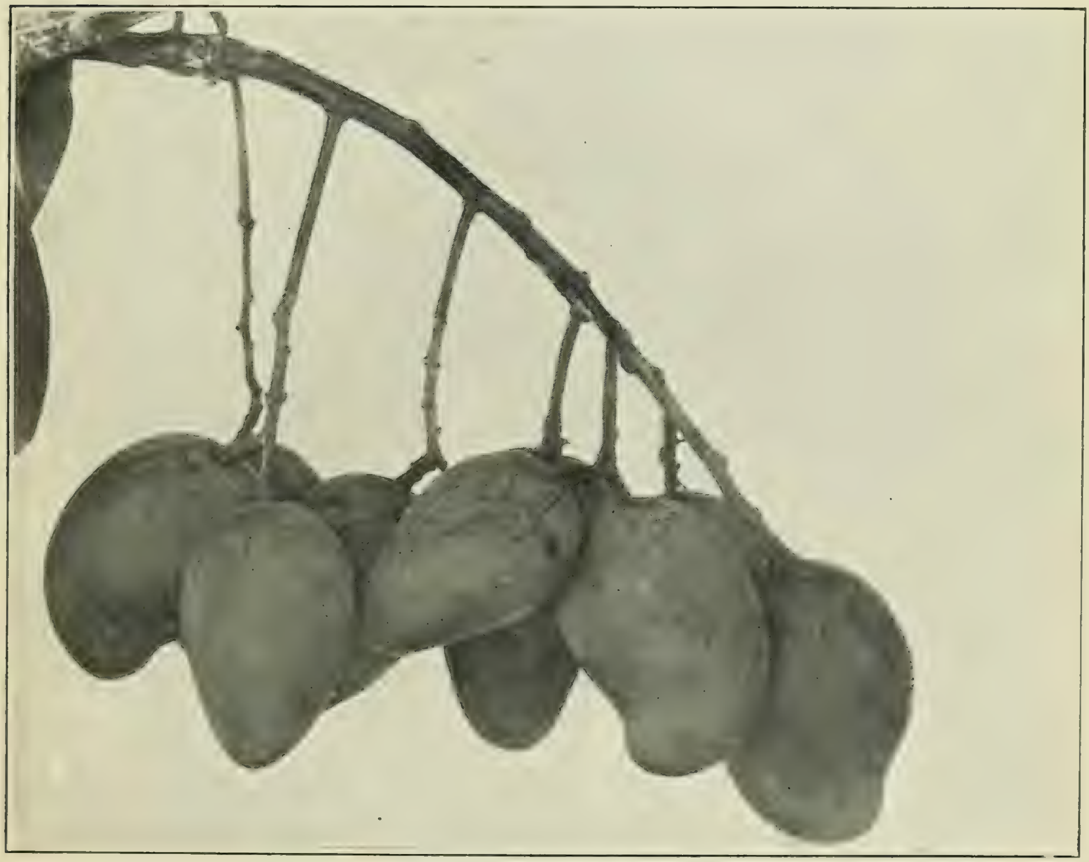

FIG. 2.—CLUSTER OF MANGOES.

and then slice off the meat. This is not possible with the fibrous seedlings now frequently found in the market.

Another easy way of handling this fruit is to cut with a penknife or other sharp instrument around the stem a circle about three-fourths inch in diameter, and then a similar circle at the distal end; then place the middle finger of the left hand within the circle made at the stem end and the thumb within the circle made at the distal end, and with a sharp knife cut the skin into six or eight longitudinal segments; then, by placing the blade of the knife under a segment at the stem end, it may be pulled off with ease. This operation is continued until all the segments have been removed, after which the fleshy part can be cut off readily with a table knife, cutting from the stem toward the apex. With the fine varieties, such as the Mulgoba and most of the Manila mangoes, no such difficulty is encountered, since the fiber is so much reduced that the fleshy part may be cut out with a teaspoon, as is done with a cantaloupe, the fruit being prepared before serving by making an X-cut on each side and peeling the corners back as far as possible, and then putting them into place to prevent the aroma from escaping. To use the fruit the corners are turned back and the melting pulp dipped out with a spoon, as shown in Plate L, figure 1.

Another way of serving this variety is to cut the fruit in half and remove the seed. The only fibers noticeable in this sort are at the edge of the seed. If the fruit be cut into longitudinal halves by running the knife near the edge of the seed, one-half of the fibers will come off; those remaining may then be readily broken, when the seed will come free from the other half. A very primitive way of eating seedling mangoes, and one thoroughly enjoyed by boys, is to seize the ripe fruit, force the teeth into the skin at the stem end, pull off strip after strip until the fruit is completely peeled, and then munch the delicious fibrous mass.

The mango is still too new on the market to be thought of to any extent for culinary purposes. In India it is said to be used in a great many different ways. It is frequently employed as an ingredient in chutneys. The green fruits have been employed in various ways for sauce and for making pies. Mango pie, made of the green fruit, is not readily distinguished from rhubarb pie. The ripe fruits make an excellent marmalade, which has a character of its own and is relished by everyone who is fond of this class of preserves.

PROPAGATION.

The greatest barrier in the way of a more rapid introduction of the mango has been the difficulty of budding and grafting. For a considerable time there was a general belief that certain varieties came true to seed. It is quite true that the seedlings come true to seed within the limits of a race, if cross-pollination with another race has not

taken place, but the variations that occur in a seedling orchard are too great to make it a profitable undertaking. Each race has its own peculiarities, and cross-pollination has more or less obliterated the demarcations. Nearly all the fruit that has been marketed has been produced from seedling trees, and no one has considered it a sufficiently safe commercial project to plant these on an extensive scale. With the advent of the fine Indian varieties the matters of propagating and planting out are being pushed as rapidly as the material at hand will permit.

Fruit trees are usually propagated most rapidly by budding, but in the case of mangoes some obstacles are met that are not encountered in the propagation of avocados. For one thing, the bud wood of the mango requires a longer time to mature sufficiently to be used to best advantage. The stock must also be in first-class thriving condition to make the buds take well. The most successful method of budding has been found to be the patch bud. This is accomplished by removing from the stock a piece of bark a half inch wide by an inch and a half long, approximately, and fitting into this a similar-shaped piece of bark, in the center of which is contained a bud from the bud stick. Then the bud is wrapped with waxed tape, as described in the paragraph on budding the avocado. The degree of success attained depends upon the rapidity and skill with which the work is done. After the buds have grown well considerable difficulty is encountered in transplanting the trees to the orchard.

Inarching, while an ancient method, is still the most successful, though probably not the cheapest means of propagating the mango. It has a great advantage over budding in that the scion wood can be used as soon as the "flush" has hardened, while in budding at least two flushes have to be sacrificed to secure bud wood that has matured sufficiently. It is true that one bud stick will usually have a dozen buds, but many of these same buds would sprout later and produce terminals for inarching.

In preparing stock for inarching it is necessary to have it in some kind of pot to enable one to move it to the tree from which the branch to be inarched is to be secured. Experiments at the Subtropical Laboratory, Miami, Fla., have shown that the best form of pot available is one made from 5-inch shingles. Enough is sawed from the thinner ends of the shingles to leave them 12 inches long. Four of these shingles are lightly nailed together and a piece 5 inches square and one-half inch thick is used for the bottom of the pot. When properly constructed such a box-pot would be approximately 5 inches square and 12 inches deep. By putting a strand of rather thin galvanized wire about the pot 3 inches from the bottom and another wire 2 inches from the top, it is made strong enough to be handled with perfect safety. When the inarched plant is to be set out, the wires are cut

with a pair of clippers and the shingles are pried apart with a hatchet, enabling one to remove the plant with no injury whatever to the roots.

The next operation in inarching is to bring the stock into contact with the scion. A fully matured end of a limb is chosen as the scion; the stock in a pot is then placed either on a scaffolding or other support in such a manner that the scion and stock can be brought into direct contact; then a strip of about 3 inches in length is cut from the side of the scion, penetrating through the bark and taking out only a small piece of wood. A similar cut is made on the stock. If these two cuts have been made properly, their flat surfaces can be brought into neat contact, when the stock and scion are bound firmly together with a stout twine. In the course of two weeks the wound should be examined carefully without loosening the twine, and, if the cut surfaces are beginning to knit, a V-shaped cut should be made on the scion, below the juncture. This cut should extend about one-third through the limb. At the end of the third week the cut may be deepened nearly to the middle of the scion, and this operation may be repeated at the end of each succeeding week, gauging the cutting so as to sever the scion from the tree in six weeks. Where the conditions of growth have not been favorable, the cutting operations should not be begun so soon, and the final cutting should not be done before eight weeks or even longer. Each time a cut is made on the scion a similar cut should be made on the stock above the wound. After the scion has been separated and the top of the stock taken off, the inarched mango should be returned to the plant house for two to three weeks to allow time for a more complete adjustment of the scion to the stock before setting out into the orchard.

VARIETIES.

Strictly speaking, there is only one variety of mango fruiting in Florida at present that is generally distributed and true to name, viz, the Mulgoba. There are many other so-called varieties, but as the trees are seedlings the product is by no means uniform in quality. The race commonly called No. 11 has been exploited as coming true to seed, but the fruits, now that the trees are bearing, vary as greatly as do seedling oranges. While this race has a certain general resemblance in color and shape (see Pl. L, fig. 2), the flavor or taste of the fruits varies from the most palatable to the most insipid, and even repulsive. In size and quantity of fiber present the mango is also quite variable, and there is a considerable variation in the date of ripening of different trees.

Even the mango known in Mexico as the Manila, and said to be the same as the "Philippine" of Cuba, is found to be exceedingly variable in shape, size, and edible qualities. The growers of this fruit are very positive in their assertions that it comes true to seed. A very

brief examination by one familiar with mangoes, however, is sufficient to show that different trees bear fruits that are distinctly different in shape, size, and quantity of fiber.

For commercial purposes the planter should strive to have in his orchard for early ripening the best selections from the No. 11 and the Manila races, for midseason the Gordon, and for late season the Mulgoba. A single fruit of the Manila mango brings as much in the Mexican market as a dozen of the common kinds. The Mulgoba is of such superior excellence that it will sell at a high price even when the market is filled with other fruit.

MARKETING.

The mango ripens from April to about the last of June. This is an opportune time of the year from the grower's standpoint, as the fruit can be placed on the market earlier than the bulk of southern peaches and northern bush fruits. The tomato crate is most commonly used for shipping the mango.

Of the fine Indian varieties the Mulgoba mangoes have been selling for 25 cents apiece. The prices obtained for the common fruit in the local markets of Florida and in the larger cities on the Gulf are so satisfactory that very little effort has been made to introduce the mango into new markets. A considerable quantity of the fruit is so inferior that it is absolutely valueless, except to furnish seed for propagation. Fine mangoes sell for from 20 to 40 cents a dozen on the tree, and good bearing trees in south Florida have produced 150 dozen each. On such trees the fruits hang in clusters (Pl. L, fig. 2).

SAPODILLA.

The sapodilla, as rough as a russet apple and as luscious as a peach (Pl. LI, figs. 1 and 2), has the disadvantage of being American in origin. The great trend of tourist travel has been toward the Orient, and there these travelers have learned to know the oriental fruits and to like them. The sapodilla is as good as many well-known fruits, yet it is almost unknown in any markets except those on the Gulf of Mexico and the east coast of Florida. There is no more difficulty in shipping this fruit than in shipping peaches. It grows without cultivation on the Bahamas, and stands the winter as far north as Palm Beach, Fla., where large trees have been producing heavy crops for many years. It grows wild in all the warmer portions of Mexico, and is common in the West Indies and throughout Central America and northern South America. In Mexico the fruit is a great favorite with the natives, both in the woods and in the markets.

The tree makes a handsome one for ornamental planting, being conical in outline, with thick, waxy, evergreen leaves (Pl. LI, fig. 2). The flowers are inconspicuous, and are borne in a heavy rosette of

leaves. In its native habitat the tree grows to be one of the tallest in the forest, but heavy-fruiting trees rarely attain to more than 30 feet in height.

In the Bahamas and on the keys of Florida the fruit is "picked with a club," thrown into a basket or barrel, and dumped at the market. A fruit that can stand such handling and still be salable certainly deserves better treatment. It has been possible to ship fruit picked in this way to Washington and New York and find it in good condition upon arrival.

The great obstacle to the introduction of the sapodilla is its growth on seedling trees. The resulting product is exceedingly variable, both in time of ripening and in quality of fruit. This defect is not unavoidable, but is rather due to lack of attention and want of persistent effort. The tree may be budded, and it may also be transplanted with a fair degree of certainty. The ordinary shield bud, such as is employed in the budding of avocados, is fairly successful.

VARIETIES.

The variations in quality, size, and shape of the sapodilla are as numerous as the trees, all the fruit grown at the present time being from seedling trees. Cultivation and fertilization, however, improve this fruit as well as any other. Among the trees grown on the Florida keys are specimens that produce fruit as large as a medium-sized apple. The flavor is usually rather mild in aromatic principle, though variations in this respect occur. In sugar content the fruit ranks rather high. Some trees bear fruit that is nearly seedless, while others bear sapodillas having as many as ten or a dozen seeds. Selection and budding will make great improvements in this respect. In the markets the fruits are usually graded according to shape and size, viz, large, medium, and small; round, flat, and long. Some growers have trees which produce fruits of superior excellence, and these become known in local markets and are in demand accordingly.

MARKETING.

At the present time the sapodilla is shipped only in small quantities, the tomato crate, with carriers, being used. In this way the fruit arrives in Washington and New York in good condition for the retail market, and is quickly bought by those familiar with it. For the near-by markets the ordinary way, as has been said, is to knock or shake the fruit off the tree, then pick it up and carry it in boxes, baskets, or barrels to the place of sale. The usual selling prices range from 10 to 25 cents a dozen, while the very fine, large specimens, grown by a few people only, are carefully picked and taken to Key West or Miami, Fla., where they sell readily for $1 a dozen.

SUGAR APPLE.

The sugar apple (Pl. LI, fig. 3) should be classed among the subtropical bush fruits. While a few specimens attain the size of a small tree, the plant begins to bear when only 2 years old and about 3 feet tall. The bush is very ornamental as well as useful. Ordinarily one has to acquire a taste for the fruit, the flavor being obscured by its large percentage of sugar, but after growing accustomed to it the flavor becomes apparent and is well liked.

The plant is not a very profuse bearer and is grown entirely from seed, though buds take rather readily. The matured fruits become edible in a week or ten days, making it necessary to place them in the hands of the consumer as soon as possible. The maturing of the fruits is indicated by the segments opening and showing a cream-colored space between. The sugar apple should not be eaten until it has softened to about the consistency of a ripe peach. Then the fruit is broken into halves and eaten with a teaspoon.

CERIMAN.

The ceriman (Pl. LII) has been grown in many conservatories in the United States. At the Missouri Botanical Garden, St. Louis, a single plant occupied many square feet of wall space, and at Fairmount Park, Philadelphia, a plant has climbed to the highest part of the conservatory; but in such locations it is by no means as fruitful as when growing on the ground under a pineapple shed (Pl. LII, fig. 3).

The plant belongs to the peculiar family of aroids, the most familiar example of which in the temperate part of the United States is the Indian turnip, or jack-in-the-pulpit. The bloom in some respects resembles a gigantic calla (Pl. LII, fig. 1), and normally the plant is a climber, attaching itself by large roots either to walls in conservatories or to trees in its native home. For fruit production it should not be permitted to reach any support which will enable it to grow more than a foot or two from the ground. Under such conditions the plant grows slowly and makes a great number of leaves and very short internodes. The trunk becomes 4 or 5 inches in diameter and sends out an abundance of large flowers.

The fruit (Pl. LII, fig. 2) ripens in fourteen to eighteen months from the time of blooming. It can be grown in all regions where no freezing occurs; light frosts do not prove injurious. The flavor of the ripe fruit is most delicious. It has been described as partaking of the qualities of the pineapple and banana. Its mild, subacid taste is penetrating, but not heavy, and the aroma is delightful. The ripening of the fruit is shown by the lower portion becoming yellow. After a few days the covering of the lower segments begins to peel and will fall off at the touch. After this it will require several days before the apex of the fruit has fully ripened.

FIG. 1.—RUSTY SAPODILLA FRUITS AND DARK GREEN FOLIAGE.

FIG. 2.—INCONSPICUOUS SAPODILLA BLOOM IN A ROSETTE OF LEAVES.

FIG. 3.—SUGAR-APPLE TWIG AND FRUIT.

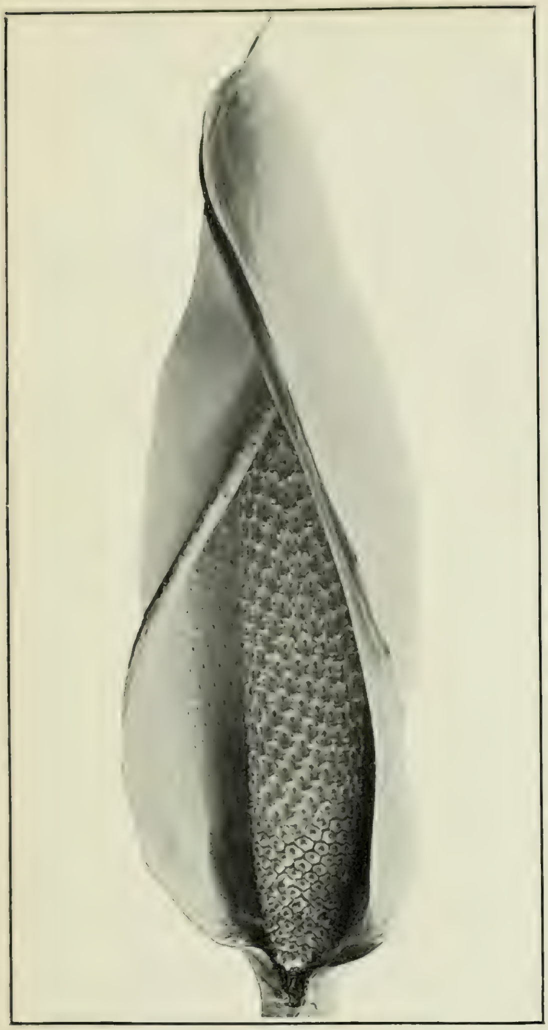

FIG. 1.—CERIMAN BLOOM OPENING LIKE A GIGANTIC CALLA.

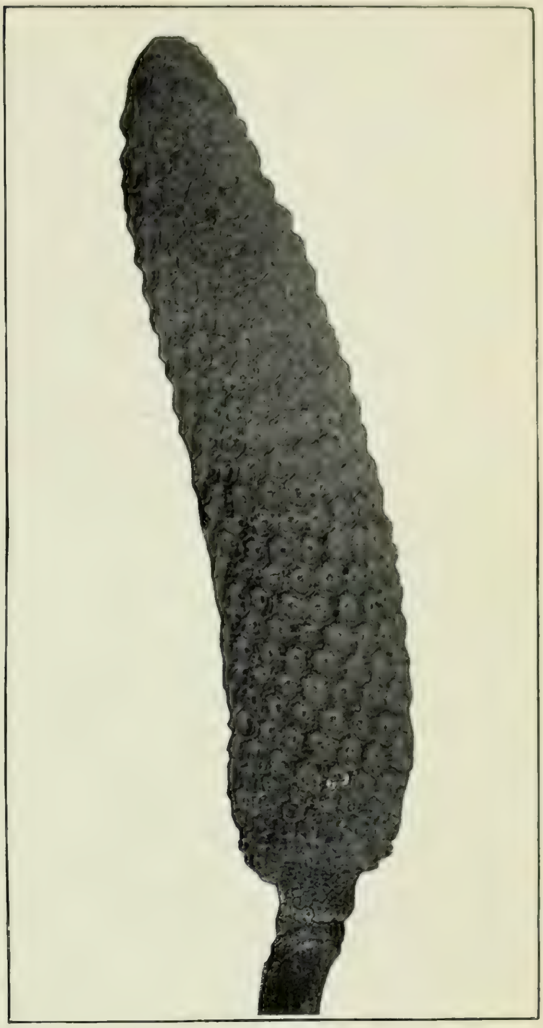

FIG. 2.—A RIPE CERIMAN FRUIT, 14 INCHES LONG.

FIG. 3.—CERIMAN FRUITING IN HALF SHADE.

PROPAGATION AND CULTIVATION.

The best way of propagating the ceriman is by cutting the trunk into segments, being careful to have at least one uninjured bud to each portion. When cut in the proper manner each segment will have at least one leaf, the blade of which may be cut off. When the stem is cut into segments these should be allowed to stand in the shade for a day or two before planting. This permits the cut surfaces to dry down and serves the purpose of callousing. After this the pieces may be planted in the place where they are to grow. If the soil be kept from drying out, there will be no great danger of the segments being destroyed. The most tardy ones may be six months in sprouting.

The most suitable soil is either a very light loam or a sandy one which contains considerable humus, and it should never become flooded or water-logged. The best location for growing this crop is in half shade, such as is produced by a pineapple shed.[a] (See Pl. LII, fig. 3.) The bright sun scalds the leaves in summer, and the light frosts in winter also cause injury to the leaves if the plant be grown in the open. Under large trees the plants thrive only moderately well, since the distribution of sunlight is somewhat uneven and during the dry season the soil under the trees becomes intensely dry. A good, heavy mulching should be provided, and for manurial purposes a good pineapple fertilizer[a] will be found best. It requires two to three years from the time of setting out for the plants so propagated to come into bearing. Plants may be grown from seed, but they will require a year or two longer to come into bearing, after which they will produce continuously for years.

The cultivation is of the simplest kind. There is no necessity for stirring the soil if the ground be kept mulched. Under such conditions very few weeds occur, and these may be destroyed at comparatively little expense.

GUAVA.

The guava (*Psidium guajava*) is most peculiar in that when ripe its odor is usually very offensive to the uninitiated, but after a considerable familiarity with it the odor is no longer disagreeable and most people like it. Not a few, especially those who are familiar with a variety of odors, consider it pleasant from the first.

Commercially, the guava is the leader of the jelly fruits. The fact, however, that it decays soon after ripening makes it impossible to keep it on the market, as is done with ordinary fruits. Jelly factories have to be established near the place where the fruit is grown.

[a] See Farmers' Bulletin No. 140, U. S. Department of Agriculture.

but with good railway service guavas may be transported 300 miles without danger of loss. For immediate home use large quantities are sent annually by express to all portions of the United States south of the Ohio River and also to New York.

The fact that the ripe fruit does not remain in good condition for more than three or four days makes it also imperative that it be sent only to customers who order it in advance. These people find it the cheapest jelly fruit in the market, in spite of the fact that the express charges are from $1 to $1.50 a crate. Even at a cost of $2.50 to $3 a crate delivered, it is considered the cheapest jelly fruit obtainable. The cost of the jelly when made by the private consumer amounts to less than 10 cents a glass, including the cost of tumblers. On the market the same quantity costs 20 to 30 cents. For transportation to northern markets the fruit has to be picked when it is just turning yellow. The guavas are then wrapped singly and placed in "carriers," six of which fill a tomato crate. For points as readily accessible as Washington, D. C., the fruit, without wrapping, may be put in carriers and shipped.

Trial shipments have been made to the best fruit stores in the larger eastern cities, but they can not handle guavas profitably, since the fruit decays so soon.

No extensive guava orchards have been planted, as the market has been somewhat uncertain. During the height of the season the jelly factories usually take all the fruit offered them at 75 cents to $1 a bushel. These prices are remunerative, since the fruit is merely shaken from the trees, picked up, and delivered. For shipping purposes the uniform charge for the fruit is $1 a crate. In the southern extremity of Florida, in addition to the regular crop, there are guavas ripening throughout the entire year. These find ready sale in the local markets at good prices.

JELLY AND OTHER CONSERVES.

Large quantities of guava jelly are annually imported from Porto Rico and Cuba in addition to that made in Florida. In color this jelly varies from light amber to dark wine. For commercial purposes the latter is preferred. A straw-colored or almost colorless jelly may be made from the white-fleshed varieties. The red-fleshed varieties are preferred, however, and by varying the cooking the shade desired is easily obtained. The main crop ripens during July and August. At this time the factories buy the fruit, as previously stated, at 75 cents to $1 a bushel, depending upon the extent of competition and the size of the crop.

The fruit is picked up every morning and taken to the factory, where it is weighed and later sorted to remove any bad fruit that may have

been delivered. It is then turned into a boiler for preliminary cooking, after which the juice is filtered through a heavy, coarse fabric, which prevents any of the pulp from passing through. The juice is then bottled, or put into jars, sterilized by means of heat, sealed, and kept in these vessels until the jelly is wanted on the market. The quantity desired is then taken from the containers, sugar is added, and the juice is boiled long enough to give the proper color, when it is placed in the jelly containers and sent to the market. The fancy product is put up in glass jars, sealed and labeled properly, while the cheaper grades are placed in paper boxes, in which form the jelly is sold as cheap as 20 cents a pound at retail.

In addition to jelly, another product is made that resembles it in firmness, but which might be briefly described as jellied marmalade. This preparation is known by several names, as guava cheese, guava paste, etc. It is molded in various cubical or oblong shapes and wrapped in oiled paper. The formulas for making it are very numerous, but in general it is composed of the best of the guava pulp, containing sufficient juice to cause it to become firm like jelly when properly cooked with sufficient sugar. In addition to jelly and cheese, wine and vinegar are also made from the guava, both of which are said to be excellent.

Canned guavas are rarely seen outside of the guava belt, but they make a fine appearance and are delicious. To prepare them for canning, the firm, ripe fruits are chosen, pared and quartered, and then treated like any other fruit. The more fastidious housekeepers choose the thick-meated guavas, and seed them in addition to paring. The fruit that has become too ripe to make good jelly or is not firm enough for canning may still be used for marmalade. For immediate table use sliced guavas with sugar and cream make an excellent dessert.

PROPAGATION.

In all the regions where guavas are grown they occur spontaneously. This is due to the fact that birds and poultry are fond of the ripe fruit, and so disseminate the seed rather widely. Most of the trees that are now fruiting are seedlings and of exceedingly variable quality. The seed germinates readily and the seedlings are very hardy.

The guava may, however, be budded, grafted, or "struck" from cuttings or from root cuttings. All of these processes are more or less difficult. The best time of year for budding, so far as known, is in the early spring, about February, when a fair percentage of shield buds will take. The skin of the nursery stock is apt to be rather thin and not tenacious; consequently the operation is somewhat tedious. Grafting may be accomplished by the ordinary whip graft during the semi-dormant period of winter. The graft should be made low on the stock, so that the scion can be covered with soil to prevent drying out while

the union is being made. Mr. E. N. Reasoner[a] finds that half-ripened wood may be used for "striking," but the bed should be provided with bottom heat. Root cuttings are said to strike readily. Another method of propagating practiced to some extent is to cut some of the smaller roots that are about a half inch in diameter and pull the cut end so as to bring it above the ground, allowing it to remain in this position. In the course of a few weeks shoots will start from the end above the ground. These may then be transplanted in the usual way.

[a] Bailey's Cyclopedia of Horticulture, Vol. II, p. 699.

PROLONGING THE LIFE OF TELEPHONE POLES.

By Henry Grinnell,
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THE DEMAND FOR POLES.

The extraordinary increase in the use of the telephone and telegraph during the last few years, combined with the fast-diminishing supply of timber used in pole-line construction, has led the telephone and telegraph companies to take great interest in experiments to find the best and most practical method for increasing the length of service of poles and cross arms. Bulletin No. 17, "Telephones and Telegraphs, 1902," recently issued by the Bureau of the Census, Department of Commerce and Labor, shows that in 1902 there were approximately 422,000 miles of telephone and 238,000[a] miles of telegraph pole lines in operation in the United States. A report lately published by the Bell Telephone System shows that since 1902 its subscribers' stations have increased from about 1,000,000 to 1,800,000, and all indications point to an equal, if not a more rapid, increase in the near future. Reports of other companies also show large growth for the last three or four years. It is therefore probably safe to assume that there are at the present time fully 800,000 miles of pole line in operation in the United States.

SUPPLY OF POLE-LINE CONSTRUCTION TIMBERS.

Of the timbers used for poles, chestnut and northern, southern, and Idaho cedar easily rank first. Longleaf and shortleaf pine, red cedar, cypress, redwood, locust, catalpa, and several of the oaks are used, but in much smaller numbers, and their employment is generally confined to the region of their growth. Still other timbers are used, but in numbers insignificant in comparison with those mentioned above.

For cross arms, longleaf, shortleaf, and loblolly pines of the South and Norway pine of the North are most largely used, while the demand for cedar, cypress, spruce, and red fir is but little less. Again, as in the case of pole timbers, a third group may be formed of those timbers used in small numbers and very locally.

[a] Exclusive of telegraph lines owned and operated by railroads.

Black locust is admitted to be the best of all woods used for insulator pins, but of late years, because of overcutting and damage by insects, the supply of black locust has been greatly depleted, and other woods are being brought into use. Among those which will probably prove satisfactory as substitutes for the black locust are Osage orange, various oaks, yellow birch, gum, hard maple, elm, etc.

Figures 107 to 109 show the main sources of supply, in the past and for the next few years, of the timbers most used in pole-line construction.

Assuming that the 800,000 miles of pole line are constructed on a basis of 40 poles per mile and that each pole contains an average of 20 cubic feet, it will be seen that there are now in use 32,000,000 poles,

FIG. 107.—Sketch map showing regions from which the present supply of pole-line construction timber is drawn.

representing 640,000,000 cubic feet of timber. If the average length of life of these poles is twelve years, there are annually needed, for the maintenance of the present lines alone, over 2,650,000 poles, containing approximately 53,000,000 cubic feet of timber; and if it requires sixty years to grow a pole, to maintain the supply there should be five poles growing for every one in use, or 160,000,000 poles for renewal merely, besides what the extension of business will call for.

Two years ago the Bureau of Forestry[a] sent out a large number of letters requesting both producers and consumers of poles, cross arms, and insulator pins to answer certain questions relative to the kind and supply of timbers used in various parts of the country. Replies to these

[a] On July 1, 1905, the Bureau of Forestry became the Forest Service by act of Congress.

questions represented a very fair expression of opinion from all the large timber-producing sections of the United States; while there was some variation in the answers to questions regarding the probable length of time the present supply would last, the consensus of opinion was that the supply of the timbers most in demand was being rapidly exhausted.

Michigan and Wisconsin lumbermen agreed that from ten to fifteen years would see all the available pole-size cedar cut out. They looked to Canada and the Northwestern States to supply poles after that time. Pole producers throughout the Southern States were of the opinion that the cedar would soon be cut out and that cypress and pine would take its place. It may be noted here that at the present time consider-

FIG. 108.—Sketch map showing regions from which more or less than the present supply of pole-line construction timber has been drawn.

able quantities of creosoted pine are used in the Gulf States, where, owing to climatic conditions, not only that part near the ground line but the whole length of untreated poles decays with great rapidity.

Throughout the chestnut regions the outlook was no better, though there are still some bodies of chestnut in the more inaccessible parts of the Southern Appalachians.

There is a large supply of pole timber in the Western States, but the heavy freight rate on shipments of poles to the East, where by far the greatest mileage is built and maintained, has precluded the possibility of making much use of this supply.

At present there is no great cause for alarm over the cross-arm situation, for there are still considerable available supplies of the

timbers used in their construction. The price is advancing, however, and it is very probable that this fact will lead to increased energy on the part of the consumers to find better methods for preserving the arms against decay.

In the case of insulator pins, however, the outlook is not so encouraging. The supply of black locust—the wood almost exclusively used in their manufacture—is practically exhausted, and up to the present time no general effort has been made to find a suitable substitute. The result of this lack of foresight is that experiments which must extend over a number of years have only now been begun, to determine which, among the several woods that suggest themselves, possess the requisite qualities.

FIG. 109.—Sketch map showing main sources of future supply of pole-line construction timber.

Such, then, is the situation confronting pole-line companies—a rapidly increasing business, demanding timber for poles, cross arms, and insulator pins, and a far more rapidly decreasing supply of the timbers now in use.

FIELD OF PRESERVATIVE TREATMENT.

Here, as in the very similar problem of railroad-tie supply, the use of measures to lessen the effects of decay promises substantial relief. This relief is likely to be felt in two ways. Preservative treatment will doubtless add new species to those now in use, and will thus augment the supply. It will also make the present supply go farther, by lengthening the term of service. Experiments to determine the comparative merits of different treatments to lengthen the life of poles have been undertaken by the Forest Service, and the general plan of

these experiments will be described in the present article. Although sufficient time has not yet passed to disclose the conclusions which the experiments will yield, it will be seen that when completed they should furnish a conclusive test of the commercial practicability of specific methods of treatment.

PRACTICAL TREATMENTS.

That a treatment shall be cheap and that it shall at the same time materially prolong the length of life of poles is essential to its commercial adoption. The Forest Service experiments were therefore confined to those methods which were cheap and which promised in some measure to prove satisfactory. The method of treatment commonly employed with other timbers involves treatment of the whole pole in an air-tight cylinder permitting the application of pressure, and is therefore expensive. For this reason it was not considered. For the larger part of the country the portion of the pole above ground does not readily decay, so that treatment of the entire pole is not necessary. In those sections of the country where the climatic conditions make it desirable, the treatment of the entire pole has given excellent satisfaction.

The investigations were confined to the consideration of various methods for protecting that part of the pole most subject to decay, i. e., the part immediately above and immediately below the ground line. Of these methods, the two referred to later as the first and the third methods of treatment were the only ones used to any extent. Either of these methods is likely to pay well. The cost of a green pole at the setting hole may be put at $5, and of a treated pole (calculated on the basis of fair prices for labor and a good preservative) at $5.40 and $5.65, respectively, for brush-treated and tank-treated poles. The average length of life of a green pole is about twelve years, and an increase in length of service due to treatment of four years in the case of poles treated by the first or brush method, and eight years in the case of poles treated by the third or tank method, is probably a very conservative assumption. By applying the formula[a] for calculating the annual charge on an expenditure occurring now and recurring regularly, we find that with interest at 4 per cent the annual charge for a green pole is $0.5328, for a pole treated by the first method $0.4634, and for a pole treated by the third method $0.4157. A comparison of these annual charges shows that by using a pole treated by the first method instead of a green pole an annual saving of about 7 cents is effected, while if a pole treated by the third method is used

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[a] $r=R\frac{1.0p^n \ 0.0p}{1.0p^n-1}$, in which r=annual charge, R=expenditure, p=rate of interest, n=years in the recurring period, and $1.0p=\frac{100+p}{100}$.

the annual saving will be about 12 cents. The difference between the annual charges for poles treated by the first and by the third method is 4 cents. (See fig. 110.)

These small savings may seem insignificant in themselves, but if we apply them to the 32,000,000 poles in use we have the following figures as the annual saving by using treated poles instead of green poles:

By first method	$2,240,000
By third method	3,840,000

These savings represent the value at the setting hole of 415,000 poles if treated by the first method and 678,000 poles if treated by the third method.

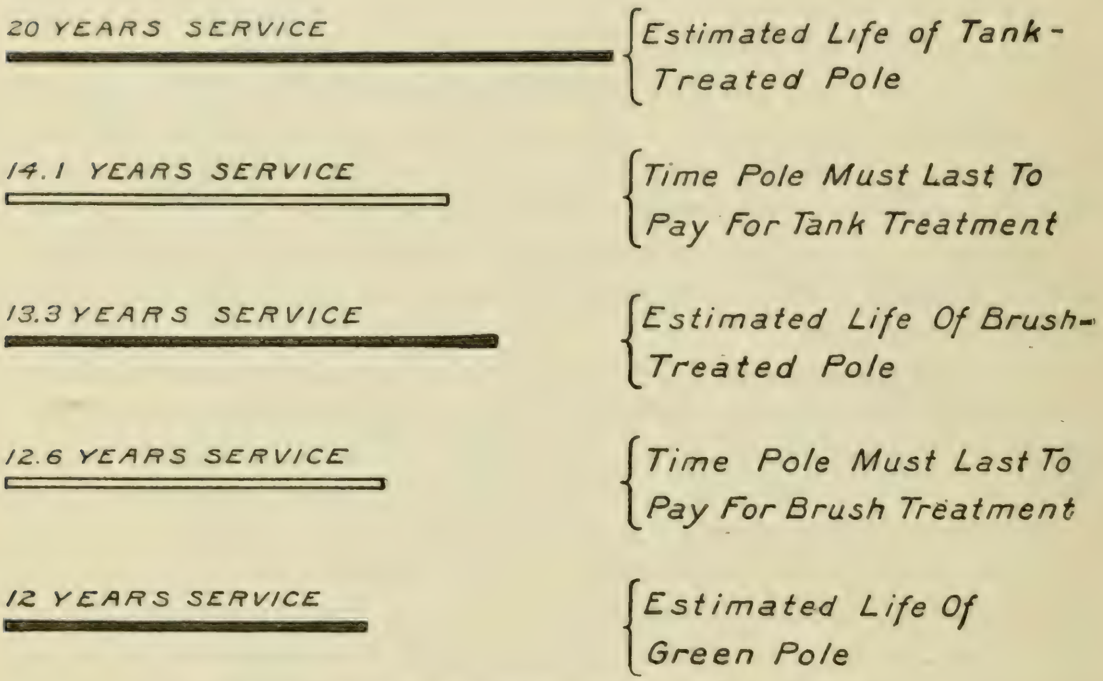

FIG. 110.—Diagram showing value of treatment of telephone poles.

The first or brush treatment can be applied at any place and to practically any number of poles without affecting the cost of treatment in any appreciable amount, for the apparatus needed for this treatment is simple and is easily hauled from one point to another. The third or tank method could be most economically applied at concentrating yards, where a large number of poles are kept on hand. In such yards permanent tanks could be constructed and various labor-saving devices for handling poles, not practicable where the apparatus had to be moved from one point to another, could be installed. For treating small numbers of poles at separate points, portable tanks could be constructed at comparatively small cost. The size and elaborateness of the tanks and other apparatus will depend upon the number of poles to be treated and the permanence of the treating yard; and the larger the number of poles to be treated the smaller will be the cost per pole.

EXPERIMENTS OF THE FOREST SERVICE.

SEASONING.

In August, 1902, the Forest Service entered into cooperation with the American Telephone and Telegraph Company, and later on—in 1904—with the Postal Telegraph-Cable Company. The main purpose of this cooperation was to determine which of several methods of applying preservative treatment is most practical. A careful preliminary study was made of such points as the effect upon the length of service of seasonal cutting and of soaking in water, and the time required for seasoning the timber to an air-dry condition. Several stations were established in New Jersey, Pennsylvania, Michigan, and North Carolina, at each of which 50 poles were cut at monthly intervals for one year. Poles were weighed as soon as cut, and then placed on skids about 2 feet above the ground to season. These poles were weighed again at monthly intervals until they ceased to lose weight, indicating that they had reached an air-dry condition.

The results of these preliminary or seasoning experiments have established many important facts regarding the seasoning of timber, and have suggested new lines of work which, it is hoped, will result in largely increasing our knowledge of the subject. It was shown, for example, that though poles cut in the spring and summer lose weight more rapidly during the first three or four months than those cut in the winter, the latter dry more regularly and at the end of six months are better seasoned. Soaking in water for from two to four weeks was found to hasten materially the rate of subsequent seasoning. The degree of shrinkage which takes place during air seasoning was also investigated. It was shown that, contrary to a somewhat common opinion among users of poles, the considerable shrinkage which is known to take place when wood is thoroughly dried by the application of artificial heat does not appear in the case of telephone poles dried out of doors, the decrease in the circumference amounting to little more than one-half of 1 per cent.

TREATMENT OF POLES.

When poles at the several stations had reached an air-dry condition, they were ready to receive treatment. Several different kinds of preservatives were applied by one or more of three distinct methods.

The first method consisted of applying from one to three coats of preservative to the outside of that part of the pole between 2 feet and 8 feet from the butt (Pl. LIII, fig. 1). The time between applications varied from a few hours to two days, according to the directions given by the manufacturers of the preservatives. Careful notes were made of the condition of the poles as regards seasoning checks, knot holes, etc.

The temperature and weight of the preservative were recorded before and after each treatment, and the amount of preservative absorbed by each pole was accurately determined. In addition, holes were bored into the poles in different parts of the treated portion, and a close examination was made to determine the depth to which the preservative had penetrated.

The second method of treatment consisted of forcing the preservatives into the butt of the pole by means of a steel cap fitted to the butt and connected by a pipe with a hand pump, while another pipe led from the pump to a large pot in which the preservative was heated. But little difficulty was experienced in forcing the preservative for several feet into the solid portions of the pole, but owing to the presence of seasoning checks the penetration was not uniform, and when high pressure was applied the preservative spurted from these checks with considerable force. Numerous preliminary trials with this apparatus having proved the practical impossibility of obtaining a uniform penetration, none of the poles treated by this method was afterwards set in the experimental lines.

The third method consisted of soaking the butts of the poles in tanks so constructed that the poles lay at an angle of about 20° (Pl. LIII, fig. 2). The butts of the poles were immersed for a distance of about 8 feet in a tank containing cold preservative, which was gradually heated by a fire underneath the tank until a temperature of from 240° to 270° F. was reached. This temperature was maintained for about five hours, when the fires were drawn. The poles were left in the tank for several hours after the preservative had become cold, so that the entire treatment consumed about twenty-four hours. By this method a penetration of about one-half inch was obtained.

The first treatments were begun at Wilmington, N. C., in April, 1905, where white cedar poles that had been seasoning for about two years were treated with seven different preservatives. The second series of treatments was made at Hominy, N. C., where seasoned chestnut poles were used. The third series of treatments was made at Mount Arlington, N. J., where chestnut poles that had seasoned for three years were used. The tank method of treatment was tried for the first time at this station. The fourth and last series of treatments was made at Thorndale and Paoli, Pa., where seasoned chestnut poles were used. The treatments at this station were practically the same as those at Mount Arlington.

SETTING THE EXPERIMENTAL POLES.

To test the effects of the different preservatives 300 seasoned 30-foot cedar poles from Wilmington and an equal number of chestnut poles from Hominy, N. C., some of them treated and some untreated, were shipped to Savannah and near-by stations in Georgia, to be set in the

FIG. 1.—TREATING WHITE CEDAR BY FIRST METHOD, WILMINGTON, N. C., STATION.

FIG. 2.—TREATING CHESTNUT POLES BY THIRD OR TANK METHOD, THORNDALE, PA., STATION.

standard Savannah, Abbeville, and Eastman toll line of the Southern Bell Telephone and Telegraph Company, together with green poles cut in the immediate vicinity of the line. This section of the country was selected primarily because of the rapidity with which timber there decays, thus insuring the obtaining of results in the shortest possible time. Several years, however, must necessarily elapse before definite conclusions can be drawn from the experiment.

The poles were set in 24 series, 34 poles in each, and were so arranged that in every case a treated pole stands between a green and a seasoned pole. In this manner soil conditions were obtained as nearly identical as is possible in pole-line building, and the data secured will afford an excellent basis for comparison when determining the relative merits of the various preservatives and of the seasoned poles on the basis of the life of a green pole. Exact descriptions of the character, composition, and depth of the soil and subsoil, and general notes of the immediate locality and of the equipment of the line, were made for each pole.

The arrangement of the poles in each series is shown in the tabular plan which follows.

Plan under which experimental poles were set on the Savannah, Abbeville, and Eastman toll line.

Pole number.	Description of pole.[a]	Pole number.	Description of pole.[a]
1	Treated with A.	18	Untreated, seasoned.
2	Untreated, seasoned.	19	Treated with D.
3	Treated with A.	20	Untreated, green.
4	Untreated, green.	21	Treated with E.
5	Treated with B.	22	Untreated, seasoned.
6	Untreated, seasoned.	23	Treated with E.
7	Treated with B.	24	Untreated, green.
8	Untreated, green.	25	Treated with F.
9	Treated with C.	26	Untreated, seasoned.
10	Untreated, seasoned.	27	Treated with F.
11	Treated with C.	28	Untreated, green.
12	Untreated, green.	29	Treated with G.
13	Treated with D.	30	Untreated, seasoned.
14	Untreated, seasoned.	31	Treated with G.
15	Treated with D.	32	Untreated, green.
16	Untreated, green.	33	Green, treated with G.
17	Treated with D.	34	Untreated, seasoned.

[a] The letters (A, B, C, etc.) are used to indicate the different kinds of preservatives employed.

A second experimental test was undertaken near Warren, Pa., by setting 600 chestnut poles from Thorndale and Paoli, Pa., and 368 chestnut poles from Mount Arlington, N. J., in the Warren and Buffalo line of the American Telephone and Telegraph Company. The plan followed was similar to that used on the Savannah, Abbeville, and Eastman line. The Warren and Buffalo line runs through a

varied country, and all types of locality, from high, rocky ridges to low, mucky swamps, are represented in the 60 miles throughout which the experimental line extends.

Several experiments have at various times been undertaken by telephone and telegraph companies with a view to solving the problem of treating poles in a cheap but thorough manner. From one cause or another, however, they have either failed entirely or the records are so incomplete as to render them practically valueless. The experiments now being carried on are of importance, therefore, in that they will add very considerable and definite knowledge to our none too extensive understanding of the seasoning and preserving of timber.

FARM PRACTICE IN THE CONTROL OF FIELD-CROP INSECTS.

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INTRODUCTION.

Generally speaking, in America the operations of the farmer extend over greater areas than do those of the fruit grower or truck raiser. The farmer may thus be said to be doing a wholesale business with nature, and measures that may be entirely practicable in case of smaller areas may be for him wholly impracticable, precisely as the business methods of the retail merchant would often drive the wholesale man into bankruptcy. Again, he comes into close contact with nature, because his grains and forage plants, the legumes excepted, nearly all belong to the grass family (Gramineæ)—the most abundant and varied of all vegetable life—and are therefore all the more likely to suffer from insects that have perhaps for centuries infested the native grass flora. When he brings these large areas under cultivation he displaces scores, perhaps hundreds, of different kinds of plants, and in their stead returns but one; and this he favors and protects as a spoiled child, with all of the science at his command. Nature attempts to prevent the outrage of a few varieties of plants in the hands of the farmer being used to displace hundreds of others throughout large tracts of country; and she does it, in part, at least, through the agency of so-called destructive insects and plant diseases. Thus is the farmer everywhere brought directly in conflict with the insect foes of his crops. His position is simply this: By bringing his acres into cultivation he has upset the natural order of things, and must now go a step farther, and, so far as possible, render unnatural the conditions for the insects involved. He can not hope to exterminate them; they will always be with him in greater or less numbers, and his crops are too numerous and his fields too broad to enable him to apply slow or expensive methods of repression. His entomological problems are scarcely less difficult than those in the commercial, scientific, or military worlds, for he must correctly forecast them, and, as far as possible, effectually forestall them, and this, at not too great expense of time, money, and labor. It is frequently the case

that measures applied against certain insects at the proper time are thoroughly effective, but the critical period for application in many cases, possibly the majority, is short. And while the problem may be simple enough if carried out over small areas, in the case of larger ones it is a physical impossibility to properly apply the requisite measures over the necessary territory within the limited space of time allowed by the peculiar habits of the insect or insects involved. Therefore measures applied by the farmer must be very largely preventive and such as can be put into application in the course of ordinary farm management. He must win by strategy what he can not expect to accomplish by open and direct assault.

In the following pages an effort is made to indicate some of the things that may be done, to suggest, rather than to give a complete discussion of the pests and measures, and thus to aid the practical farmer in still further perfecting and widening the scope of his system of management, so as to include other pests of which we at present know little or nothing.

The kinds of insects involved in farming operations are too numerous to permit a farmer's giving his undivided attention to individual suppression, and he must adopt measures that will affect all that have similar habits. In this paper no attempt will be made to include all of these pests, but to select a few of the best-known representatives as illustrating what may be accomplished by applying certain measures, which might be equally successful in case of others not here mentioned. It frequently occurs that a number of different insects having one like habit may be affected by one and the same remedial measure, and thus a number of quite different pests may be dealt with in a single operation.

A PRACTICAL KNOWLEDGE OF THE HABITS OF DESTRUCTIVE INSECTS ESSENTIAL.

One of the first and most important requisites to the intelligent control of destructive insects is a working knowledge of them and their habits. Technical knowledge is not here important, though not without value, but the farmer must be able, in a measure, to distinguish in their several stages of development the more common insects that he wishes to control, as well as to understand their different ways of living and of attacking his crops. This is what may be aptly termed a business acquaintance. With technical names he need not trouble himself, as these are more for international and strictly scientific use, but he will need to know the insects themselves as he does the plants he cultivates, and to study the ways of each, precisely as he studies the disposition of his horses in order to be able to handle them properly. The American farmer may be up to date in matters pertaining to breeding and management of live stock, varieties of wheat, corn, and

other grains, but many years behind the times in his knowledge of the insect pests of his farm. This business acquaintance with the common farm insects is coming to be a part of the equipment of the twentieth century farmer, and the lack of this element in his practical education is an expensive defect. Whether he realizes the fact or not, it will figure in the size of his bank account or the rapidity and ease with which he is able to cancel a mortgage. News of a $25,000 fire in some city will be scattered broadcast over the country by the public press of that or the following day, but a $100,000 loss to farm crops, on account of the ravages of an obscure insect in some section of the country, may never become known to the public; yet the amounts involved in these losses are not changed by their relative publicity.

It is not to be supposed that, with all the knowledge of insects that we possess, we will be able to prevent all losses by their ravages, but it is very often due to a lack of information among farmers that the amount involved is so enormous. This lack of practical information of the things that are to be controlled constitutes the greatest obstacle to the control of insect pests. In many cases the farmer does not know the precise causes of the trouble or how to deal with them broadly and decisively in his agricultural methods; nor will he ever be able to do so until he increases his present knowledge of insects. If in need of information relative to the identity of insects, he has but to apply to this Department, or, if he prefers, to the nearest State agricultural experiment station, to secure it.

CROP ROTATION.

Crop rotation is everywhere acknowledged to be essential to good husbandry, and at the same time a very decisive means of dealing with some of the most destructive insects.

BENEFITS OF CROP ROTATION.

Nature, left to herself, seldom abruptly displaces one kind of vegetation with another, and insects, through long association with certain varieties of plants, become so fixed in their habits that they can not encounter a sudden radical change without experiencing fatal results. Even where insects are merely forced to migrate from one field to another, the farmer is not infrequently benefited, for the reason that the migrants often meet disaster in adverse winds, or they are beaten to death by storms or overcome by heat, so that relatively few survive to reach their destination. This is especially true of such frail insects as the Hessian fly and the wheat midge. The wheat-straw worm is two-brooded, adults of the first brood appearing in early spring from the stubble of the previous year. These are nearly all females, largely wingless, and therefore for the most part unable to fly from one field to another. Thus it will be seen at once that it is very advantageous to change the wheat crop from one field to another in order to avoid

the attacks of the wingless females. The eggs are deposited in the young wheat stems just as these begin to joint, and the young worms make their way into and destroy the embryo head. A second generation appears later, but these individuals are fully winged and can not be reached in the fields by any repressive measures. This brood appears less injurious in the North than in the South, where its damage seems to have been attributed to the Hessian fly.

In some sections of the country there occurs a form of chinch bug with wings so aborted as to prevent flying, and which seems especially fond of timothy. In some localities inhabited by this form dairying is carried on quite extensively, and, on account of saving labor, rotation of pastures and meadows is not generally practiced. But it has been found that where a system of permanent timothy pastures and meadows prevails within the territory occupied by this form of chinch bug, the latter becomes established in such numbers as to kill the timothy by sucking the juices from the bulbous roots. Wherever outbreaks of this character occur a change of crop has been found to afford entire relief.

Perhaps the most striking effect of crop rotation is to be found in the case of the western corn rootworm, which costs farmers of the corn belt millions of dollars annually. The eggs are deposited in late summer and fall, about the roots of corn. These eggs hatch the following spring, and the larvæ attack and devour the roots, thereby damaging the corn, in some cases the loss being nearly total. It has been demonstrated again and again that a rotation of crops, using for the purpose some of the small grains for a single year, will utterly destroy the pest, even in the most seriously affected fields, and corn may again be grown on this land with perfect safety. In fact, it is only where this cereal is planted on the same ground year after year in succession that the insect becomes at all troublesome.

DANGERS FROM CROP ROTATION.

However efficient, in general, rotation of crops may be in the suppression of insect pests, the measure may easily be so applied as not only to prove ineffective, but actually disastrous. This is especially true in the change from a grass to a grain crop, and also in the process of breaking up and bringing under cultivation swamp lands, notably in the Middle West. The farmer who destroys the grass plants in his fields and in their stead attempts to grow Indian corn, by so adjusting his plowing and planting that the grasses are killed out, leaving the insects that feed upon them on the verge of starvation at the time his corn is pushing above ground, will find that he has made a serious mistake. A certain period of time must elapse between the destruction of the old and the starting of the new vegetation, in order to starve or drive out the insect enemies.

In many portions of the Middle West a very large percentage of the annual loss to the corn crop by reason of insect attack is occasioned by this sort of a change from grass to a corn crop.

HOW SOME OF THE DANGER MAY BE AVOIDED.

In the case of reclaimed swamp lands it is always best to plow during the summer, in the fall, and again in the spring before planting to corn. It is sometimes best to crop once with rye before attempting to grow corn at all. The reason for this is that the enemies of grasses and rushes growing in these lands before their reclamation will remain as long as this sort of vegetation exists, even to a limited extent, and if planted at once to corn they will attack this precisely as they do their native food plants, and destroy it. Very many serious losses have proven this to be true. On the other hand, where the reclamation has been completed before any attempt is made to grow corn on these lands, no such trouble has been experienced.

A precisely similar trouble is sometimes experienced with timothy meadows of long standing. An insect, commonly known as the bill bug, breeds in the bulbous root of this grass, sometimes in sufficient numbers to kill out the larger portion of it. The pest develops in the fall and remains in the field over winter to begin operations as usual the following spring. Now, if the infested field were to be plowed late in summer or early in fall the insect would probably abandon it, or, if not then, certainly in spring, as it could neither feed nor breed there; but if, as is frequently the case, plowing is left until spring and corn is planted soon afterwards, the insects transfer their attention to the corn, frequently killing the plants outright, and in other cases causing what is generally known as "frenching." This trouble is due to injury to the lower part of the stem, causing the plant to dwarf and throw up numbers of lateral shoots or suckers from the same root, no ears being produced. In the two cases just cited it is essential that the existing vegetation be entirely destroyed, thus either starving the insects or forcing them to abandon the field before the ground is planted to corn in spring.

SUMMER FALLOW[a] AND SUMMER, FALL, AND WINTER PLOWING.

These are all efficient measures in the extermination of injurious insects, the first being especially valuable in this direction, because it not only tends to exterminate all insect life in the fields thus treated, but prevents their becoming infested during the period of fallow. Next to this, in point of efficiency, might be placed midsummer plowing without further cultivation until fall plowing.

[a] Summer fallow as here used includes plowing the land in the spring without planting it to any crop and giving the land sufficient cultivation during the summer to prevent all growth of grass and weeds.

The clover root-borer, a small brown insect, whose young is a white grub with brown head and jaws, is an introduced pest, coming to us from Europe; and it has now become established over most of the country east of the Mississippi River wherever red clover is grown. The eggs are deposited during May and June, and the young at once enter the main roots and proceed to riddle them with their burrows, passing out of this stage largely in July and August, when either no food is required or they have, for the most part, reached the adult stage and can then make their way to other fields. As a rule, the clover begins to die in spots over the field in late July or in August. Ordinarily, if this injury is noted by the farmer, it is attributed to the effect of dry weather, and the further destruction that may not become more obvious until the following spring is likewise charged up to the effect of winter. Now, the young are footless grubs, without eyes, and living roots are with them essential to life. Let the roots wither or die while the grubs are still young and they must perish. If while the insect is in this helpless stage, which continues some time after the hay crop has been removed, the land is broken and the clover roots thrown up to the action of sun and wind, these will wither and dry out, thus destroying the insects infesting them. While this does not save the clover, and nothing now known will do so under such circumstances, it destroys the pest, so that it does not develop and make its way to other fields. A farmer can thus, in a large measure, protect himself from these ravages; and if whole communities would unite in putting such a system of cultivation into effect this pest need no longer be a menace to the clover crop. It will be observed that whether this ground is to be sown to fall wheat or planted to corn the following spring, the breaking up of the sod at the time mentioned only anticipates the ordinary treatment by a few weeks or, at most, months.

There are three groups of insects that are of special importance in the change from grass to a corn crop. These are cutworms, wireworms, and grubworms, each group differing radically from the others in appearance and habits, except that all of them are primarily grass insects. The eggs being deposited in summer or early fall, the young become partly grown before winter, make their way downward into the soil as cold weather approaches, and hibernate there, but come toward the surface in spring, feeding voraciously in continuing their development. Probably four-fifths of the annual loss to the corn crop in the United States is due to the ravages of these three groups of insects; yet nearly all these yield more or less completely to summer fallowing or to plowing up the ground in midsummer, fall, or midwinter. In the case of summer fallow the deposition of eggs is prevented and the existing generation of insects, if there be any such, is more or less effectually destroyed. Midsummer plowing has somewhat the same effect on the worms, while fall and winter plowing have

the effect of throwing the hibernating insects toward the surface, leaving them in a condition of torpidity and at the mercy of the weather of the colder months. Even where these insects have descended to a depth below that reached by the plow, the more rapid and frequent passage downward of the moisture from rains seems to affect them adversely. Besides, the roots of the grasses are more generally killed out by this treatment and there is no food left in early spring to sustain the few insects that escape. Also, and with no little advantage to the farmer, a portion of the spring's work is accomplished in advance of one of the most strenuous periods of the farm year.

MEASURES NOT ALWAYS PRACTICABLE.

In hilly countries, and especially where the soil washes easily, as it does in many portions of the Southern States, it becomes very essential that the ground be cultivated as little as possible, especially during fall and winter, and the measures just described can not under such conditions be generally applied. If the grass vegetation can not be exterminated in a field and some time allowed for the insects thus deprived of their food supply to either decamp or starve, the next best thing to do is to plow the ground late in spring and plant immediately. By this method the insects are allowed to go on subsisting upon their original food supply, which is usually sufficient, until the corn has become too far advanced to admit of their seriously injuring it, or else the insects themselves have passed into a stage of their development in which no food is required. Unfortunately, the general practice in changing from a grass crop to a spring grain crop, notably corn, is to first exterminate the grass and then at once replace this with the cultivated crop. This is really depriving certain insects of one kind of food, supplying them with another much like the first, and then marveling that they destroy it. We know that some of the corn and sorghum insects of the South live also in crab grass.

PREPARATION OF THE SOIL AND TIME OF PLANTING.

Soil preparation is one of the legitimate ways of fighting insects. There is not a reputable stockman in the country who does not understand the worthlessness of a stunted pig, calf, colt, or lamb, and who is not aware of the necessity of keeping a young animal in a vigorous, growing condition from its birth. If this is essential with animals it is equally so with cultivated plants. It is the stunted or starved plant that is more often the prey of insects, though it can not be said that this holds good in all cases. However, a field of young grain in a healthy growing condition will sustain without material injury an attack that a less vigorous one would not. So far as plants are concerned, it matters little whether a soil is lacking in fertility or whether this fertility is present and beyond reach. There is sufficient nutriment in a healthy seed to enable it to throw a shoot upward to light and air and rootlets downward to draw from the soil. But suppose

these rootlets go about among solid clods begging, as it were, for food. Stunted plants are no more profitable than stunted animals. Take two fields of equal fertility of soil. One is plowed a considerable time before seeding, and is harrowed and worked over until a thoroughly pulverized, compact seed bed is formed. Seed placed in this ground will begin to draw from it as soon as the rootlets enter it and the plant above ground will be full of vigor. If the first shoot is destroyed by the Hessian fly the result is only to stimulate the throwing up of tillers, and the soil will sustain them. Indeed, if not too severe under such conditions, it is doubtful if the fly is not beneficial, because more tillers are produced and the roots are in a soil from which they can draw sufficient fertility to support them. Grain sown late in such a field will soon get sufficient root growth to enable the tillers to withstand the winter.

Now, take a second field, indifferently plowed and the surface smoothed over by a single harrowing that has only rattled a little loose soil down into the spaces between the clods. A rootlet starts out to feed the plant, but goes begging. The single shoot thrown up is destroyed by the Hessian fly, and the root is unable to find food enough among the clods to sustain tillers, so no tillers are thrown up, and the crop is seriously injured by what in the other case resulted rather beneficially than otherwise. To one who goes about the country examining fields in connection with entomological investigations any number of examples will be found of just such cases as these, until he asks himself how much loss is really due to Hessian fly attack and how much to poor or indifferent farming; and what is true of wheat and Hessian fly is more or less true of other grains and their insect enemies.

The corn root-louse, or, more properly speaking, root-aphis, is an obscure but serious pest of the corn plant, though were it not for the industrious ant it would do little injury. However incredible it may appear to many farmers, ants collect the eggs of the aphides in the fall and keep them in their underground homes during the winter. In the spring, as the young aphides hatch, they are conveyed to the roots of grass and weeds that spring up in the fields, where they are kept until the young corn plants appear above ground. The ants then burrow down to the roots of the corn, and, placing the aphides thereon, care for them as the herdsman does his cattle. The result is that the sap is extracted by the aphides from the corn roots, the plants are dwarfed, and the crop in many cases is seriously affected.

It has been learned that if ground intended for corn is frequently stirred between the time of plowing and first cultivation the homes of the ants are continually disarranged and no weed or grass roots are allowed to grow in the soil to furnish food for the young aphides prior to the appearance of the corn roots. Thus a more thorough preparation of the soil by frequent stirring from the time of plowing becomes a

practical and, to all appearances, efficient measure for the control of this pest, which is by no means an insignificant one.

As indicated in the foregoing, the time of planting may prove an important factor in insect control. Many of the insects included in the three groups previously mentioned cease their feeding as summer approaches and enter a stage of development in which no food is required, and if planting can be sufficiently delayed much of the loss by their ravages can be avoided. Of course latitude has much to do with the time of seeding, and measures that can be put in effect to the southward may not prove so practical in the North.

WELL-KEPT PREMISES.

Under this head are to be included a number of operations of seemingly minor importance to an active farmer, and therefore more often overlooked or neglected. Their importance from the standpoint of injurious insects is much greater than is generally supposed, and it is indeed difficult to compute the consequent losses. For instance, the writer has traced a destructive invasion of chinch bugs in a wheat field in spring to shocks of corn that had been allowed to stand out over winter, the wheat having been sown among corn in the fall. In precisely the same way outbreaks of the same insect in Iowa have been traced directly to Osage orange hedges and the usual growth of matted grass and weeds that is often found in connection with them. It is just such places as these that attract the bugs in fall and wherein they pass the winter, scattering to the cultivated grains in spring to breed and work their destruction.

The timothy joint-worm, a new enemy of this grass now under investigation, lives in the stem and injures both the hay and the seed, shrinking the latter from 10 to 20 per cent in weight. It is found in great abundance along roadsides and fences, and in other neglected places, and that it spreads to meadows and injures them is beyond question. In localities where these places are mown or grazed off and the grass lands rotated with other crops we do not find the meadows badly affected by this pest. Plate LIV, figure 1, shows a timothy meadow in Wayne County, Ind., nearly one-half of the stems containing joint worms; figure 111 the shortened length of the heads in this meadow. Plate LIV, figure 2, shows an uninjured meadow from the same locality and figure 112 the relative average condition of the heads of timothy.

The same measure that applies so aptly to this insect is effective against the invasion of the clover fields by the clover-flower midge. This minute fly is a close relative of the wheat midge, is two-brooded each year, and does serious injury to the seed crop of red clover by blighting the ovaries of the blossoms. But it can be easily managed on the part of the farmer by simply mowing very early for hay or grazing lightly in spring, or even mowing at this time, so as to retard the first blooming

until the minute pest has come and gone. In this way no insects are produced to give rise to the second brood, and the fall crop of seed is thus enabled to develop without injury.

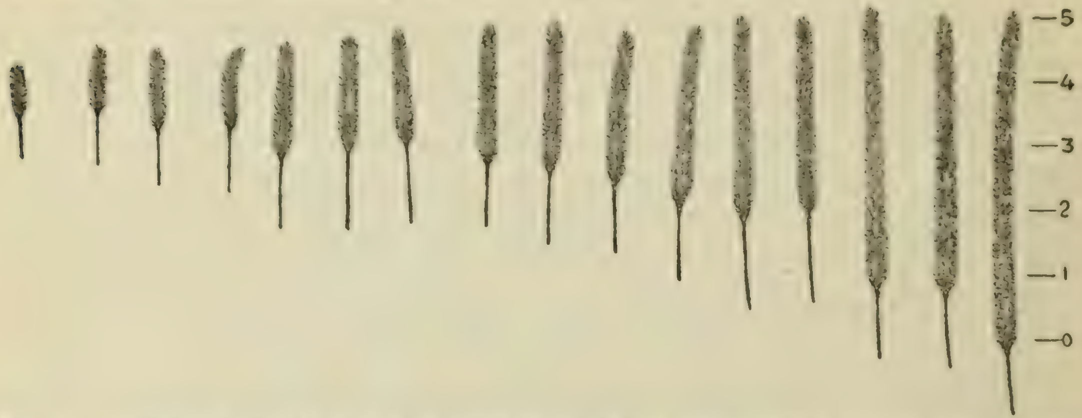


FIG. 111.—Illustrating average length of heads of timothy in field infested by the timothy jointworm, shown on Plate LIV, figure 1. Notice the large percentage of undersized heads. Scale of inches at right. (From a photograph.)

Other roadside and fence-corner grasses and weeds harbor other insect pests of field crops, not alone as a nursery, but because matted grass, fallen leaves, and other rubbish afford the best possible protection

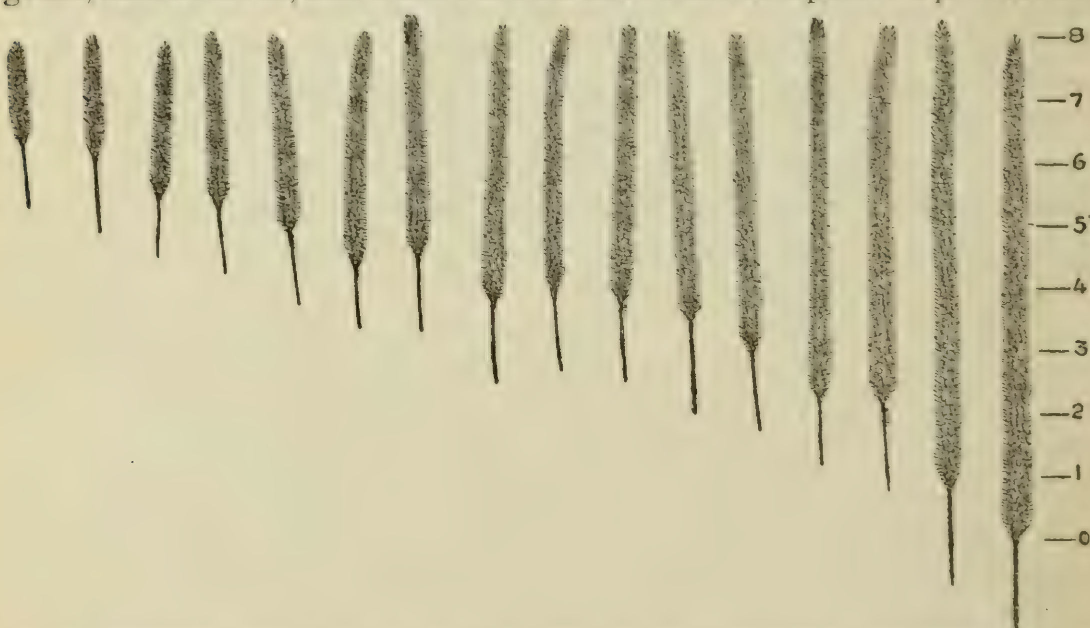


FIG. 112.—Illustrating average length of heads of timothy in uninfested field shown on Plate LIV, figure 2. Notice the relatively greater percentage of large heads as compared with figure 111. Scale of inches at right. (From a photograph.)

during winter. The farmer who keeps these places mown or grazed during summer, or burns them over during winter or early spring, is saving his money by not rearing up and fostering enemies of his crops.

DEALING WITH THE HESSIAN FLY.

IN WINTER-WHEAT REGIONS.

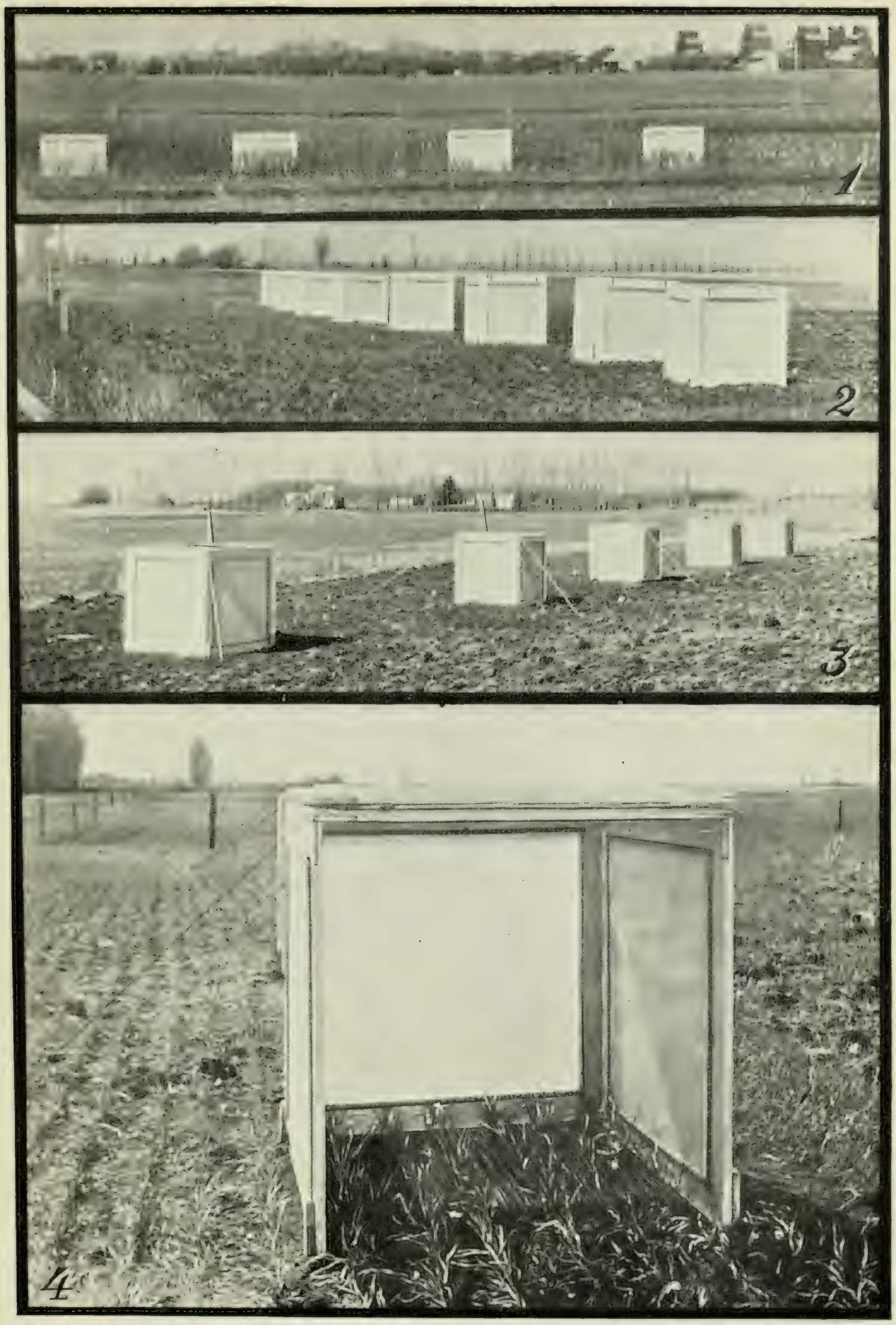
In case of the winter-wheat crop, with especial reference to the Hessian fly, the time of seeding in the fall is an important matter. The Hessian fly is two-brooded, the spring brood appearing earlier to the

FIG. 1.—A TIMOTHY MEADOW IN WAYNE COUNTY, IND., IN WHICH NEARLY ONE-HALF OF THE STEMS CONTAIN JOINT WORMS.

[The average lengths of heads of grass are shown in text figure 111. (Original.)]

FIG. 2.—A TIMOTHY MEADOW IN WAYNE COUNTY, IND., WHERE VERY FEW JOINT WORMS WERE TO BE FOUND IN THE GRASS STEMS.

[The average lengths of heads of grass are shown in text figure 112. (Original.)]



STUDYING THE NUMBER OF BROODS AND TIMES OF APPEARANCE OF THE HESSIAN FLY IN THE SPRING WHEAT REGIONS OF THE NORTHWEST.

[Figs. 1, 2, breeding cages in position in fields of grain; fig. 3, cages as placed before grain had germinated; fig. 4, cage with door open, showing young grain growing within. (Original.)]

south and later to the northward, but in the fall this order is reversed and the autumn brood appears earlier to the north and later to the south. This applies to the winter-wheat region east of the Mississippi River. Recent investigations by the Bureau of Entomology in experimental sowings of wheat have shown this gradual retardation to amount to nearly two months between northern Michigan and northern Alabama and South Carolina. The pest breeds only in wheat, rye, and barley (chiefly in the first), so that if seeding can be delayed until the flies have come and gone little injury is sustained, and it thus becomes possible for the farmer to avoid the ravages of this pest in the fall by simply practicing moderately late sowing. If there were no Hessian fly in the fall there would be none in the spring, as the spring brood has its origin in the one appearing in the fall. The best proof of the value of this measure is the fact that progressive wheat growers over the country are putting it into successful operation, and there is every indication that, when it is generally carried out, the effect will be to prevent much of the enormous losses that now occur.

IN SPRING-WHEAT REGIONS.

Recent investigations have shown that the problem of Hessian fly control in spring-wheat regions is an entirely different one from that of fall wheat. Formerly it was not supposed that the pest could exist in excessive abundance where fall wheat was not grown. But it did so nevertheless. It was then thought to be necessarily single-brooded, but an agent of this Bureau has determined by a long series of careful experiments that there are actually two broods during the short northern summer, while flies continue to emerge from the old stubble of the previous year nearly up to the time of harvest. This wholly unexpected state of affairs has been determined by studying the Hessian fly under confinement in the fields in a long and extensive series of breeding-cage experiments that are illustrated in Plate LV. In these cages the flies were carried through their different transformations from egg to adult during the entire summer, the data thus obtained being checked by field observations. As a result, we find that the farmer of the Northwest will be obliged to adopt different methods of controlling the pest from those carried out where fall wheat only is grown. Whatever these methods are, they will have to be cultural or such as can be applied in some phase of farm management.

CONCLUSION.

It is the farmer himself who raises the insect pests that ravage his fields and thereby steal from him the profits of his labors. By reason of his large areas of cultivation, he is unable to manage these pests

after he has reared tnem. The fact that he does not see them or properly estimate their capacity for destruction does not in the least alter the case or the amount of loss they cause him. In view of their great numbers and variety, he can not hope to cope with each kind singly, but must adopt a system of farming that will include general preventive measures. The best proof of the practicability of this plan is the fact that individual farmers, and among them the most successful, are putting it into practice.

FORMALDEHYDE: ITS COMPOSITION AND USES.

By Bernard H. Smith,
Of the Bureau of Chemistry.

INTRODUCTION.

During the past few years we have heard much of bacteria—"germs," which endanger life, and "fungi," of which our forefathers never heard—that prey upon the crops. Bacteria, however, are either good or bad. An illustration of the first class is the kind that grows upon the roots of clover, peas, and similar plants, having the power of obtaining for the plant from the air that expensive plant food, nitrogen. Illustrations of the second class are unfortunately so common that an example is hardly necessary; the germ that causes consumption might be cited.

Various means of combating injurious bacteria have been suggested, and one of the most valuable chemical reagents used for this purpose is formaldehyde. Used as a gas or as a watery solution, formaldehyde is a most valuable disinfectant, deodorant, fungicide, and preservative.

GENERAL PROPERTIES.

ISOMERISM.

In order that the action and usefulness of formaldehyde, as well as its limitations, may be better understood, a short discussion of its characteristics and properties is necessary. Formaldehyde is a gas having a sharp, penetrating odor, and while not poisonous in the ordinary sense of the word, it has a very irritating effect upon the nose, throat, and other mucous membranes. It has the property of combining with albuminous matter, and its effectiveness as a disinfectant is due to its entering into combination with the protoplasm of bacteria. The aqueous solution, often called formalin, formol, etc., is supposed to contain 40 per cent of formaldehyde.

Formaldehyde possesses the property known as "isomerism." This word is derived from two Greek words, one meaning "equal" and the other "a part," and is used to designate those substances which while having the same percentage composition possess totally different properties, i. e., it is applied to two or more different substances which are composed of the same elements and of the same proportion of those elements. Formaldehyde exists in three of these isomers: Formaldehyde (CH_2O), composed of one molecule; paraformaldehyde $(CH_2O)_2$, composed of two, and trioxymethylene $(CH_2O)_3$,

composed of three molecules. The clear-water solution of formaldehyde doubtless contains the first two forms, and when the solution is subjected to very low temperatures, and from some other causes, the third variety is formed, which, being insoluble in water, crystallizes out as a whitish sediment.

NONCORROSIVENESS.

One of the chief advantages of formaldehyde over other chemical disinfectants is that it is noncorrosive toward all metals, with the exception of unpolished steel and iron, which it attacks but slightly. It does not injure the finest fabrics, but it should be remembered that formaldehyde is nearly always slightly acid, owing to the presence of formic acid. Though it has a tendency to harden animal tissues, it seems to have no effect on wool, and it is usually stated that it has no injurious effect upon leather, which, so far as the gas is concerned, is undoubtedly true.

The following experiment was recently made by the author to determine this point. A high-grade piece of calfskin was cut into four strips. No. 1 was immersed in water for an hour; No. 2 was subjected to formaldehyde gas for twenty-four hours; No. 3 was immersed in a 38 per cent neutralized solution of formaldehyde for an hour; and No. 4 was not treated at all. After two days these strips were cut into smaller strips and several of each were given to a leather expert, who was asked to distinguish between them. The ones which had been wet were easily picked out, and those soaked in the formaldehyde solution were, in general, easily distinguished from those which received only the water treatment, being slightly harder and more warped. When rubbed for a few minutes both samples Nos. 1 and 3 became perfectly pliable. The strips treated with gas only and the blanks could not be told apart. The results of the experiment indicate that the gaseous treatment certainly does not injure leather and that even the liquid treatment has but little immediate effect; but the fact that the leather soaked in the solution of formaldehyde warped decidedly would justify the inference that some action in addition to that which the water produced took place, and in all probability the wearing quality of such leather would be injuriously affected.

COMPOSITION OF THE COMMERCIAL ARTICLE.

At the meeting of the Association of Official Agricultural Chemists in St. Louis in 1904[a] it was suggested that much of the formaldehyde on the market supposed to be of 40 per cent strength was in fact much weaker. This disinfectant is used in large quantities in treating seed potatoes for scab and also in the treatment of seed oats, barley, and wheat for the prevention of smut; and in this work it is essential that the solution used should not be far below the standard, otherwise when the formaldehyde is diluted in accordance with the directions obtained

[a] U. S. Dept. Agr., Bureau of Chemistry, Bul. 90, p. 106.

from a State experiment station or other authentic source such a degree of dilution may be obtained as to render the treatment unsatisfactory.

To determine the strength of the commercial article a number of samples have been obtained from different parts of the United States and subjected to analysis. The larger part of these samples were purchased directly for the Bureau of Chemistry in the open market. The Ohio samples were forwarded by the State dairy commissioner, having been collected by his inspectors. The results of the analyses and the sources of the samples are given in the following table:

Analyses showing percentage strength of commercial formaldehyde in samples obtained in 1905.

No.	Place of manufacture.	Place of purchase.	Forwarding agent.	Formaldehyde.	Remarks.
				Per cent.	
1	Michigan	Atlanta, Ga	R. I. Smith, Atlanta, Ga	37.90	Slightly cloudy.
2	Missouri	do	do	35.95	
3	Unknown	do	do	37.43	
4	Michigan	Fayetteville, Ark	J. H. Norton, Fayetteville, Ark	37.62	
5	Unknown	do	do	37.81	
6	do	Amherst, Mass	E. B. Holland, Amherst, Mass.	37.81	
7	do	Northampton, Mass.	do	37.20	
8	Germany	do	do	32.45	
9	do	Des Moines, Iowa	L. G. Michael, Ames, Iowa	33.50	
10	Michigan	Ames, Iowa	do	38.57	
11	Illinois	do	do	36.67	
12	Unknown	Moscow, Idaho	C. A. Peters, Moscow, Idaho	37.55	
13	do	Bozeman, Mont	V. K. Chesnut, Bozeman, Mont.	38.60	
14	do	do	do	38.59	
15	do	do	do	36.93	
16	England	Columbus, Ohio	Horace Ankeney, Columbus, Ohio.	37.11	
17	Unknown	do	do	35.54	
18	do	Dayton, Ohio	do	36.55	
19	do	Indianapolis, Ind	do	37.26	
20	Germany	San Francisco, Cal.	Felix Lengfeld, San Francisco, Cal.	35.75	Heavy precipitate.
21	Unknown	do	do	37.43	
22	do	do	do	37.45	
23	do	do	do	39.11	
24	do	do	do	38.70	
25	do	Pullman, Wash	R. W. Thatcher, Pullman, Wash.	36.20	Of jelly-like consistency.
26	Pennsylvania			36.25	From stock of Bureau of Chemistry.
27	Germany			37.55	
28	do			37.25	
29	do			36.55	

The results of this single investigation indicate that the amount of formaldehyde contained in the preparations sold in the United States averages approximately 37 per cent. Some of these samples, particularly those obtained from the far western States, contained large quantities of insoluble polymerized formaldehyde, the correspondents from those States writing that it was very difficult to obtain samples

not having such a precipitate. Why the Pacific coast States have so much of this product it is difficult to explain. In one or two of those samples, particularly in the one from Pullman, Wash., the volume of precipitate continued to increase until the contents of the bottle became a jelly-like white mass. Formaldehyde in this condition is of little use as a disinfectant unless used in a steam autoclave,[a] and as a fungicide it is valueless, for when the white precipitate has once formed it is very insoluble and it is impossible to tell, without an analysis, what percentage of active substance is available in the solution.

METHODS OF DISINFECTION.

Formaldehyde used as a spray or as a gas is a very effective disinfectant, destroying even the more resistant bacteria. To accomplish this the amount used must be proportional to the space to be disinfected and the exposure must continue for a definite length of time. One pound of the commercial "40 per cent" solution retailing for about 35 cents should be allowed for each 1,200 to 1,500 cubic feet of space, and the treatment should last from twelve to twenty-four hours. Formaldehyde is more efficient in a warm room, because under such conditions its tendency to polymerize or form solid particles is much less than at lower temperatures.

Bacteria at the spore stage are the most difficult to kill because of their impervious surrounding membranes, but, as Abbot points out, "All of our quarantinable diseases are caused by nonspore-bearing organisms and our object is to disinfect, not sterilize." However, considerable care is necessary in order to disinfect thoroughly, and that this may be accomplished the room or space to be disinfected must be tightly closed, all cracks being stuffed with cotton or strips of cloth or covered with adhesive paper, and all objects in the room must be freely exposed. Formaldehyde gas does not have great penetrating power, and such articles as bedding and mattresses should be thoroughly wet with the solution, or if possible, it is better to treat with formaldehyde gas and steam in a small closed space.

There are many methods of applying formaldehyde as a disinfectant, among which may be mentioned using the liquid as a spray on the bare surfaces of the room, or hanging sheets and applying the spray to them. Evaporation from an open dish with or without the addition of glycerin or calcium chlorid is effective, and this method may be altered by using a retort and conducting the gas into the room by means of a tube, generating the formaldehyde gas from wood alcohol by various lamps devised for the purpose. The gas may also be generated from the solid paraformaldehyde or formed in an autoclave, where the liquid is heated in a closed container until a high pressure is reached, when it is admitted to the apartment to be disinfected.

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[a] An apparatus for heating under pressure.

If only a small amount of disinfecting is to be done, a combination of the spray and sheet methods will meet the requirements fully as well as the others, which, though more scientific, involve the purchase of special apparatus. It has been suggested, however, that such a large quantity of the solution is polymerized upon the sheet in the evaporation as to render this method of little value. With a view to determining the percentage of polymerized formaldehyde remaining upon the sheet at ordinary room temperature under usual conditions, the following experiment was recently conducted in the Bureau:

In a small room containing 600 cubic feet a sheet 81 by 90 inches was suspended, upon which was sprayed 7 ounces of a clear solution of formaldehyde, which is about the maximum amount of the solution that can be put upon a sheet of this size without dripping. After the room had been closed eighteen hours a strip of uniform width from the top to the bottom of the sheet was subjected to analysis. Less than 1 per cent of the proportional amount of the formaldehyde used was found upon the sheet. The experiment was repeated, using another sample of formaldehyde, and the results obtained in this trial were comparable with the first, which would indicate that there is no great amount of loss of formaldehyde by polymerization in employing the sheet method.

If the solution is evaporated by heat from an open dish in the room, or from a retort outside, the addition of from 10 to 15 per cent of glycerin is advisable. Glycerin has a very high boiling point, and its addition tends to prevent polymerization. Calcium chlorid is added for the same purpose and also because of its affinity for water, as it has been thought by some that the drier the gas the more effective would be the disinfection. It is now generally conceded, however, that a limited amount of moisture is desirable for the best results. The effect of small quantities of calcium chlorid in raising the boiling point is hardly appreciable.

Many lamps have been devised for generating the gas by the slow combustion of methyl or wood alcohol. The majority of these, however, give but a comparatively small proportion of the formaldehyde gas theoretically produced, and for the most part they are untrustworthy. If a large space is to be disinfected an autoclave of some sort will doubtless prove most satisfactory.

USE AS A DEODORANT.

Formaldehyde is a true deodorant, acting chemically upon the offensive compounds and forming others without odor. The commercial solution may be considerably diluted for this purpose, a strength of from 3 to 5 per cent being effective, while it does not vaporize so rapidly as to cause discomfiture on the part of the user. For use about sinks and drains, or in vaults and cesspools, it is one of the best deodorants known.

APPLICATION AS A FUNGICIDE.

The many fungi which attack crops are themselves low forms of plants. Many of these survive the winter in the form of spores, the larger part of which remain on the ground where the crop was grown. Enough of these, however, stay on the seed of the crop to insure the recurrence of the disease the following year, even though a new field free from the disease be used.

The successful farmer knows that it is not profitable to grow potatoes from scabby seed nor on ground where last year's crop was afflicted with scab, though he may not know the scientific reason involved, namely, that there are scores of spores upon each scabby tuber and that thousands lie in wait in the soil where an infected crop grew. If the seed before planting can be subjected to some treatment which will not injure its germinating power but will kill any spores that may be adhering to it, the advantage is obvious; for then by using a new field the disease can be avoided. Treatment with formaldehyde accomplishes this result and is not only efficacious in the prevention of potato scab, but is equally so in the case of oat, barley, and wheat smut and other similar fungous diseases.

The treatment usually recommended for potatoes is to soak the seed tubers for two hours in a solution prepared by adding 8 ounces of formaldehyde (38 to 40 per cent) to 15 gallons of water. If the seed is then planted upon a clean field, the crop should be free from scab.

The dilution usually recommended for the treatment of seed grain is 1 pound of commercial formaldehyde to 50 gallons of water. This solution is sprinkled or sprayed upon the seed until the latter is moist enough to pack in the hand. It is then shoveled into a pile, covered over, and left for at least two hours before sowing. If desired, the seed may be allowed to dry and be sown when convenient. This treatment will not injure the germinating power of the seed except to a very slight extent, which is offset many times by the benefit obtained.

GENERAL USES AS A PRESERVATIVE.

Because of its marked antiseptic properties formaldehyde is an efficient preservative. During the last few years it has largely displaced alcohol as the preservative of anatomical specimens, a dilute solution being much used for this purpose in medicine and surgery, in pharmaceutical preparations, and in microscopy. Sixteen years ago, when the antiseptic properties of formaldehyde were first discovered, the compound was practically unknown except to the chemists; now its uses have so multiplied that they have extended to food products, especially milk and cream. Under various trade names it has been put upon the market as a "harmless" preservative of food products, but the highest authorities consider it harmful in any quantity, and its use in food products is prohibited in a large number of States.

WASTE IN LOGGING SOUTHERN YELLOW PINE.

By J. Girvin Peters,
Forest Assistant, Forest Service.

INTRODUCTION.

The total stand of southern yellow pine was recently estimated at about 300,000,000,000 board feet. This is in excess, however, of estimates by the best posted southern lumbermen. Therefore it is probable that the present stand of southern yellow pine can scarcely exceed this amount. The annual cut is practically 10,000,000,000 board feet, and there is every reason to believe that this will increase. It is fairly safe, then, to conclude that within twenty-five years southern yellow pine will have almost ceased to be an important commercial commodity.

Yellow pine stumpage twenty years ago was worth not over 50 cents a thousand; it is held to-day at from $2 to $5, the average value probably being $3. Twenty years ago timber land in the South brought $1.25 to $5 per acre; to-day it brings from $10 to $30. The history of the white pine in the Lake States is repeating itself in yellow pine in the South.

Deductions from actual measurements have shown that the timberland owner in the South generally is not enforcing as full utilization of his timber as is possible. The result is that not only is he losing the stumpage value of the timber not utilized, but he is also hastening the time when his timber supply shall become exhausted, a time at which its stumpage value would probably have greatly increased.

CONDITIONS UNDER WHICH LOGGING IS CARRIED ON.

In general, logging is carried on under one of the following conditions:

(1) Land and timber owned, and the timber logged and milled, by one and the same party.

(2) Land and timber owned by one party, timber logged under contract by a second party, and milled by the first party.

(3) Land and timber owned by one party, stumpage bought, and timber logged and milled by a second party.

As a rule there is a marked increase in waste in logging from condition 1 to condition 3, because where the owner of the timber land is

the lumberman it pays him to saw any grade of lumber that will show a profit over the cost of manufacture; but where the buyer of the stumpage is the lumberman the stumpage price is reckoned along with the cost of manufacturing, and upon the existence of a low or high stumpage price depends whether it is practicable for the lumberman to saw low-grade top logs or only the clear length of a tree.

CONDITIONS STUDIED IN THE PRESENT ARTICLE.

The bulk of southern yellow pine is in Mississippi, Louisiana, and Texas. In the latter two States material for a special study of waste in logging was gathered by the Forest Service in the winter of 1904. Measurements were taken on 347 sample areas on the cuttings of a large lumber company, which furnished an excellent example of conditions favorable to wasteful logging. The aggregate of these 347 sample areas was 335.5 acres, located on 8 recent cuttings, from which the tram spurs had been taken up. It was impossible, therefore, that any more timber could be logged from the land.

The logging operations fall under the third of the conditions specified above. The timber was owned by a land company, which sold the stumpage to a lumber company at $4 per thousand feet. In this region the cost of producing lumber, including cutting and hauling of logs to the mill, sawing and handling, depreciation of mill plant, etc., was about $8 a thousand. The total cost of the product ready for shipment was therefore about $12 a thousand.

The lumber company paid a very high stumpage price; the land company exercised no supervision in the woods over the cutting of its timber. The natural result was that practically nothing was taken from the woods which, though merchantable, would not show a profit over its total cost. In this case it meant a waste of the resources of the seller, and careless logging by the buyer; waste, because a large amount of merchantable timber was cut and left in the woods; careless logging, because a large number of small trees were indiscriminately cut for use in logging or were knocked down by falling timber, which is merely another form of waste—a waste of future supply. (Pl. LVI, fig. 2.)

The lack of supervision by the land company and the high stumpage price paid by the lumber company go hand in hand as the two great factors to which the waste may be attributed. The result of the absence in the woods of a representative of the land company is best illustrated by the large amount of merchantable timber left behind in the tops of logged trees. The stumpage price has a direct bearing on this form of waste. It will be remembered that this price was $4 per thousand feet, and that in consequence the total cost to the lumber company was about $12 a thousand. The value of the lumber that the top logs would saw out would average, as shown further on, about $10

a thousand. Although this cost of production is an average price merely, and does not indicate that each additional thousand feet of lumber entails an added expenditure of the full $12, since the expenses incident to lumbering the area as a whole have been already incurred, it is plain that the higher the cost the less the incentive to the lumber company to utilize low-grade material. In other words, the company would not have been out of pocket $2 per thousand in consequence of taking lumber which would bring only $10 per thousand, in spite of the fact that the average cost of production, including such items as taxes, construction of plant and railways, etc., is $12 per thousand; but the fact that for every thousand that was taken the lumber company would have to pay $4 in stumpage, and would therefore have only $6 left to defray the expense of handling and milling this low-grade timber, would decidedly discourage its use, since it would yield very little profit aud might involve a loss. The owner, however, loses the stumpage price, $4, for every thousand feet in the woods. Here is where supervision would make itself felt. It is to the interest of the seller of the stumpage to see that all of the tree which can be converted into lumber is paid for.

PART-MERCHANTABLE CULLS AND TREES DESTROYED.

A feature markedly in evidence after logging is the number of part-merchantable culls—trees left as culls by the sawyers, but which would yield a merchantable log. Measurements on over 300 acres show that more than 6 per cent of the trees standing after logging consist of part-merchantable culls. These are generally big trees, containing in the butt cut rarely less than 200 board feet of sound timber, and being in some instances over 40 inches in diameter on the stump, so that the lumber from even one log of such trees would unquestionably cover the expense of handling them. Moreover, these part-merchantable culls, if left standing, will probably be absolute culls by the time of the next cutting. The safest plan to insure the utilization of culls about which there is any doubt as to their merchantable contents is to cut every one of merchantable size—10 inches and over on the stump—and where the sawyers are paid by the thousand feet cut and not by the day, to allow them at least the number of feet in the butt cut of every cull felled. Where this plan is adhered to it is a paying one.

A large number of trees are knocked down, badly broken and splintered by falling timber, or are cut for skid poles, cut as "bed trees," across which to fell other trees in order to obtain a good "fall" and so prevent the saw from pinching, or cut merely to get them out of the way. Most of these trees are below 10 inches on the stump, and hence unmerchantable, though measurements show 58 per cent of them to be

fairly fast-growing sap trees, which should be the basis for a future stand. Measurements further show that of the total number of sap trees which might have been left standing after logging, 25 per cent, or one-fourth, were broken, knocked down, uprooted, or in some way incapacitated for future growth by careless logging.

On one of the cuttings investigated the trees are "spotted," or marked, for removal, thereby insuring the cutting of every tree about which there is any doubt as to its being above or below the diameter limit. The value of marking timber with respect to part-merchantable culls alone is unquestionable, since figures show that where timber is marked practically none of this class is left standing. The conclusions, then, are that—

(1) Some merchantable timber is left standing which will in all probability become cull by the next cutting, and should therefore be cut now.

(2) A great many small, growing sap trees are destroyed by careless logging.

(3) The best results are obtained by spotting or marking the timber for removal.

MERCHANTABLE TIMBER LEFT ON THE GROUND.

A very large part of the waste in logging is represented by merchantable timber left on the ground in tops, broken and knocked-down trees, right-of-way trees, bed trees, sound logs cut but not skidded, and windfalls with sound heart. By far the greatest part of this waste is contained in tops. Frequently in cutting long logs for bill stock only one log is cut from a tree where it is possible to cut a second and even a third log. For instance, from a tree 20 inches on the stump, a 36-foot log was cut, 12 inches in diameter at the top end. The remainder of this tree would have yielded a merchantable log 40 feet long and 9 inches at the top, scaling, according to the Doyle Log Rule, 62 board feet. From another tree, 21 inches on the stump, a 34-foot log, 14 inches at the top, was cut. What was left of this tree would have yielded a merchantable log 40 feet long and 10 inches in diameter at the top, scaling 90 feet. (See Pl. LVII.)

The estimate here given of the amount of such timber wasted is unquestionably conservative. The practical value of such figures, however, rests entirely upon the fact that the timber is merchantable. Only timber which would have produced reasonably straight and perfectly sound logs was taken into account. Red-heart timber is exceedingly common, and, owing to the prevalence of so-called blink punks and to the bleaching of red heart exposed to the sun, which makes the rot difficult to detect, the woodsmen employed to take the measurements were required, wherever there was the slightest doubt as to the soundness of any piece of timber, to chop into the particular piece at the spot supposedly affected. Also, only timber was taken

FIG. 1.—VIRGIN STAND OF SOUTHERN YELLOW PINE.

FIG. 2.—SNAGS OF TREES KNOCKED DOWN BY FALLING TIMBER.

[The larger tree is 16 inches on the stump. That part of it lying on the ground, after being butted of splinters at the end, will cut a sound log 26 feet long and 9 inches at the top, containing 41 board feet.]

FIG. 1.—SPECIMEN TOP LOG LEFT AFTER LOGGING. IT WILL CUT A LOG 40 FEET LONG AND 10 INCHES AT THE TOP END, YIELDING 90 BOARD FEET.

FIG. 2.—MERCHANTABLE TIMBER LEFT IN TOPS AFTER LOGGING. BILL STOCK WAS CUT HERE.

into account from which could have been cut at least a 12-foot log with a diameter at the small end not less than 8 inches, and then only provided no branches were included which would exceed 5 inches in diameter. These specifications were adopted because the smallest merchantable yellow-pine log must be not less than 8 inches in diameter at its top end, nor less than 12 feet in length, and because a knot over 4½ inches in diameter will make of a yellow-pine board a cull, and a branch 5 inches in diameter outside the bark will make about a 4½-inch knot.

The lumber company, however, practically regards 16 feet as the shortest merchantable log length, since it handles no 12-foot and hardly any 14-foot lengths.

To be especially conservative in estimating this waste, 16 feet has been assumed as the shortest merchantable log length. The results from measurements on 318.5 cut-over acres show that the average loss per acre was equivalent to 13 logs, each 22.8 feet long and 9.8 inches in diameter at the top, containing 667 board feet by the Herring rule. This figure, 667 board feet per acre, represents the amount of timber which could have been saved to the land company by efficient supervision of the logging.

Though at the time the measurements were made, in January, 1904, the shortest merchantable length was generally regarded throughout Mississippi, Louisiana, and Texas as 16 feet, 12-foot lengths were cut in some few localities, and they are certainly merchantable. Had lengths as short as 12 and 14 feet been assumed as merchantable the average waste per acre would be 962 board feet in 19 logs 19.6 feet long and 10.1 inches in diameter at the small end; or, in other words, with 12 and 14 foot lengths accounted for, 6 more logs could have been gotten per acre, containing 295 board feet.

Absolute proof that this timber was merchantable could have been had only by cutting the logs from the tops, etc., getting them to a mill, and sawing them into lumber. This, however, was not feasible, if for no other reason than the removal of the tramways. Therefore, a cutting was selected on another tract in the same region, where logs were being cut at least as far into the tops as those measured on the land company's tract.

On this cutting the logs of 1,405 trees were scaled in the woods, and each log was so marked that when it reached the mill it could be identified and the lumber cut from it could be graded directly from the saw. Enough of these logs were followed through the mill and the lumber graded to furnish complete results for 722 trees. The top logs from 185 of these 722 trees were selected as representing the lowest grade and as being practically identical with the logs scaled as waste on the land company's tract as to both grade and size. The amount of lumber by grades which these logs sawed out and the market value of the lumber of each grade at the prices current in March, 1904, is given in detail below. As was to be expected, the bulk of the lumber, or

nearly 90 per cent, graded into common boards and dimension, the greater part of which went into No. 1 common dimension.

Amount and market value of the graded long-leaf pine lumber sawed from 185 top logs.

Grade.	Per cent.	Board feet.	Market value.
Heart timbers	4.38	529	$5.29
A flat flooring	.06	7	.11
B flat flooring	.04	5	.07
1 C flat flooring	4.28	517	6.20
2 C flat flooring	1.12	135	1.15
1 common boards	6.36	769	8.46
2 common boards	1.03	125	1.12
Clear finish	.21	26	.57
Star finish	.17	21	.42
1 common dimension	67.86	8,203	82.03
2 common dimension	14.49	1,751	14.45
Total	100.00	12,088	119.87
Average value per M board feet			9.92

From the above table, then, it appears that the market value of the lumber sawed from these top logs averages $9.92 per 1,000 feet. The practical question for the company was, therefore, could it afford to manufacture this lumber which it can sell for only $9.92?

It may be said in this connection that the course which market prices have taken since the spring of 1904 has been such as to dispel all doubts as to whether such lumber as the above is worth taking. Many lumber companies in the southern pine belt which would not saw top logs two years ago are now using their trees far up into the limbs. The excuse for waste in logging is now less than ever before. Nevertheless, the essential fact remains that the higher the stumpage price the less is the incentive to a lumber company to take the lower grades, and the greater the importance to the timberland owner of protecting his interests by specifying for utilization of all merchantable timber and by providing for adequate inspection to enforce observance of contract terms. Lumber companies which are operating on their own lands are much less likely to leave good timber in the woods, though even here the conservatism of established custom tends to retard the use of up-to-date methods; but the seller of stumpage must expect to lose if he does not require the purchaser to pay for all merchantable timber left on the ground through wasteful logging.

The conclusions in regard to merchantable timber left on the ground in tops, etc., are that—

(1) The amount of waste, if 16 feet is assumed as the shortest merchantable log length, was 667 feet per acre; if 12 feet, 962 per acre.

(2) The market value of the lumber which this waste would saw out was $9.92 per 1,000 feet.

WASTE IN HIGH STUMPS.

The fixation of stump heights is, in any case, purely arbitrary, for the object is simply to have the small trees as well as the large trees cut as reasonably low as possible. It is believed that a stump height of 24 inches for sound trees 24 inches and over on the stump at 2 feet above the ground, and of 18 inches for sound trees under 24 inches on the stump, would in this particular case have given the best results. On this basis the waste in cutting high stumps on the land company's tract was calculated. It appeared that the average stump height for trees 24 inches and over on the stump was 29 inches; for trees under 24 inches on the stump, 27 inches; and that this represented a loss of 218 board feet per acre, or 1.85 per cent of the total yield.

It is significant that the largest lumber companies in the South are now beginning to cut low stumps, usually 24 inches high, against 30 to 36 inches formerly, realizing thereby a slight profit not only in the quantity of lumber saved, but especially in its quality. However, where no discrimination is exercised in cutting low stumps, this profit will decrease proportionately with the increase of trees with damaged butts. Only sound-butted trees will yield a profit on low stumps. What is supposed to be gained in the woods by cutting trees with damaged butts too low is lost in the mill at the trimmer, where the original length may be reduced by at least 2 feet. The indiscriminate cutting of low stumps is especially impractical when a mill is sawing bill stock, logs of specified lengths being cut in the woods to fill a particular order. The stumps measured were separated into three classes—(1) sound, (2) pitchy, and (3) doty or rotten. Of the stumps on 333.5 acres, 7.4 per cent were pitchy; 4.8 per cent doty. There were, then, 87.8 per cent of sound stumps, which could have been cut on an average 4 to 13 inches lower, thereby saving 218 board feet per acre to the land company.

A pitchy stump results from a scar, and fire is usually the agent which makes the scar. In the natural healing process a copious exudation of pitch from the wound takes place, in consequence of which the wood becomes pitch-streaked to a depth proportionate with the size of the scar. This condition produces what are ordinarily known to the loggers as rich, fat, or pitchy stumps, so common on burned areas. Fire-scarred timber saws out most of the pitch-streaked lumber culled at the mill. As a prominent lumberman expressed it, "Every tree with a defective butt is a separate proposition, about which no hard and fast rule as to a low stump can be laid down."

The conclusion, then, is that a low stump height should be enforced in the case of all sound-butted trees, and that this will result in an appreciable gain to both the land company and the lumber company—to the one from an increase in the amount of timber, to the other more especially from the high quality of lumber thus secured.

USE OF SKID POLES.

A large number of young trees, 5 to 8 inches in diameter, are cut for skid poles. Where logs are loaded by a cross-haul team, ground skids are essential. For this purpose inferior and unhealthy trees should be selected in preference to thrifty, growing trees. The basis for a future yield must be the growing trees which remain standing after logging. Therefore, indiscriminate cutting of small trees will tend to diminish the future yield. The number of skid poles was counted on several switches of varying lengths. The result is shown in detail in the following table, the feature of which is the high percentage of sap poles. The terms "sap" and "heart" used in the table refer respectively to thrifty, growing trees, and to unhealthy or matured slow-growing trees. When standing they are distinguished entirely by the appearance of the bark, which in the former is loose, exfoliating, and furrowed; in the latter, comparatively smooth and tight. "Sap" and "heart" are terms perfectly intelligible to the logger, and have been used as the best means of distinguishing between what should and what should not be cut for skid poles.

Skid poles cut for 8.28 miles of switches, through southern pine forest yielding about 10,000 board feet per acre.

Class of pole.	Number of poles.			Percentage of each class.
	For entire length of switches.	Per mile.	Per section.	
Sap	885	107	28	63
Heart	484	58	351	34
Cull	39	5	641	3
Total	1,408	170	1,020	100

Of the total number of sap trees destroyed by logging, it was found that about one-fifth were cut for skid poles.

The number of skid poles required varies with the amount of timber cut. If a section of land will require 6 miles of tramway, the above table shows that upward of a thousand skid poles are necessary. It is possible to check up this estimate—a conservative one—as follows: If the average acre yields 10,000 board feet, the whole section will yield 6,400,000 feet. One skidway is allowed to about every 12,000 board feet logged; if two skid poles are allowed to a skidway, the total number of poles per section is 1,066, which is practically the same as the number shown in the above table. This estimate is very conservative, for often third and fourth poles of 2 to 3 inches in diameter are placed alongside the larger poles to ease the skidding cart over the latter.

Where a steam loader operates no ground skids are necessary, for the loader can pick up logs from the ground or from a skidway with equal ease. Where, however, it is impossible to load the logs until some time after cutting, skid poles are desirable to prevent them coming in contact with the ground, owing to the possible bluing of the sapwood which might occur.

It might appear feasible to haul the poles from an old switch and relay them on a new one, thus keeping the same skids in use continuously. Such, however, is not the case, for the reason that the skidways are filled with logs before the track is laid.

To conclude, in the use of skid poles, dead, dying, and deformed trees and those trees distinguished by the loggers as heart trees, also hardwoods where available, should be used in preference to thrifty sap trees, which are important for the future stand.

CORDUROY.

During the rainy season in the Gulf States, beginning about November and continuing usually through March, the ground is more or less soft and boggy, with the result that in many localities logging is extremely difficult, so that corduroying is indispensable. Small trees of about 3 to 8 inches in diameter are used for this purpose. They are cut into 12-foot lengths and laid crosswise and close together on the right of way. This gives the ties a solid floor to rest on, and so keeps the rails above the surface of the bog.

In selecting corduroy, as in selecting small trees for skid poles, absolutely no discretion, as a rule, is exercised. A thrifty sap tree and a dead tree stand equal chances of being cut. The rule already laid down concerning the use of sap and heart trees for skid poles is equally applicable here. Moreover, since in many cases sawyers begin felling the timber along a tramway at about the time it is being graded, it would be entirely possible to use the tops of the trees as corduroy, provided they were of a desirable size; and wherever hardwoods are available, as where the right of way crosses a hardwood bottom, conservative logging would compel their use.

For corduroy, then, available hardwoods, tops of pine cut for saw logs, or heart trees, as described under skid poles, should be used, and the cutting of thrifty sap trees for the purpose should be discouraged.

WINDFALLS AND GIRDLED TREES.

In some instances no windfalls are taken from the forest, even though the heartwood is perfectly sound. Windfalls, as a rule, are fairly large trees, in which the percentage of sapwood is small. The sapwood will probably have blued or rotted; but if the heart is sound and at least 8 inches in diameter at the top of a merchantable length, there is certainly no good reason for leaving a windfall in the woods.

There occur in clumps over some areas trees girdled and killed by insects. The sapwood of such trees has usually blued and soured, but the heart in many cases is sound and not bored as yet by secondary insects. These trees, though as a rule containing merchantable timber, are rarely cut. Left standing, they act as breeding places for insects and induce further depredations. For the most part, the affected trees are over 10 inches in diameter on the stump, and consequently of merchantable size. They should by all means be felled, provided a merchantable log can be gotten at least 16 feet long showing 8 inches of sound heart at the top end.

What has just been stated in regard to insect-killed trees applies also to trees girdled by the guy cables of a steam skidder, comparatively few of which, however, are left standing after logging.

BRIDGE TIMBER.

The number of bridges in tramway construction will vary with the topography of the country. A bridge rarely requires less than 1,000 feet B. M. of timber, and therefore some discretion in selecting the timber is perfectly reasonable. It does not pay to handle logs which have been put into bridge work, for the reason that the outlay incurred in dislodging the upper tiers of stringers and fillers and in snaking the logs out of difficult depressions is prohibitive. To use cull logs, then, is the practical alternative. The large number of trees affected by red heart insures the availability of cull timber in almost every locality.

Seven bridges were selected indiscriminately for investigation. The smallest contained 468 feet of sound timber, the largest 6,455 feet. Of the total number of logs used in constructing the seven bridges, 82 per cent were sound and clear, containing an average of 2,624 feet per bridge.

The lumber which could be sawed from these logs would bring an average price of at least $15 per 1,000 feet. If the total cost to produce the lumber is $12 per 1,000 feet, the net loss to the lumber company is $3 for each 1,000 board feet of sound timber in bridges where it is possible to use cull timber; the loss to the land company is the stumpage rate, or $4 per 1,000 feet.

CONCLUSION.

A set of rules is given below, embodying the specific conclusions reached in this discussion of waste in logging yellow pine, the strict enforcement of which will be essential to the success of clean logging. These rules assume, however, that a diameter limit has been adopted below which trees shall not be cut, and that the trees to be cut will be "spotted," or marked, for cutting. Otherwise the cost of marking

as specified in the rules would be prohibitive. In the past the Forest Service has found in preparing working plans for yellow-pine lands that, in the interest of forest management for future crops, a diameter limit in the neighborhood of 18 inches is usually advisable. The subject of waste in logging, however, is one which deserves attention on its own merits, and has been discussed in the present article entirely independently of the question of management. Yet it must be said that the full use even of the present forest naturally goes hand in hand with plans for the full use of the forest as a permanently productive resource.

RULES FOR THE PREVENTION OF WASTE IN LOGGING YELLOW PINE.

(1) The following classes of timber to be "spotted," or marked, for cutting:

(*a*) All red-heart trees 10 inches and over on the stump.

(*b*) All insect-killed trees which will yield a merchantable log.

(*c*) All trees needed for skid poles, corduroy, and bridges, the removal of which is necessary.

(2) All trees to be cut which are marked.

(3) No sound trees below the diameter limit to be cut for "bed" trees.

(4) The lengths of logs to be so varied that the merchantable timber in every down tree shall be utilized up to that point in the top where the diameter is 8 inches. Any such timber left in the woods shall be scaled under direction of the logging superintendent and paid for by the purchaser at double the stumpage price.

(5) Sound trees 24 inches and over in diameter on the stump at 2 feet above the ground, neither cat-faced by fire nor hollow-butted, to be cut not higher than 24 inches from the ground; sound trees under 24 inches on the stump to be cut not higher than 18 inches from the ground. Stumps of trees with hollow butts, or butts made pitchy or "fat" from fire or other injuries, to be cut high enough to avoid all or as much of the defect as possible. It should be the duty of the timber spotter to mark each tree at its proper stump height, that is, 24 inches from the ground for trees 24 inches and over on the stump, and 18 inches from the ground for trees under 24 inches on the stump, and to mark trees with defective butts so as to avoid all or as much of the defect as possible.

(6) No sap trees to be cut for skid poles until the nearby supply of heart trees and culls shall have been exhausted. Hardwoods to be cut for skid poles wherever available.

(7) No pine to be cut for ground skids where a steam loader is operating.

(8) Available hardwoods, tops of pine, heart trees, or culls to be used for corduroy.

(9) Windfalls and girdled trees which will yield a merchantable log to be utilized.

(10) Red-heart timber, if available, to be used for stringers, caps, or fillers in bridge construction.

(11) Care to be used in the felling, so that trees below the diameter limit will not be broken or badly injured. Stubs or snags of broken trees to be cut where they will yield a merchantable log.

(12) The decision of the logging superintendent to be final in the execution of these rules.

PROMISING NEW FRUITS.

By William A. Taylor,

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INTRODUCTION.

In a country like the United States, which embraces so wide a range of climatic and soil conditions, the origination and dissemination of fruit varieties is a very important phase of economic pomology. Without the origination of varieties adapted to peculiar regional conditions, there are few sections in which profitable commercial fruit culture can be permanently maintained. A considerable degree of adaptability to climate, resistance to particular diseases or insects, and suitability for special uses is essential to the profitable maintenance of fruit plantations in the open air in most of our territory. While a few varieties of most cultivated fruits possess a high degree of endurance of varying conditions, such varieties are usually of rather inferior quality and not well suited to highly specialized uses. Until a sufficient number of American-grown sorts has been accumulated our fruit growers must continue to test such new sorts as give promise of meeting their special needs. The present article of this series[a] calls attention to some of the more recently introduced varieties that appear to possess distinct merit for testing in different fruit districts.

VIRGINIA BEAUTY APPLE.

[PLATE LVIII.]

This excellent winter variety appears to have originated early in the last century as a chance seedling on the farm of the late Mr. Zachariah Saferight, now owned by Mr. C. C. Edwards, in Carroll County, Va., which was then a part of Grayson County. The original tree, which is still standing, is reported to have borne fruit in 1826. Soon after that date the variety was disseminated throughout Carroll, Grayson, Wythe, and Pulaski counties by Mr. Martin Stoneman, who used scions of it for top-grafting trees in orchards on various farms.[b] Old men in that region state that it was known to them as a disseminated variety in their boyhood. It was first disseminated under the names "Zach" and

[a] See Yearbooks of the Department of Agriculture for 1901 (p. 381), 1902 (p. 469), 1903 (p. 267), and 1904 (p. 399).

[b] Letters of R. M. Crockett, Pulaski, Va.; Prof. William B. Alwood, Blacksburg, Va.; H. C. Wysor, Dublin, Va.; J. W. Stoneman, Cap, Va., and S. D. Stoneman, Gambetta, Va., 1901–6.

"Zach Red," but as neither of these appears to have been published they are not admitted as synonyms. About 1850 Mr. Stoneman named the variety "Virginia Beauty," under which name it appears to have been first catalogued and offered for sale soon after 1871 by the Franklin Davis Nursery Company, then of Richmond, Va., which began its propagation in nursery in that year.[a] So far as known, it has no published synonyms. The earliest published description appears to be that contained in the Report of the Pomologist of the Department of Agriculture for 1895, page 36.

Though apparently never extensively advertised or illustrated, the Virginia Beauty is now quite widely distributed throughout the mountain region of Virginia and North Carolina, and is recognized as a promising variety for like latitudes, at least as far west as eastern Nebraska. Its mild flavor, which closely approximates sweetness, is highly appreciated in southern markets, where the variety commands a premium on this account, and accordingly it is being considerably planted as a commercial variety in the mountain region referred to.

DESCRIPTION.

Form quite variable, ranging from oblate to roundish oblong; size medium to large; surface smooth, glossy; color dark yellow, almost entirely covered with purplish red, showing occasional dim stripes of darker red; dots variable, numerous, russet, some indented; cavity irregular, of medium size and gradual slope, sometimes lipped and usually russeted; stem short, rather stout, frequently bearing bracts; basin regular, small, shallow, slightly furrowed and lumpy; calyx segments thin, converging; eye medium, closed; skin moderately thick and tenacious; flesh greenish yellow, fine grained, tender, juicy; core medium to large, conical, clasping; seeds numerous, of medium size, short, plump, brown; flavor mild subacid, almost sweet; quality good to very good for dessert use in the fresh state and for baking. Season, October to February in the mountain region of North Carolina and Virginia.

The tree is reported to be a moderately strong, rather upright grower, becoming somewhat pendulous after reaching bearing age.

The specimen illustrated on Plate LVIII was grown near Taylorsville, Alexander County, N. C.

CARSON APPLE.

[PLATE LIX.]

The original tree of this variety was obtained about 1835 by a relative of Mr. Nathan Moore, of Toledo, Ohio, from a small apple seedling nursery in Wood County, Ohio, owned by a family named Carson. When it came into bearing, about 1850, it was so attractive

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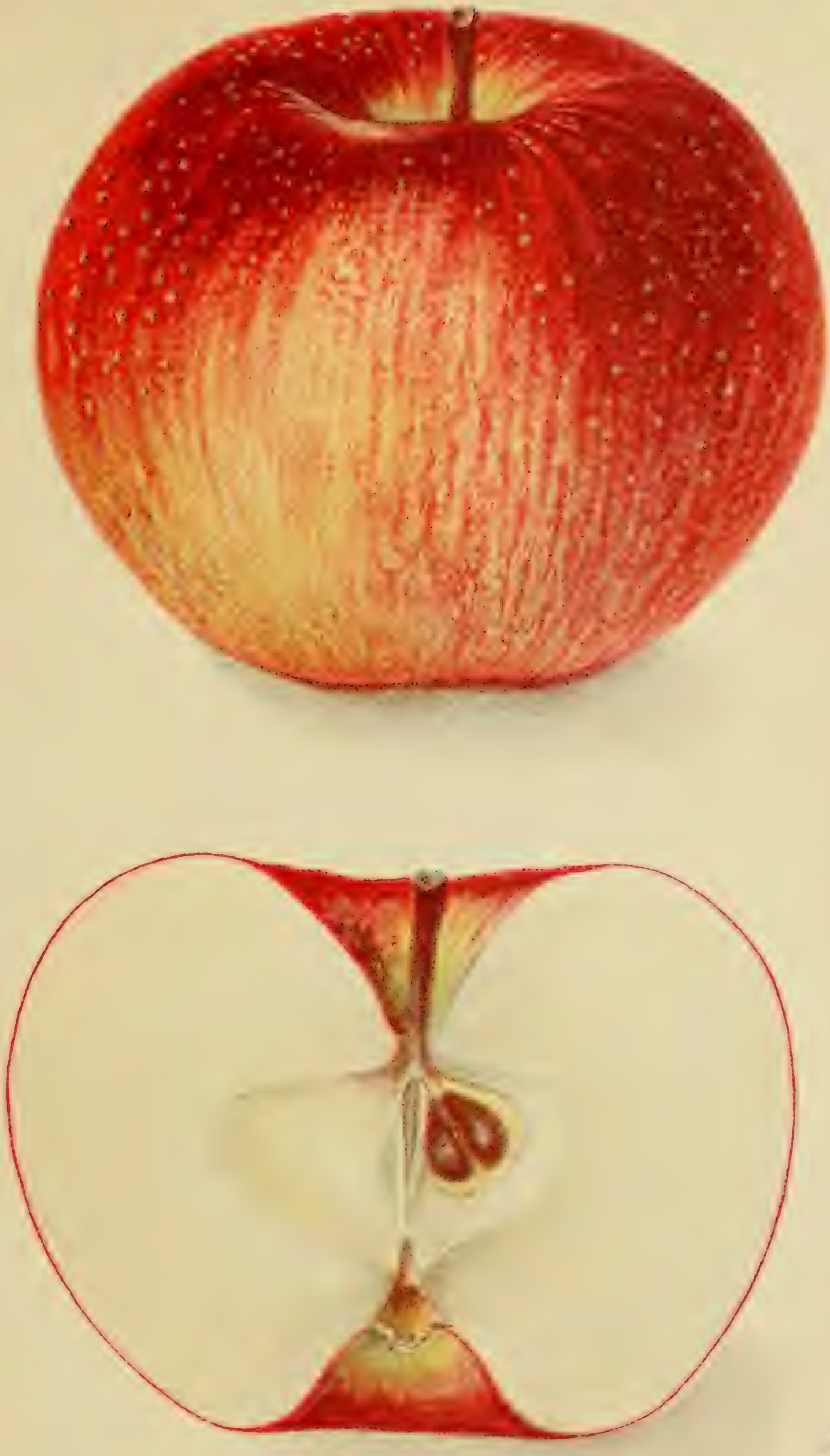
[a] Letter of W. T. Hood, Richmond, Va., March 28, 1906.

VIRGINIA BEAUTY APPLE



CARSON APPLE.

in appearance and of such excellent quality that Mr. Moore began its propagation and dissemination in northern Ohio about 1855 under the name "Carson," which it has ever since borne. The earliest publication of the name appears to have been in the report of the Kentucky State Fruit Committee in the Proceedings of the American Pomological Society for 1875 (p. 135), where it was recommended for planting in the central and southern portions of Kentucky. Its excellent record for productiveness, beauty, and quality in northern Ohio for a half century renders it worthy of experimental planting throughout the Lake region and the New England States, both for the home orchard and as a commercial variety.

DESCRIPTION.

Form oblate, sometimes slightly conical; size large; surface smooth, with occasional russet knobs and patches; color pale yellow, washed, splashed, and narrowly striped with bright crimson; dots rather large, conspicuous, and protruding; cavity medium, regular, deep, russeted; stem of medium length and rather slender; basin very large, deep, abrupt, furrowed, and sometimes russeted; calyx segments converging; eye large, closed; skin thin, tough; flesh yellowish, with satiny luster when fresh cut; texture fine, tender, juicy; core small, broad, oval, clasping, nearly closed; seeds few, plump, medium, brown; flavor subacid, pleasant; quality very good. Season, November to March in northern Ohio.

Tree vigorous and upright in habit, very productive.

The specimen illustrated on Plate LIX was grown near Toledo, Ohio.

CROCKER PEAR.

(SYNONYM: *Crocker Bartlett.*)

[PLATE LX.]

One of the most evident needs of the American commercial pear grower is an attractive winter variety of good dessert quality that is at the same time productive and at least fairly resistant to blight. Most of the European winter varieties thus far tested in this country have failed in one or more of these important particulars when transferred to America, so that the supply of desirable winter sorts is rarely equal to the demand of our domestic markets. One of the most promising new varieties in this field is the "Crocker," which appears to have originated in a small orchard planted by gold miners on the American River, near Loomis, Cal., about 1850 to 1860. This orchard, which consisted of about 4 acres of apples, pears, peaches, and plums, with some grapes and figs, was purchased by Mr. L. L. Crocker in 1872.[a] It then contained a thicket of some 50 young pear

[a] Letters of L. L. Crocker, February, 1905.

sprouts surrounding an older tree of an unrecognized winter variety. Desiring to clear the ground to make way for planting other trees, Mr. Crocker noticed fruit upon some of these young trees, which were evidently suckers from the stock upon which the old tree had been budded or grafted. He therefore deferred their destruction until the end of the season, to permit the fruit to ripen. The pears remained on the trees until December, when they began falling, although still hard and inedible. Specimens that were laid away ripened gradually from January until the end of winter and were of such excellent quality that Mr. Crocker transplanted five of the largest sprouts to his orchard, where they are still bearing annual crops. Later he began the nursery propagation of the variety, and gradually increased his plantings of it until he now has over 3,000 bearing trees. It is locally known as the "Crocker Bartlett," and has been disseminated under that name by Mr. Crocker since 1902. It has but recently begun to attract attention elsewhere, but is considered worthy of testing in eastern pear districts.

DESCRIPTION.

Form oblong, obovate, pyriform, somewhat angular; size medium to large; surface rather smooth; color rich golden yellow, somewhat netted and overspread with russet; dots minute, russet; stem medium to long, rather slender, inserted obliquely, with little or no depression; basin of medium size, regular, deep, abrupt, russeted, and furrowed; calyx segments rather small, converging; eye small, closed; skin rather thick, but quite tender; flesh yellowish, buttery, juicy, with some woody granules near core; core of medium size, oval, slightly open, meeting the eye; seeds short, plump, round, rather numerous; flavor mild subacid to sweet and very rich; quality very good.

The tree is reported to be a vigorous grower, thus far free from blight, and regularly productive. The fruit is somewhat subject to scab in the locality of its origin, and therefore needs to be sprayed to protect against this disease. Season, January to March in Placer County, Cal.

The specimen illustrated on Plate LX was grown at Loomis, Cal.

EVERBEARING PEACH.

[PLATE LXI.]

The so-called "Spanish" group of peaches, which is supposed to have been introduced into both Mexico and our own Gulf region by the early Spanish explorers and missionaries, is in some respects our most interesting group of peaches. It unquestionably attained wider distribution in the United States during the period of exploration and colonization which preceded the development of commercial peach culture

EVERBEARING PEACH.

than the so-called "Persian" group, to which most of our older cultivated varieties belong.

Hunters and trappers, and even the Indians, appear to have aided in the dissemination of these peaches in many sections, so that the early settlers in many parts of the Mississippi Valley and the Upper Lake regions found the type so firmly established in certain localities as to appear indigenous. From the Gulf to the Great Lakes it was thoroughly established by the beginning of the nineteenth century, reaching its northern limit of planting in orchard form, so far as known to the writer, in the so-called "Indian peach orchard" on the Kalamazoo River, near the present village of Douglas, Mich., where a bearing orchard of 300 trees was found by the settlers when they reached there, about 1834. In the mountain regions of southwestern Virginia, western North Carolina, and eastern Tennessee there are numerous seedling orchards of the type still in existence, and it is a significant fact that in recent years nurserymen throughout the Northern and Eastern States are turning to that region for sound and disease-free seed for planting.

Notwithstanding the early introduction and wide distribution of the type under such names as "Indian Peach," "Indian Cling," "Squaw Peach," etc., it has given rise to but few varieties that have been considered worthy of perpetuation by budding. The "Columbia," which Coxe originated in New Jersey from a seed taken from Georgia, was for many years after its description in 1817 apparently the only described variety. At the present time there are but few varieties, and most of these are restricted in their planting to the region in close proximity to the Gulf of Mexico, to which they appear to be better adapted than those of any other group. None of these has yet attained distinct commercial importance, but several are highly esteemed for home use. A marked characteristic of this group is that certain individual trees have a long blossoming period and a correspondingly long season in which the fruit matures. It is this that gives special value to the "Everbearing," a variety which originated about 1885 in the garden of a Mrs. Page, at Cuthbert, Ga. Blossoming, as it does, through a period of several weeks, it rarely fails to set a fair crop of fruit, while the fruit in turn ripens through a period of from six to twelve weeks on the same tree.

The variety was named and disseminated by the P. J. Berckmans Company, of Augusta, Ga., in 1897. It has been found insufficiently hardy in New Jersey, but is considered worthy of planting for home use throughout the recognized peach districts of the South. It is not recommended as a commercial peach, as the peculiar color and long ripening season would doubtless prevent it from becoming a profitable market sort.

DESCRIPTION.

Form roundish conical; size medium to large, the later ripening fruits being smaller than the earlier ones; cavity large, regular, deep, abrupt; stem rather stout; suture shallow; apex rather prominent; surface smooth, thickly covered with long, loose, velvety down; color greenish white, striped and mottled with purplish red; skin thick, tenacious; flesh whitish, considerably stained and veined with red, meaty, tender, and juicy; stone of medium size, oval, free; flavor subacid, rich; quality good to very good. Season, July 1 to September 1 or later in southern Georgia.

Tree vigorous, compact, productive; glands reniform; flowers large.

The specimen illustrated on Plate LXI was grown at Augusta, Ga.

GOLDEN PLUM.

(SYNONYM: *Gold.*)

[PLATE LXII.]

Of the hybrid plums originated by Luther Burbank that have been introduced for a sufficient time to render a forecast of their climatic requirements possible, this variety appears adapted to the widest geographical range. The original tree was grown in 1887 or 1888, by Mr. Burbank, from a seed of Robinson (*Prunus angustifolia*), which was the result of a cross with pollen of Abundance (synonyms *Botan*, *Yellow-fleshed Botan*, *Sweet Botan* of Burbank, but not of others), one of the best known and most widely grown of the Japanese plums in America. It was named "Golden" by Mr. Burbank in 1892, and a brief description of the variety, based on specimens submitted by him, was published in the Report of the Pomologist of the Department of Agriculture for that year.[a] It was catalogued and illustrated by Mr. Burbank under this name in his catalogue of New Creations in Fruits and Flowers, June, 1893. About that time the original tree and the right of introduction were purchased by the Stark Brothers Nurseries and Orchards Company, of Louisiana, Mo., which catalogued it for dissemination in the autumn of 1894 under the name "Gold," which was registered as a trade-mark in the United States Patent Office on February 26, 1895. The prior application and publication of the name "Golden" entitles it to precedence under the code of nomenclature of the American Pomological Society and has, therefore, been generally adopted by pomologists.

The variety has been planted in most of our plum districts, and, while not of the highest dessert quality, is a hardy, productive, and excellent fruit in most of the territory where either the Japanese or the Chickasaw plums succeed.

[a] Report of the Secretary of Agriculture, 1892, p. 263.

DESCRIPTION.

Form globular to globular oblate; size medium to large; cavity of medium size, deep and abrupt; stem of medium length, rather slender; suture shallow, except at apex, which is slightly depressed; surface golden yellow, lightly blushed with carmine when well ripened and covered with thin bloom; dots numerous, russet or gray; skin moderately thick, tenacious, rather acid, and when picked prematurely quite bitter; stone small to medium, oval, cling; flesh yellowish, translucent, with yellow veins, tender and juicy, yet firm enough to endure shipment well; flavor rich, subacid, pleasant; quality good to very good. Season medium, about July 20 to 30 at Augusta, Ga.; reported by Mr. Burbank to ripen through a period of five or six weeks during July and August in Sonoma County, Cal.

Tree dwarfish and compact, with small foliage, resembling its Chickasaw rather than its Japanese parent in these respects, a good bearer, and apparently hardy throughout all but the coldest plum districts. It is apparently particularly well adapted to the South Atlantic and Gulf States.

The specimens illustrated on Plate LXII were grown at Augusta, Ga.

DAMSON PLUMS.

[PLATE LXIII.]

In the effort on the part of commercial fruit growers and nurserymen to secure plums of large size and bright color that are suitable for dessert use in the fresh state as well as for cooking, the value of this important group of culinary plums has been largely overlooked in recent years. The production of damsons has lagged behind that of other plums, so that it may well be questioned whether the total product of this type now available in our markets is as large as it was twenty-five years ago. The market demand for the fruit continues strong in practically all city markets, so that the average wholesale price of damsons is considerably higher in most of them than that of the Domestica, native, or Japanese plums. This is especially true of the later ripening varieties, the fruit of which is available for domestic preserving after city families return from their country outings. As the damsons are adapted to a wide range of climatic conditions and are, as a rule, quite regularly productive, the present outlook appears to favor an increase in their commercial planting in the districts where they are known to succeed. This is especially true of varieties and districts that yield fruit which can be marketed after September 15 in the larger cities.

The varieties chiefly grown in this country are the "Common," "Cluster," "French," and "Shropshire," the last named being by

far the most extensively planted. Quite recently renewed interest in the damsons has brought to light several promising new sorts, of which the three following are considered worthy of illustration at this time:

RILEY.

This variety was discovered as a chance seedling about 1890 on the grounds of Mr. J. N. Riley, at Washington C. H., Ohio. It has an excellent record for productiveness and is reported to be especially resistant to the black-knot. Mr. Riley began its propagation in a small way about 1890 and disseminated it locally without a name shortly thereafter. It was named "Riley," in honor of the originator, in 1901 by Messrs. McNary & Gaines, of Xenia, Ohio, and was introduced by them in 1902.

DESCRIPTION.

Form globular; size medium; cavity small, shallow, abrupt; stem slender and of medium length; suture very shallow; apex minute; surface moderately smooth, glossy; color very dark brownish purple, covered with a profuse bluish-white bloom; dots small, russet, indented; skin thick, brittle, without trace of bitterness; flesh yellowish, translucent, with yellow veins, meaty and juicy; stone of medium size, roundish oval, semiadherent; flavor subacid, rich; quality good to very good for culinary use. Season, August 15 to September 1 at Washington C. H., Ohio.

The tree is reported to be a strong grower, both in nursery and in orchard, and very productive.

The specimen illustrated on Plate LXIII was grown at Washington C. H., Ohio.

SCIOTO.

This variety has been grown at Chillicothe, Ohio, formerly a noted damson district, for nearly seventy-five years, generally under the name "Mussel," but sometimes as "Chickasaw," the name commonly applied to the native species *Prunus angustifolia*. It was brought to Chillicothe by Miss Palace Hill in 1831, in the form of young trees, from Petersburg, Va. These trees were from the nursery of her brother, Mr. Joseph C. Hill, who started a nursery on Halifax street, in that city, in 1820. The variety had been found by him on the farm of his brother, Mr. Thomas Hill, near Bollings Bridge, North Carolina, on the Roanoke River.[a] It is a damson of superior quality and is highly esteemed in Ross County, Ohio. It is reputed to reproduce itself very closely through its seedlings, though commonly propagated by sprouts. So far as known, it has not been formally named and

[a] Statements of William E. Hill, Chillicothe, Ohio, January, 1906, through letters of William B. Mills.

GOLDEN PLUM.

RILEY.

SCIOTO.

PRINGLE.

DAMSON PLUMS.

introduced. It has been gratuitously disseminated in recent years under the name "Scioto" by Mr. William B. Mills, of Chillicothe, Ohio.

DESCRIPTION.

Form oblong to obovate; size medium to large for a damson; cavity small, shallow; stem medium in length, slender; suture very shallow; apex minute; surface smooth; color very dark purplish brown, almost black, covered with a profuse bluish bloom; dots minute, russet; skin moderately thick, tenacious, without bitterness; flesh yellowish green with whitish veins, meaty, firm, and moderately juicy; stone oval, free, small; flavor rich, subacid; quality good to very good, both in the fresh state and when cooked. Season, August 20 to 30 in Ross County, Ohio.

Tree a vigorous, upright grower, more spreading than most of the damsons, and very productive.

The specimen illustrated on Plate LXIII was grown at Chillicothe, Ohio.

PRINGLE.

This variety was discovered as a sprout from the stock of a Lombard plum tree in the orchard of Mr. A. C. Pringle, at Mears, Mich. The Lombard tree had been brought from a nursery at Geneva, N. Y., in 1863. After the sprout began bearing, the lateness of its fruit attracted attention, and the high prices received for it in the Chicago market led to its propagation and dissemination under the name "Pringle," by E. Hawley & Sons, of Hart, Mich., about 1896.

DESCRIPTION.

Form roundish oval; size large for this type; cavity regular, small, shallow; stem rather long, stout; suture shallow; apex slightly depressed; surface very smooth and glossy; color dark blue, covered with bright blue bloom; dots numerous, minute; skin moderately thick, tenacious, somewhat bitter; flesh translucent, greenish, with yellow veins, meaty and juicy; stone rather large, oval, adherent; flavor mild subacid; quality good for culinary use. Season late, October 1 to 15 in Oceana County, Mich.

Tree vigorous, upright, spreading, but rather slender, with very smooth wood and few spines. Unites well with myrobalan stock, but not at all with peach.

The specimen illustrated on Plate LXIII was grown at Hart, Mich.

EULALIA LOQUAT.

[PLATE LXIV.]

The loquat continues to attract interest in subtropical districts, especially in southern California, and several originators are now giving special attention to the development of improved varieties. One

of the most interesting yet introduced is the Eulalia, which was originated by Mr. M. Payan, of Olive, Cal., as one of several seedlings from seed of the "Advance"[a] planted by him in 1897. The Advance tree from which the seed was secured stood beside a red-fruited seedling tree, which is supposed to be the staminate parent. When the seedling bore its first crop in 1893 the red color of its fruit, which extends through the flesh as a distinct pinkish tinge, attracted attention, and Mr. Payan at once began its propagation. He at first named it "Red Eulalia," but in May, 1904, reduced this to "Eulalia," in conformity with the code of nomenclature of the American Pomological Society. So far as known to the writer the variety has not been previously published or described. Its dissemination was begun by Mr. Payan in 1905.

DESCRIPTION.

Form truncate pyriform to obovate pyriform, borne in large, rather loose terminal clusters on stout woolly stems inserted without depression; surface smooth, sparsely covered with light down; apex depressed; basin irregular, abrupt, corrugated; calyx segments broad, short, downy, converging; eye medium, partially open; color orange yellow, blushed, and washed with red when tree-ripened and overspread with a thin bloom; dots numerous, aureole, light gray; skin thick, tough, acid; flesh pinkish, translucent, orange, melting, tender, very juicy; seeds of medium size, rather numerous; flavor subacid; quality good. Season, February to May in Orange County, Cal.

The tree is reported to be a rather vigorous grower, spreading and productive, and has thus far shown no blight.

The cluster illustrated on Plate LXIV was grown at Olive, Cal., and is rather below the usual size of the variety grown at that place.

PECANS.

[PLATE LXV.]

Interest in the pecan as an orchard nut continues to increase, and a large number of named varieties are now offered by southern nurserymen in the form of budded and grafted trees. Aside from the ten varieties described and illustrated in 1904[b] but few of these have yet been fruited outside of the localities where they originated or on other than their original trees. Of the numerous new sorts that have come under the observation of the writer, the following are considered distinctly promising and worthy of test in their respective climatic regions.

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[a] For an illustration of the Advance loquat, see Yearbook of the Department of Agriculture for 1901, Pl. LII.

[b] Promising New Fruits, Yearbook of the Department of Agriculture for 1904, pp. 405–416, Pls. LVI and LVII.

HOLLIS.

(SYNONYMS: *Hollis's Jumbo; Jumbo; Risien*, through error; *Post's Select*, in part; *Georgia Belle.*)

The original tree of this variety is a wild seedling which was discovered on the Colorado River bottom, on the farm of the late Thomas Hollis, near Bend, San Saba County, Tex., now owned by Mr. P. B. McCoury. It is reported to be from 75 to 100 years old, 100 feet high, and 3½ feet in diameter. It has averaged about 300 pounds of nuts per annum for several years, and yielded 540 pounds in 1905.[a] This original tree has long had a high local reputation in the region of its origin, where it has been known as "Jumbo" and "Hollis's Jumbo." It appears to have been first propagated by Mr. E. E. Risien, of San Saba, Tex., about 1884, he having received scions of it from the late Dr. Gregg, of that place. Its general introduction under the name Hollis appears due to Mr. C. Falkner, of Waco, Tex., who began its nursery propagation about 1900. Since that time it has been considerably disseminated throughout central and eastern Texas by top-grafting and through nursery stock. Nuts from the original tree are reported to have been exhibited at the New Orleans Exposition in 1884–85 by Mr. F. H. Holloway, then of Burnet, but now of Fairland, Tex.[b] Nuts from the same tree have been widely sold for seed since about 1899 under the name "Post's Select," which had previously been applied to the Post, an entirely distinct variety.[c] Specimens of the Hollis, received from Mr. F. M. Ramsey, then of Bluffton, Tex., in 1891, under the name "Jumbo," were described and illustrated under that name in 1896,[d] and other specimens received from Mr. E. E. Risien, San Saba, Tex., in November, 1890, without name, appear to have been erroneously described and illustrated under the name "Risien" in the same publication.[e]

DESCRIPTION.

Size medium to large, averaging about 45 to 50 to the pound; form roundish oblong, with very blunt base and apex, very regular and symmetrical; color rather dull yellowish brown, with numerous purple splashes; shell thick, with partitions thick but soft, rendering the cracking quality good; kernel short, plump, rather dark in color, broadly grooved, releasing the shell easily, and of excellent form for confectioners' use; texture firm, but rather coarse; flavor sweet; quality good to very good.

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[a] Letters of P. B. McCoury, Bend, Tex., January, 1906.

[b] Letter of Mrs. M. E. Hollis, Lometa, Tex., March, 1906.

[c] See Yearbook of the Department of Agriculture for 1904, p. 411, Pl. LVII.

[d] Nut Culture in the United States, Division of Pomology, Department of Agriculture, p. 63, Pl. IX, fig. 7.

[e] Nut Culture in the United States, Division of Pomology, Department of Agriculture, p. 64, Pl. VIII, fig. 14.

The Hollis tree is a strong, rather upright grower, with stout, light-gray wood, showing large yellowish dots. The crop is said to run very uniform in size, and the nuts fill well. It is recommended for testing throughout eastern and central Texas and northward toward the limits of the range of the pecan.

The nuts illustrated on Plate LXV were grown at Bend, Tex., by the present owner of the original tree.

Moneymaker.

The original tree of the Moneymaker variety is one of a large number of seedlings in the orchard grown by Mr. S. H. James, Mound, La., from nuts planted by him about 1885. The nuts planted were purchased in New Orleans by Mr. James, and are supposed to have grown somewhere west of that city, between New Orleans and the Texas boundary. The seedlings from this lot of seed are quite distinct in habit of growth, color of bark, and foliage from the pecans of the Mississippi Valley, resembling more closely the characteristic Texas form of the species. The original Moneymaker tree began bearing at an early age, and has continued to increase its yield almost without interruption in a very satisfactory way. When examined by the writer in October, 1902, it was a beautiful, spreading tree, and had just yielded a crop of about 130 pounds of nuts. Mr. James began the propagation of the variety by budding and grafting in 1898, having catalogued it under the name "Moneymaker" about 1896.

DESCRIPTION.

Size medium, averaging 50 to 60 nuts per pound; form roundish oblong to roundish conical, rounded at base, usually with rather blunt apex; color bright brownish yellow with few purple splashes; shell rather thick, with thin partitions, cracking well; kernel roundish oblong, plump, bright, and rather broadly grooved, releasing the shell easily; texture moderately firm and compact, rather dry; flavor sweet; quality good to very good. The crop runs very uniform in size and the nuts fill well.

The tree is a strong, spreading grower, with large pale-green foliage, young wood pale green covered with light bloom, and with large dots. The hulls are nearly round and very bright in color, giving the fruiting tree an aspect quite like the Persian walnut (*Juglans regia*).

The thrift and productiveness of this variety in the latitude of Vicksburg, Miss., where it originated, render it promising for test in the more northern pecan districts, where hardiness is likely to be an important point.

The specimens illustrated on Plate LXV were grown at Mound, La.

EULALIA LOQUAT.

PECAN VARIETIES.

SCHLEY.

(SYNONYM: *Admiral Schley.*)

This variety is a seedling of the Stuart, grown from nuts from the original tree of that variety at Pascagoula, Miss., planted about 1881 by Mr. A. G. Delmas, Scranton, Miss., upon whose grounds the original tree of the Schley still stands. It is considered by the originator the best of a large number of seedlings grown by him. He named it "Schley" in 1898, and began its propagation by top-grafting in 1900. In 1902 Mr. D. L. Pierson, of Monticello, Fla., secured scions from the original tree and catalogued and introduced it as "Admiral Schley," under which name it has been quite widely disseminated.

DESCRIPTION.

Size medium to large, quite variable, ranging from 45 to 60 per pound; form quite variable, oblong conic to long obovate, with conical apex; color golden brown, with few purple splashes toward apex; shell very thin, partitions thin and brittle, cracking very easily; kernel long, slender, bright, rather deeply and narrowly grooved, but releasing the shell so easily that the entire kernel can readily be removed without mutilation; texture fine grained; flavor delicate, sweet, and rich; quality very good.

The thinness of shell, attractive color, and fine quality of this nut leave little to be desired in a dessert pecan, but the slenderness of the kernel is objectionable from the confectioner's standpoint. The crop is quite variable as to quantity, and the nuts vary considerably in size and form.

The tree is a rather slender grower, with bright brownish-green young wood, with numerous large, light dots. The original tree, now 25 years old, bore about 125 pounds of nuts in 1905. The variety should be tested in all districts near the Gulf of Mexico.

The nuts illustrated on Plate LXV were grown at Scranton, Miss.

SUCCESS.

The original tree of the Success pecan stands on the grounds of the late William B. Schmidt, at Ocean Springs, Miss., where it was grown from a nut supposed to have been planted by him about 1890. The attractiveness and superior quality of its crop were noticed by Mr. Theodore Bechtel in 1901, who began its propagation in the spring of 1902. The variety was named and introduced by Mr. Bechtel in 1903.

DESCRIPTION.

Size large, running about 45 to 50 nuts per pound; form oblong, with rather sharply conical base and blunt apex; color grayish brown, with rather heavy purple stripes, especially toward apex; shell of

medium thickness, with moderately thick partitions and fair cracking quality; kernel roundish oval, plump, bright, somewhat flaky in texture, but of pleasant flavor and very good quality.

Tree vigorous, rather upright, and regularly productive so far as observed. Promising for the Gulf region.

The original tree has been crowded by neighboring seedlings until recently, so that it is smaller than most pecan trees of its age in the same locality, but it yielded 45 pounds of nuts in 1905.

The specimen illustrated on Plate LXV was grown on the original tree at Ocean Springs, Miss.

Young.

The original tree of the Young pecan is a planted tree, probably 60 or 70 years old, in the grounds of Mr. C. B. Delahoussaye in St. Martinsville, La. The parentage and early history of the tree are at present unknown. The large size and thinness of shell of the nuts borne by this tree attracted the attention of Mr. B. M. Young, of Morgan City, La., about 1891, who propagated it by top-grafting in 1895. It was named "Young" by Burnette[a] in 1902, and was first catalogued for dissemination by J. F. Jones & Son, Monticello, Fla., in 1904.

The Young bears a striking resemblance in both tree and nut to the Russell, and, as it is much older, is possibly the parent of that variety.

DESCRIPTION.

Size medium to large, running about 50 to 60 nuts to the pound; form compressed, ovate conical, with pointed base and sharply conical apex; color rather dark grayish brown, with a few purplish splashes toward apex; shell very thin, cracking very easily; partitions thin and soft; kernel bright, oblong, symmetrical, releasing the shell easily, but not always plump at tip; texture fine; flavor delicate and rich; quality very good.

The tree is a vigorous grower, of rather pendulous habit, with slender brownish-green wood, conspicuously dotted. It has a good record for productiveness in recent years and is a promising fancy table nut for the Gulf region.

The specimen illustrated on Plate LXV was grown at Morgan City, La.

TRAPP AVOCADO.

[PLATE LXVI.]

The avocado (*Persea gratissima*), variously known in the Tropics as "avocado pear," "avocate," "aguacate," "alligator pear," "midshipman's butter," "palta," "vegetable marrow," etc., has in recent years

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[a] Louisiana Agricultural Experiment Station Bulletin 69, second series, p. 874.

TRAPP AVOCADO

assumed distinct commercial importance in southern Florida. It occupies a rather unique position among tree fruits, inasmuch as it is chiefly used as a salad, so that it has been very properly designated by Collins[a] "a salad fruit." The name "alligator pear," under which it is known to English-speaking people in Florida and the West Indies, and which is commonly applied to it in our markets, is a regrettable misnomer, as the species belongs to the laurel family, is subtropical in its climatic requirements, and has little in common with the pear. The forms commonly found in Florida are almost tropical, enduring little more frost than the mango, though a form introduced into the United States from Mexico by the Division of Pomology in 1893 is proving considerably hardier both in California and in Florida than the sorts usually grown.

While avocados have long been prized in the West Indies and Florida for home consumption, there does not appear to have been any considerable demand for them in northern markets until about 1887, when Mr. P. W. Reasoner notes[b] that one firm in the New York market handled from 300 to 500 West Indian fruits per week during the season from June to November. Shipments from south Florida to northern markets began about as soon as express transportation was available, and many small plantings of seedlings are now found on the east coast, mostly below Palm Beach, and on the neighboring keys. The seedlings are exceedingly variable in productiveness and in the size, form, color, flavor, and time of ripening of the fruit, as noted by Rolfs,[c] and not until its bud propagation was mastered was it possible for planters to perpetuate particular individual varieties.

The earliest commercial budding appears to have been done by Mr. George B. Cellon, Miami, Fla., in 1901, and since that time budded trees of several desirable varieties have been planted in considerable numbers in that region. From the commercial standpoint one of the most important features is lateness of ripening, so that the fresh-picked fruit can be marketed in the North from October to December. Of the varieties that are known to be of this character, the "Trapp" has been most widely propagated.

This variety appears to have originated as one of a lot of seedlings grown from seed planted about 1894 by the late Mr. S. C. Trapp in his garden at Cocoanut Grove, Fla. The fruit from which the seed was taken is supposed by Mrs. Trapp to have come from Key West. The original tree is now about 10 to 20 feet in height and is in healthy condition. Its late ripening habit and other desirable qualities having

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[a] Bul. 77, Bureau of Plant Industry, Department of Agriculture, "The Avocado, a Salad Fruit from the Tropics," 1905.

[b] Bul. 1, Division of Pomology, Department of Agriculture, p. 40.

[c] Bul. 61, Bureau of Plant Industry, Department of Agriculture, "The Avocado in Florida," pp. 21–23, 1904.

attracted attention, its propagation by budding was begun in 1901 by Mr. Cellon, who introduced the variety under the name "Trapp" in the following year.

DESCRIPTION.

Form roundish oblate to oblate pyriform; size medium to large; cavity regular, small, shallow, with gradual slope, somewhat furrowed; stem stout; apex slightly depressed; surface smooth and undulating, with numerous brownish dots, some of which are indented; color pale green, with faint and indistinct pale-yellow stripes; skin very thick and tough, separating readily from the flesh; flesh fairly thick, firm, but smooth and rather oily in texture, ranging from pale green near the skin to greenish yellow next the seed cavity; flavor mild, pleasant; seed large, oblate, with loose seed coats, and loose in the cavity, sometimes germinating in the fruit when allowed to remain late on the tree, though, so far as observed, without injury to either texture or flavor of flesh; quality very good. Season, from October 1 to January in south Florida, occasional specimens having remained on the tree in good condition until March.

The tree is reported to be a fairly vigorous grower and very productive.

The striking commercial characteristic of the variety is its lateness of ripening, which renders it marketable for the midwinter holiday trade, when very high prices are realized. A large proportion of the budded trees thus far planted in Florida consists of this sort.

The specimen from which the illustration on Plate LXVI was made was from the original tree at Cocoanut Grove, Fla.

CAUSES AFFECTING FARM VALUES.

By George K. Holmes,
Chief of Division of Foreign Markets, Bureau of Statistics.

INCREASES OF LAST FIVE YEARS.

A PROSPEROUS PERIOD.

Farm real estate in the United States has gained in value in such a degree since the census of 1900 that an examination of the causes of this gain may be not only interesting, but instructive, to the economic student as well as to the practical agriculturist.

Inquiries addressed to 45,000 State, county, and township crop correspondents in the autumn of 1905 secured reports which, when properly tabulated, establish the conclusion that at this time, about five years after the census, the real estate of farms, medium in quality and equipment of buildings and improvements, has increased in value 33.5 per cent.

RATES OF INCREASE HIGHER SOUTH AND WEST.

The highest percentage of increase, 40.3 per cent, was found in the South Central group of States, and close after that 40.2 per cent in the Western group. Third in order is the South Atlantic group, with 36 per cent, while a close fourth place is held by the North Central States with an increase of 35.3 per cent. The lowest increase of the five groups of States into which the country is divided in the census reports occurred in the North Atlantic States, where it is 13.5 per cent.

Cotton farms lead.—The grouping of farms according to principal sources of income adopted by the census was followed as nearly as possible in this investigation, and the computation of increase in value of medium farms per acre has been made for each group.

The rate of increase for cotton farms is highest—48.2 per cent. Second in order are the hay and grain farms, with an increase of 35 per cent; the live-stock farms increased in value per acre 34.3 per cent, and the farms devoted principally to sugar are found to have increased 33.2 per cent. Rice farming follows with an increase of 32.2 per cent in value per acre, while close to this is 32.1 per cent for tobacco farms. The farms having no special sources of income have an increase in value per acre amounting to 30.1 per cent, below which are the fruit farms with an increase of 27.9 per cent, the vegetable farms with 26.7 per cent, and, lowest of all, the dairy farms with an increase of 25.8 per cent.

YEARLY RATE OF GAIN.

The foregoing percentages of increase appear extraordinarily large when compared with the percentage of the increase of the average value per acre of all farms from 1890 to 1900, which was 25 per cent, an average of 2.5 per cent a year as compared with an average of 6.7 per cent per year as ascertained by the Department.

ABSOLUTE GAIN.

Although the inquiries of the Department were confined to medium farms, there are reasons for believing that the averages derived from the reports are applicable to the various totals of the farms of the census, including farms below and above medium, classified according to principal sources of income; and, with the understanding that the application is subject to qualifications, the increases in value of all farms during the five years have been computed.

INCREASE IN VALUE FOR TEN CLASSES OF FARMS.—For rice farms the increased value of the farm real estate during the five years is $3,000,000, after which are the sugar farms, with an increase of $20,000,000. The tobacco farms increased $57,000,000, the fruit farms $94,000,000, and the vegetable farms $113,000,000. The dairy-farm increase of $369,000,000 is exceeded by the increase of $460,000,000 for cotton farms, and considerably more by the increase for farms devoted to general purposes, including a small element of farms with minor specialties, which was $768,000,000. The grand aggregate of increase for all classes of farms is $6,131,000,000, more than two-thirds of which is contributed by the increase for hay and grain farms, $1,983,000,000, and $2,263,000,000 for live-stock farms.

INCREASE IN VALUE FOR FIVE GEOGRAPHIC DIVISIONS.—Nearly four-fifths of the National aggregate increase in value of farm real estate during the five years is found in two groups of States—the North Central States, with more than half of the total increase, or $3,572,000,000, and the South Central States, with one-fifth of that increase, or $1,201,000,000. The South Atlantic and Western groups of States have nearly the same increases—$514,000,000 and $500,000,000, respectively. The smallest increase is left to the North Atlantic States, where a net gain of $344,000,000 remains after deducting some reported decreases in value.

EXPLANATIONS OF INCREASES.

From every agricultural neighborhood in the United States explanations have been received of the increases and decreases in the real-estate value per acre of medium farms during the last five years. Subject to some qualifications, the general principle is that the farm

land itself has become more highly capitalized by a larger amount of net profit per acre. Only the main features of the analysis can be given in this article.

PRICE AND NET PROFIT.

In the general matter of price of farm products farming had long been performed under disadvantages that were often discouraging until a few years ago. With now and then a year of exception in favor of this or the other crop it has been a general fact that prices of farm products, long previous to these recent years, have fallen too near the full economic cost of production, which is considerably larger than the immediate cost of production and includes many items generally overlooked by farmers. Indeed, it is quite certain that the price has at times fallen below the full economic cost of production, of which the most conspicuous illustration was afforded seven years ago, when the price of cotton fell to 4½ cents per pound, or even lower, at the plantation.

LAND MORE HIGHLY CAPITALIZED.—In 1905, at the end of the five-year period covered by this investigation, the prices of farm products have risen out of the depths to which various causes had previously sunk them, so that the farmer is at last getting a fair net return for his labor and farming operations in most products. This is naturally reflected in the higher capitalization of agricultural land. This conclusion is not advanced theoretically, but is amply sustained by the reports of many thousands of correspondents in all parts of the country and for all classes of farms for which there has been a considerable increase in price of products.

EFFECT OF CHEAP PUBLIC LAND.

One can well realize how directly the availability of cheap public land suitable for farming has depressed the value of old agricultural land and kept from rising to its otherwise natural level the value of the newer land taken into cultivation, upon reading the statements of many correspondents, particularly in the agricultural margin near the land recently acquired from nation, State, or railroad. The National land that can be utilized agriculturally is now reduced to about 300,000,000 acres, but nearly all of this is suitable only for grazing, since it can not be used in dry farming nor under irrigation.

Much cultivable land, however, especially in the Southwest, has passed into private ownership during the five years under review, and there is striking testimony from many correspondents that until it passed into private ownership it held down the value of the acquired farms in near-by regions. This effect has extended backward upon the farms farther and farther away, even to the Atlantic coast, where the direct cause has not been as apparent as in the neighborhood where its effect is closely associated with it.

EFFECT OF IMMIGRATION.

While the public land suitable for farming has been reaching exhaustion the flow of immigration from foreign countries and from the older parts of this country has been continuing in its direction, and where no farming land could be obtained from nation, State, or railroad the influx of agricultural people was halted in regions where farms had been established in more recent years, and the consequent pressure of new demand upon a fixed area increased the value per acre during the five years often as much as 50 to 100 per cent.

LOWER RATES OF INTEREST AS A FACTOR.

Along with the general causes that have elevated the price of farm land during the last five years should be mentioned the diminishing rate of interest. So great in the aggregate have been the savings of the farmers and persons in other occupations in the North Central States and in other sections that a large amount of these savings has sought investment in farms, even to the extent of raising farm values and diminishing the rate of interest, so that an advance of the price has followed often with no increased net profit per acre.

PASSING OF THE COTTON-CROP LIEN.

In the cotton belt the abolition of the crop lien in consequence of profitable prices of cotton has worked a greater economic revolution than has taken place in any other part of the country or for any crop other than cotton. When the cotton planter ceased to pay an extremely high rate of interest for an advancement of supplies—estimated at 40 per cent fifteen years ago—and became able to sustain his plantation with his own capital, as he did three years ago, and was often able to retain a large portion of his cotton for sale at a time when most to his own advantage, his land was at once converted into an economic stronghold and appreciated in value in a greater degree than the land devoted to any other large crop.

CITY DEMAND FOR COUNTRY HOMES.

In the North Atlantic States, and in a less degree in other groups, there has been some back pressure upon the land from the cities, and in this reversion of the tide of population from country to city the old farm lands have not been lost to agriculture, although, in so far as they have become the diversion of wealthy men, they may have become unprofitable. In some regions the old abandoned farms are becoming the country homes of city families, and are passing back into some sort of cultivation and production.

EFFECT OF BETTER FARMING.

It would by no means be fair in the explanation of increase of farm values during the last five years to confine it to increases in price of products and to pressure of demand upon area. Very large effects have been derived from better cultural methods; from the substitution of profitable for unprofitable crops; by the adoption of more intensive culture and crop; by better applied labor; by larger and cheaper facilities for reaching markets; and by some improvements in the business features of marketing products. Each one of these causes is of large account and all together combine to make the net return per acre larger than it was five years ago by an amount sufficient to raise the capitalization of farm lands in a considerable degree.

IMPROVEMENTS.

The values embraced in this investigation include improved and new buildings and all improvements upon farms. In many cases correspondents have reported a large percentage of increase in farm values per acre where the increase was almost entirely due to added improvements in the way of better dwellings, new barns, improvements in old barns, new granaries, and new buildings for the protection of live stock in winter.

Throughout extensive areas there have been great additions to land values as the result of draining by tile and open ditches, and the latter are sometimes so large as to be called canals. Increases have resulted from the removal of the stumps of forest trees and the construction of new or better boundary fences. Better and more durable roads on the farm and between the farm and its market town or railroad station have had a distinct effect upon the farm values.

Along with numerous improvements, not all of which can be mentioned here, stands forth the improvement of the soil itself. There is a materially increased production of live stock, with the resultant increased acreage of forage and grain crops which in rotation produce farm manures, humus, and rest; enrich the soil, as with nitrogen brought by legumes; and improve the mechanical condition of the soil for all crops. In regions needing commercial fertilizers, nitrogen, phosphorus, potash, and lime have been used more abundantly and more intelligently, and on crops bringing better prices.

FARMERS' NEW ECONOMIC INDEPENDENCE.

A matter of great importance in its bearing upon the increased value of farm lands is the new economic independence of farmers, fundamentally growing out of their improved financial condition. Farmers now occupy a strong economic position, founded upon the tendency of the consumption of some important products to increase faster than

population does, and upon the tendency of the desires for these products to increase faster than the production does, so that with respect to these products consumption is close upon the heels of production.

Poultry.—It may seem a matter of small consequence to mention poultry and eggs as an instance, but it should be remembered that the values of these products now reach an annual figure of half a billion dollars or more, or an amount about equal to the value of the wheat crop. The price of eggs has been high and growing higher for several years, because consumers have wanted more eggs than have been produced. The exports are not worth mentioning. Apparently there is no limit to the consumption of fresh eggs at a moderate price.

Fruit is in the same category. There is not enough fruit of any kind raised in this country at the present time which is actually placed upon the market in the grade of first quality, or better, that is produced in sufficient quantity to meet the wants of consumers at a moderate price. The city family that has bought first-grade apples in almost any recent year has paid a luxury price. This is true also of pears, plums, peaches, and oranges, and it is true of the small fruits, such as cherries and grapes. The assertion may easily be extended to most, if not all, of the commercial berries—strawberries, currants, blackberries, and raspberries.

Butter is another product that tends to underrun consumption. We have no larger butter exports from this country because the price of first-grade butter is often lower in London than in New York. The highest priced butter in the world in its home markets, taking first and fancy grades and ignoring specialties in other countries too small for notice, is found in this country. With regard to milk and cheese also the economic position has become stronger.

The annual products of dairying, of fruit and vegetable raising, and of poultry keeping aggregated nearly $2,000,000,000 in farmers' hands in 1905, or three-tenths of the gross value of all farm products; and these particular products belong to the class of those for which there is a tendency of demand to be greater than supply. In the case of none of these products is there a desired quantity satisfactory in quality obtainable by consumers at moderate prices. The public is underfed in the higher grades of these luxuries of the farm.

Meat animals, too, are establishing themselves in a stronger position in favor of the farmer, because of the tendency of population increase to outfoot the increase of these animals; but this statement, although true under natural conditions, may become subverted in its application to this country by the prohibitive legislation of importing countries.

In wheat production also the farmers of this country are in a position that is at least moderately strong. Canada and Argentina

may stand in the way of a more advantageous position for a dozen years or so, but in the meantime the increasing demand of the world for wheat promises to the wheat grower that he shall not again suffer from the consequences of overproduction.

LINES CONVERGING UPON HIGHER VALUES.—The foregoing lines of evidence converge upon the conclusion, which is now apparent in all parts of the United States, that in his new economic independence the farmer is now more than ever before free to choose his crop, and this is a matter of tremendous importance. This removes obstacles to the rotation of crops and to intensifying culture and methods. It gives the farmer ability to raise leguminous crops, with their important benefits to the soil. It enables him to multiply his domestic animals, with further consequences upon tillage and land fertility. It enables him to adapt himself to his best markets with the best crops. The agricultural situation just indicated is very appreciably reflected by increased land and improvement values.

MINOR DECREASES IN VALUE.

While the net result of changes in the average acre-values of farms in the last five years has been a marked increase for the whole country, decreases have been found within small areas, and these should not be lost to view in the grandeur of the counter movement.

FARM TO CITY.

The migration of farmers' sons to town and city, to industry, trade, and transportation—a common fact especially apparent in the North Atlantic and North Central States—is throwing farms upon the market for sale, and this occurs sometimes in neighborhoods where there is no immigration and little, if any, local demand for farm lands. The unavoidable result is that in such neighborhoods farms have decreased and are still decreasing in value.

SCARCITY OF FARM LABOR.

Probably no cause of depreciation of farm values is so frequently mentioned in nearly all parts of the country as the scarcity and deterioration of farm labor. The reports on which this statement is based generally refer to wage labor, but the scarcity is found, though less prevalently, in the supply of tenant labor also, particularly that of a trustworthy sort.

FARMERS "IN A RUT."

A cause of depression in farm values in many places in the North Atlantic States is the continuance of crop production which meets the

competition of the prairie farms. There is a considerable fraction of farmers who are "in a rut" and seem lacking in adaptability to new conditions of competition, and more particularly to new market conditions which have grown up around them and which are guaranteeing a profit to the producers of such crops as can be supplied directly by them to near-by consumers, or perhaps with small intervention by middlemen.

TEMPORARILY ADVERSE WEATHER.

Another cause of decrease in farm values, but one that alternates with causes of increase, is unfavorable weather—too much or too little rain, devastating freshets, parching droughts, excessive or deficient sun heat, frosts that are too late in the spring or too early in the autumn, or severe winter freezes in a latitude not accustomed to them. Such unfavorable weather conditions depress the value of farm real estate, even though they have continued for no longer than one year; and when they have continued for two or three years the depression in values is extreme. In such cases there is an eventual recovery, sometimes promptly within a year and sometimes within a few years.

A FEW PRICE DEPRESSIONS.

Some depressions in price have been in evidence during the five years under review. The tobacco crop in some of its varieties has suffered in this respect for several years and this in the face of stationary if not diminishing production. The owners of tobacco farms in some counties assert that the value of their lands has decreased within five years because the offers to buy tobacco have come solely or mostly from one buyer, who would take the crop only at his own price.

In the case of the extraordinarily large rice crop of 1904 also there was a diminished price which at once made itself felt in diminished land values as compared with those of the preceding year, although during the five-year period there was some increase.

The marked drop in the price of cotton in December, 1904, from which there was no full recovery until half a year after, diminished the aggregate value of cotton plantations and farms by many millions of dollars while the lower price continued. So it happens that farm-land values are as sensitive to lower and low prices of products as they are to higher and high prices.

DECREASES LOCALIZED AND RESTRICTED.

In preceding paragraphs are given the more frequently mentioned causes of depression in farm values during the last five years, but these causes are not generally prevalent and are often highly localized and specifically restricted.

ITEMIZED INFLUENCES UPON VALUE.

In passing from a general survey of the subject to particulars, an itemized account of definite causes of increase and decrease in farm real-estate values has been prepared from the statements of correspondents. No attempt is made to give due weight to any of these items; some are very common and others rare, and any attempt at weighting them or estimating their prevalence or importance would be impossible with any degree of success.

CAUSES OF INCREASE.

Improvement in cultural methods.

Immigration from Eastern States into the North Central and Western divisions.

Substitution of crop rotation for one-crop farming.

Changing from grain farming to dairy farming.

Introduction of seeding to grass into cultural method where it did not exist before.

Increase of improvements.

New buildings, buildings kept in better repair, better fences.

Tile draining for land that was too wet or too wet in wet seasons.

Acquirement of irrigation rights.

Use of hand cream separators, by reason of which market for cream has been acquired at creameries or in cities.

New or expanding manufacturing industries in near-by markets.

Increase of adjacent urban populations.

Raising sugar beets for sugar factories.

New or improved facilities for transportation.

Railroad extensions to isolated places.

Intensive agriculture in numerous directions.

Raising vegetables for neighboring canneries.

Improvement in fertility and productiveness of the land.

Improved economic conditions; general prosperity.

Increasing timber values.

Constructing levees against freshets.

Introduction of alfalfa as a live-stock feed and soil improver.

Employment of implements and machines not before in use.

Movement of city families to acquire country homes.

Increase of local loan capital, causing a decrease in the rate of interest.

Farms diminishing in size and increasing in average value per acre because of better attention and improvements and more intensive methods.

Immigration of Hebrews or Poles or people of some other race or nationality in such numbers as to set up a special local demand.

Higher price of wheat.

In Eastern States a diminution of Western competition.

Improved facilities for marketing the crops.

Increasing demand for milk in cities.

Abandonment of "resting" land in favor of seeding to grass in rotation.

Immigration from foreign countries.

Higher prices for products.

The construction of good roads.

New railroad towns, affording new local markets.

Substitution of truck farming for extensive agriculture.

Demand for farm lands created and stimulated by extensive advertising.

Substitution of wheat for grazing and stock raising.

Relief from the depressing influence of sales of near-by Government land.

More profitable marketing of products because of cooperative shipping.

More real money in circulation.

Large farms cut up and sold to various purchasers at advanced prices.

In Eastern States a substitution of products with good local markets for former local products subject to Western competition.

Farm land now sought as investments by farmers and other possessors of surplus for investment, not only in near-by regions, but in other States.

Immigration of Scandinavians, "everlasting workers and very economical."

Substitution of fruit farming for extensive agriculture.

Increasing demand for corn land.

Through the efforts of industrial agents of railroad companies in securing immigrants from other parts of the United States and from foreign countries.

Change from grain to fruit or vegetables.

New or increased markets because of near-by lumbering operations.

Increased or more intelligent use of fertilizers.

Increase in business of keeping summer boarders.

Better markets.

New or better facilities for traveling between city and country regions, whereby the buying and maintenance of country homes is becoming more feasible.

Rural telephones.

Rural electric railways connecting with town and city.

Rural free delivery of mail.

Immigration into Southern States from North Atlantic and North Central divisions.

Irrigation applied to new rice fields in Texas and Louisiana.

Cancellation of burdensome debt (little or no value received therefor) incurred by various counties to promote railroad building.

Maturing of fruit trees.

Abundance of deposits in local banks, causing a decline in the rate of interest paid by them, whereby farmers have preferred to invest in agricultural land.

Dredging ditches; bringing unimproved land into cultivation.

State officials inducing immigration from other States and from foreign countries.

Extension of wheat area by raising durum, or macaroni, wheat.

Supply of water obtained from artesian wells in arid and semiarid regions.

Clearing and reclaiming swamp lands (in southeastern Missouri).

Removing stumps; clearing land of trees and bushes; erecting barns, dwellings, and granaries; building fences, etc., in a poor agricultural region.

A series of good crop years.

Townspeople buying farms for investment.

The doubling back of immigration; the stream of immigrants had gone beyond into an unprofitable farming region and returned to the nearest profitable one.

Technical knowledge of agriculture supplied by bulletins, periodicals, books, lectures, schools, and demonstration farms.

CAUSES OF DECREASE.

Devastations of the codling moth.

Partial collapse of an unreasonable "boom" in land prices

Several successive wet seasons.

Cotton boll weevil.

More frequent floods in lowlands than in former years.

In some parts of the East, western and southern competition.

High and increasing wages of farm labor.

No material increase in prices of certain products.

Disastrous effects of smelter smoke and coke smoke.

Devastations of the San Jose scale.

Crop failure, in some places for only one year.

Emigration from North Central States farther west, or to Canada, or to the South.

Scarcity of tenants and inability or indisposition of owners to cultivate.

Inefficient and scarce farm labor.

Unproductive land remaining without prospect of improvement.

Emigration from a cold climate to the warmer South.

Excessive advance in agricultural land prices, followed by emigration to cheaper lands in other States.

Succession of severe winters.

Deterioration of farms owing to tenancy.

Drifting of farmers' sons from farms to towns and cities and eventual abandonment of such farms by parents to tenants; sometimes, and in comparatively small areas, followed by abandonment of tenancy and of cultivation.

Diminution of supply of farm labor because of cotton mills.

Scarcity of farm labor owing to numerous causes, among which are better wages paid in town and city and in manufacturing, trade, and transportation.

Because of a new "stock law" compelling farmers to fence in.

Poor markets or entire absence of any market at all.

Lower prices of cattle and various products at various times.

Freight charges too high, especially as discriminating against complaining farmers and in favor of competitors in other regions.

Habitual neglect, poor cultural methods, waste, laziness, ignorance.

Pollution of water of streams by sulphur water pumped from mines.

Subsidence or drainage of land surface on account of excavations in coal mines.

The West Indian hurricane of September, 1900, from the effects of which several Texas counties have not yet recovered.

Depressed tobacco prices.

The large rice crop of 1904.

Neglect to replenish the soil, washing of fertility into streams from unprotected land; gullies made by rains; encroachment by shrubs, sprouts, bushes, and briers.

The clearing of timber from farm woodland, leaving the land less valuable.

Exhausting the fertility of the land.

Remoteness from a railroad and depletion of population by enticements of more exciting or remunerative places.

The hopelessness of improvements because of the absence or insufficiency of water, as in arid or semiarid regions.

ILLUSTRATIVE LOCAL CONDITIONS.

PANORAMIC VIEW OF PROMINENT FEATURES.

A panoramic view, although brief, of local conditions as affecting farm acre-values may be derived from the abundant material supplied by correspondents, and will be instructive. The statements apply to medium farms unless otherwise stated, and cover five years.

NORTH ATLANTIC STATES.

NEW ENGLAND.—In Sagadahoc County, Me., the "inquiry for farms as country homes or for improved potato culture has raised values 25 per cent in three years." The demand for farms "has increased more than the price" in Belknap County, N. H.; yet there are still many back farms with good buildings, good soil, stone walls,

plenty of wood and water, and with good roads and markets, for sale at $8 to $12 per acre. Land is "at a premium" in some parts of Cheshire County where farms are sought for country homes. The business of keeping summer boarders has become large in more than half of New Hampshire, with new profit to the farmers.

Investors are buying some abandoned farms in Vermont, and in Rutland County capital has been looking toward farm mortgages for investment. More profitable dairying in Orleans County has much increased the number of cows and raised the price of farm lands. In Berkshire County, Mass., the increased farm acre-value is due to better-known methods of cultivation, better farm machinery, better methods of utilizing crops when grown, and better ways of getting to market, with much help derived from silos and good roads. Trolley railways in Hampden County have given an upward tendency to the value of all land along their lines.

New York.—Farms in Cortland county, with medium buildings, can be bought for $8 per acre which a few years ago were worth $40 per acre. The demand for farms in Dutchess County by wealthy families in New York City has considerably raised their price. Factories in Genesee County have robbed the farms of the better grade of help, and farming is suffering for want of labor. Many farms have been sold in Queens and Nassau counties recently at prices ranging from $700 to $4,000 per acre, some being for development and others for large estates. The hop farms of Oneida County have risen from $25 per acre in 1890 to $60 in 1905.

The substitution of sugar beets, potatoes, cabbages, fruits, and milk for hay and grain in Ontario County has made farms more salable and of higher value. Improved fruit farms in Orleans County with apple orchards of 500 to 1,000 trees have doubled in value since 1900, and the same increase is true for pear and small-fruit farms.

Swamp lands in Steuben County that have been reclaimed for celery or lettuce growing have risen from $8 per acre to $80 and $125. Several very prosperous years in the cauliflower and potato section of Suffolk County, on Long Island, have stimulated the demand for farms and the price of land. In some parts of Ulster County land has advanced over 100 per cent in five years because "the Hebrews are buying almost everything they can get and establishing boarding houses; some places which sold for $3,000 in 1900 are now selling for $10,000." A Yates County correspondent writes that "no investment pays as safe and high a rate of interest to-day as a good farm in western New York."

Pennsylvania.—"Dollar wheat and good prices for hay, eggs, butter, milk, poultry, and even sweet corn in Adams County have helped to raise farm prices, and sales of farms are more readily made than five years ago." The farmers of Butler County are discontented because the oil wells and steel mills are attracting labor away from the farms, with consequent depression in farm values. The fear that farms will be drained dry through underlying coal mines in Cambria County is decreasing their value. Farms in Chester County are gaining in value on account of the growth of improvements.

Higher tobacco and wheat prices are raising the value of farms in Lancaster County, and in one district at least lower rates of interest are more highly capitalizing land values. Farms in Montgomery County not accessible from electric railways and macadamized roads are having a dull sale with low prices.

SOUTH ATLANTIC STATES.

Maryland.—Fruit land in Anne Arundel County has decreased in value on account of the San Jose scale. People from the North and Middle West are coming to Charles County to buy farms, and land formerly abandoned is now profitably producing corn, vegetables, and wheat. "Owing to extensive advertising by the State board of immigration farm lands have risen in price from 20 to 30 per cent" in Dorchester County; "since 1900 many parts of this county have been improved rapidly with

large farm dwellings, barns, and other buildings; miles of wire fencing have been put up, and much land cleared and improved; the growing of melons, cantaloupes, tomatoes, and small fruits is increasing every year, and farmers are prosperous." The abundance of capital seeking investment in Talbot County is reported to be a large cause of increased farm values, and the investments are sustained by packing and canning factories.

VIRGINIA.—Cooperative marketing has much increased the profits of raising sweet potatoes and other farm products in Accomac County and caused a great rise in farm values. Low tobacco prices have diminished the value of many tobacco farms in the tobacco belt in the southern tier of counties. Farm values in Augusta County are rising on account of new cement works and owing to better farm fences, buildings, and roads. Farm values are affected in Bedford County by better local markets, by rural free delivery of mail, by better railroad conveniences, and by immigration from the North Atlantic and North Central States.

Apples and tomatoes are raising the price of farms in Botetourt County. The increase in the value of all farms in a section of Dinwiddie County is due largely to higher prices of timber. Dairy farming, new and better buildings, trolley roads, and an increased market in Washington, D. C., have raised values in Fairfax County. The more liberal use of fertilizers has advanced values in King and Queen and other counties.

NORTH CAROLINA.—In Alamance County "the people are seeking small farms so as to be able to do their own work, since the young men are finding work off the farm and labor is so unreliable, especially among the young people." A correspondent in Catawba County, who has been writing deeds for thirty years, reports that he has "never seen such a rush in land matters at any period as there is now." A Chatham County correspondent writes that "land in the new bright-tobacco belt is worth almost anything asked."

In Currituck County "lands that will produce sweet and Irish potatoes are bringing fabulous prices." In Forsyth County "the farmer is not looked upon as he was years ago," and farm land has much increased in value. Road improvement and cotton factories have increased farm-land value in Gaston County. Such farmers in Lenoir County as have begun to "raise their own meat and bread," as have ditched their farms and built new houses for tenants, and as have increased the use of fertilizers have profited notably.

SOUTH CAROLINA.—Truck farming is "increasing in value every day" in Beaufort County; "a few years ago lands on this island were 'butchered,' but in the last few years a few planters have come in, and lands that have been a drug on the market readily sell at $10 per acre, and there are some plantations that can hardly be bought at any price."

In Cherokee County "the white renters are getting tired of paying rent and are becoming owners; besides this the employees of cotton mills who have saved money enough to buy land have become so tired of millwork that they are getting out into the country again." Owing to the increase in the price of cotton, cotton lands in Lexington County have been fertilized better and improved to a higher state of productiveness, while buildings have been remodeled and rebuilt, with the result that acre values have increased 100 per cent during the last five years.

The introduction of tobacco culture into Marion County "has worked wonders in the financial condition of the farmers, and lands that were worth $10 per acre in 1900 are now readily selling for $50 to $75." The thousands of peach trees recently planted in Oconee County have largely raised land values.

GEORGIA.—From Appling County the report is that "the increase in the value of farm lands is because more interest is taken in farming, better machinery is used for cultivating and harvesting, and home seekers are coming South." "The business

men of Macon, in Bibb County, are buying all the farming land that is for sale as an investment, and much of such land is lying idle."

There is an active demand for land for fruit and general farming in Floyd County, and many thousands of fruit trees have been planted within a few years; "the advance in the price of cotton, horses, and mules has been the main cause of the advance in the price of farming land."

The lands of Houston County are bought for peach growing and consequently are going higher in value every year. The increase in the value of farm lands in Morgan County "has been remarkable for several reasons—educational advantages, increase in the value of cotton, the partitioning of large landed estates into small farms bought and settled upon by thrifty white people."

FLORIDA.—"Generally speaking," writes a De Soto County correspondent, "land values have about doubled in the last five years owing to hard winters in the northern counties of the State, which made De Soto the banner orange county of the State. Vegetables are more extensively planted than formerly and are becoming more remunerative." The largely increased farm values in Duval County are due to increased production per acre and improved methods of culture.

NORTH CENTRAL STATES.

OHIO.—Farm land has increased $10 per acre since 1900 in Ashland County; "farms are kept in very good repair, and the soil is looked after more carefully than formerly by the use of barnyard manure and other fertilizers." From Carroll County comes the complaint that "one of the greatest factors in lowering the value of farm lands is the extreme scarcity of help and the high wages demanded for very unsatisfactory labor."

Tobacco has been selling for good prices in Darke County, and "this has been the principal cause of the boom in land prices." Land suitable for gardening has increased more than any other kind in the neighborhood of Columbus, in Franklin County. A new milk-condensing factory in Fulton County is said to be the chief cause of the rise in land, and in Geauga County farms so situated as to be able to sell milk for city consumption have been the ones to increase most in value. The higher price of white oak has raised the value of farms in Trumbull County, and in Wyandotte and other counties the making of good roads has added value to the farms served by them.

INDIANA.—A large part of the increased value of farms in Adams County is due to new improvements, tile draining, and the construction of many miles of durable roads. A Jennings County correspondent believes that "the two principal causes of the advance in prices are improved highways and better methods of soil management." Marsh land in Kosciusko County has been enhanced in value fourfold by drainage and by growing onions, celery, and potatoes. Farm values are increasing in Ripley County because farmers are coming from the higher priced land in the northern part of the State to buy the cheaper land in this county. Farms have doubled in value in Lake County, 45 miles from Chicago, on account of market facilities.

ILLINOIS.—"Farms have been selling above their real value" in Bureau County because money was plentiful and could not readily be loaned at interest; "farms are not paying more than 3½ to 4 per cent on the investment after deducting taxes and cost of keeping up the improvements." Crawford County has large commercial orchards just coming to maturity, which have much increased acre values. There has been a migration of farmers from the high-priced land of the northern part of the State into Edwards County, with consequent rise in land prices.

The bottom lands of Fayette County have increased in value threefold by draining and levee building. "All farm lands have increased 50 per cent in value in the past five years in Henry County on account of the high prices of corn, cattle, and hogs, because of the safe investment for money in land and farm mortgages, and the

abundance of money at 5 and 5½ per cent." The extinguishment of an enormous county debt by Macoupin County has removed a long-standing depression from farm values in that county. "A change from the old methods of farming to the more modern practice of handling soil and live stock is raising the price of land" in Massac County.

MICHIGAN.—Fruit lands on the shore of Lake Michigan are three or four times more valuable now than they were four years ago. "There is now a steady flow of people from the city to the farms, with a steady rise in the value of farm lands" in Calhoun County. Farms containing some timber are the ones that have increased in value in Grand Traverse County. The establishment of "several beet-sugar factories within reach of the farmers of this [Gratiot] county has done more to enhance the value of farms than any other cause within the last five years."

Farming in Huron County is entirely different from what it was five years ago, and values have increased for several reasons—better highways, chicory growing, the bean crop taking the place of wheat and rye, better buildings, more intelligent utilization of land, improved breeds of horses and other live stock, higher prices for swine, and better contact with outside markets. Grape raising has increased rapidly in Kalamazoo County, and "choice locations for this fruit have doubled in value."

Lands in Muskegon County, as in other counties bordering on Lake Michigan, have risen in value rapidly during the last five years on account of the summer-resort business. A large influx of settlers into Osceola County a few years ago mostly accounts for the advance in land values. Raising cucumbers for pickles has combined with sugar beets to make higher land values in Ottawa County.

WISCONSIN.—Dairying and potatoes have rapidly enhanced the values of farm lands in Adams County. The wild lands of Jackson County are being bought in large tracts for stock farms; marshes are turned into cranberry bogs; and the "cut-over lands" are rapidly settled upon—all causing largely increased values. Old log buildings have been taken down in Oconto County and their places taken by modern buildings. Better buildings and a better state of cultivation have raised farm-land values in Outagamie County; and dairying, hogs, and sheep have had their due effects in Pierce County.

Tobacco lands have increased in value more than any other in Vernon County on account of high prices for that crop. "Formerly we had to haul potatoes 18 miles," writes a Waukesha County correspondent, "but three years ago a railroad was built 6 miles from here, and that will explain much of the rise in farm values; a creamery in the center of the town raised values to some extent."

MINNESOTA.—Heavy rains and too much wet weather since 1902 have depressed the value of farm lands in Benton and several other counties. Reasons for higher farm values in Lesueur County are thus stated: "Sugar-beet raising is booming here; Bohemians are the principal people, and they do not mind the drudgery of farming and have large families; dairying is largely increasing, and half the people have hand separators and sell or ship their cream." Illinois men have been coming to Martin County, with a consequent sharp advance in the price of farms.

Emigration from Meeker County to the cheaper lands of northern Minnesota and of Canada has prevented large advances in farm lands. The immigration of farmers from Iowa and Illinois into Murray County raised farm prices so high three years ago that there has been a subsequent fall of perhaps $10 per acre. "Overspeculation and gambling by land agents in poor and worthless land" in some parts of the Red River Valley several years ago have been followed by a fall in the price of lands to their sound value.

IOWA.—Lands have not recently been as salable in Blackhawk County as some time ago, because many of the tenant farmers have gone westward or northward in quest of cheaper lands. The low rate of interest paid by banks on deposits in Clinton County is regarded as causing investors to buy farm lands, whereupon the sellers

have moved to cheaper land in the West. Many improvements are reported from Greene County, where the farmers have been building better houses and barns and tile-draining their land.

The general estimation of the desirability of farm ownership as an investment is indicated by the statement of a Polk County correspondent, who believes that "farm land is just as good as a gold bond with diamonds in the corners."

MISSOURI.—Fruit growing in Barry County has greatly increased the value of land. The increase in the value of Boone County farms is because of the great number of farmers in Illinois, Iowa, and Indiana who have sold their high-priced farms and come to this county to buy larger ones with the same or less capital. The rapid growth of St. Joseph, with its stock yards and meat-packing industries, has influenced the price of farms favorably situated in Buchanan County.

The price of land in Christian County did not change from 1900 to 1904 for the reason that many farms were for sale, the owners being about to leave for new regions and take up Government land which was open for settlement, as in Texas, Oklahoma, and openings farther north. The Ozark region in southwest Missouri was so advertised at the Louisiana Purchase Exposition in 1904 that immigration ensued, with consequent rise of land values. The increase of land values in Howard County is due in part to the better financial condition of the county, which has become free from a bonded debt of $600,000 for two railroads, one of which was not built.

The prosperous condition of the farmers of Lincoln County is such that many of them with large bank accounts, being unable to place their deposits at interest, have invested in farm land. Land has gradually advanced in price in the last few years in Mississippi County, especially wet land which has been drained by dredge boat, ditches, and canals. The stationary values of land in a portion of Ozark County are explained by a correspondent who writes that "we are 40 miles from a railroad, so the home seekers who have means are a little slow in locating among us." The lead mines of St. Francois County have brought in immigrants and advanced the market price of farm products.

SOUTH DAKOTA.—The rise in price of land in Edmunds County is said to be mostly due to the artesian wells, which are now guaranteed to be flowing for $300 to $500. From Meade County the explanation is that "as long as there is Government land to be homesteaded east of us, we can not expect any fancy prices for our land." Unirrigated farm lands have not advanced in price in Butte County, but irrigated lands have advanced fully 50 per cent in five years.

NEBRASKA.—Creameries have given an increased value to farm land in Brown County. The demand for land in Clay County comes considerably from those well-to-do farmers who desire to establish their sons near them and from those coming into the State; and in Otoe County the many German farmers are especially prosperous, and all their surplus money is invested in land. A Richardson County correspondent believes that "a dangerous condition confronts the young farmer, as he is unable to buy at these large prices and capitalists are buying whatever they can get." Alfalfa land in Valley and Webster counties, as everywhere else, is somewhat higher priced than neighboring land that will not raise it.

KANSAS.—Barber County was nearly depopulated in 1900 because of the Oklahoma movement, and consequently lands have more than quadrupled in value under resettlement. Prior to 1900 Comanche County was devoted entirely to grass, but since that time land has been bought in small tracts, and under proper cultivation has been found to be very productive for wheat and corn, with consequent remarkable increase in price. The dairy-farm lands of Ford County have the highest values on account of being in the alfalfa district. The land of Johnson County has about doubled in value since 1900, being favorably situated near Kansas City and in demand for farm homes.

Immigration to western Kansas has raised the value of all kinds of land, and Meade County, among others, is being rapidly developed for wheat production as well as cattle raising, and, in addition to the foregoing, alfalfa has greatly increased the value of land. The large wheat and corn crops of Ottawa County and many other counties in the State are attracting many eastern farmers, who are bidding up the price of land.

SOUTH CENTRAL STATES.

Kentucky.—Several millionaires have established stock farms in Lexington, in Bourbon County, in the past five years, and the demand for stock lands has caused the price to advance rapidly. Bracken is a tobacco county, and land for raising this crop is becoming scarce and the demand is greater than the supply. The advance in the price of timber has increased the value of farms to some extent in Clinton County. There has been a marked advance in the character of farming in Hickman County; "a younger and more skilled class of farmers are acquiring possession of the lands and devoting more attention to raising hogs and cattle." The advance in the price of farm lands in Lee County "would probably have been more marked if it were not that they have been badly cared for; hillside lands have been worked and washed in many instances until ruined, while bottom lands have been continued in one crop until they are worn out."

Farming interests have revived in Muhlenburg County in consequence of the reduction of a debt of more than $1,000,000 to a small figure. The desire of capitalists, merchants, and others to retire upon a good bluegrass farm in Shelby County is raising prices of farms to a fancy figure. There has been a large migration of tobacco-raising people from the mountain country into Spencer County, whereupon the prices of tobacco lands have much increased.

Tennessee.—A correspondent in Bradley County accounts for advanced farm prices by writing that "more and better farming is done than ever before; lands of all kinds are being improved and better homes built; millions of fruit trees are being set out and a spirit of improvement seems to be prevalent." In addition to this there is considerable immigration from the North.

One of the reasons for the increased value of land in Lawrence County is the raising of cantaloupes and tomatoes, which are sent to Chicago and other far-away places. From Madison County the report is that "we have gravel roads leading out 5 miles from Jackson, and land on these roads can not be bought at a reasonable price at all."

The introduction of alfalfa has had a wonderful effect on hay and grain lands in Montgomery County, and the farmers are quitting tobacco and resorting to hay, fruits, vegetables, live stock, etc.

Alabama.—Possibly farms would increase in value, in the opinion of a Coosa County correspondent, if it were not for the uncertainty of labor, which rises from three causes: "The best of our citizens are going West; secondly, the flocking of all our able-bodied laborers to the public works; thirdly, the tendency of labor to farm without intelligent direction and its general demoralization." Lands devoted to apples and pears in Dale County have probably decreased in value, owing to blight, while peach and other crops have greatly increased the land values. Owing to the better price of cotton during the last three years and "plenty of money" in Macon County, it is rare that a planter can be induced to fix a selling price on his farm.

Mississippi.—Lands of all kinds have advanced very much in the past five years in Alcorn County, "since people from other States are seeing the advantages in this part of our Southland and are coming here in great numbers." In Bolivar County increased values are due to the protection of land from the usual overflow of the Mississippi River by improved levees and to the many investments of northern men in delta lands. "There is a new railroad in this part of Green County," writes a correspondent, "and almost everyone is wanting to buy farm lands, and I can not find anyone who wants to sell out at any price."

Lands in Hinds County which in 1900 were devoted to corn and cotton are now for the most part used for fruit and vegetable growing and dairy products for consumption in Jackson, and the prices of these lands have about doubled. Strawberry growing has developed considerably in Holmes County and much raised the price of land used for the purpose.

LOUISIANA.—Irrigating canals along the Gulf coast have raised the value of rice land. Draining ditches and levees are much increasing the land values in Ascension Parish. In De Soto Parish truck farming and cooperative marketing are increasing farmers' profits; vegetable lands along the railroads are much in demand in East Feliciana Parish and all Government lands have been taken up by farmers from the North Central and Eastern States. The higher price of cotton and increased immigration from the Northern States have much advanced farm-land values in Lafayette Parish.

Rice lands unprotected by a levee in the southern portion of Saint Tammany Parish are down in price, but protected lands are sold at fancy prices. Early vegetables and berries in Tangipahoa Parish grown for the Northern markets overshadow all other farm products and land prices have much increased. Land in Union Parish in 1900 "was a drug on the market at $1.50 per acre; but since railroads have been built here it sells now for $3 to $15, and is going higher."

TEXAS.—The cotton-boll weevil has held cotton land at a stationary price or diminished it in a considerable number of counties. "A flood of immigrants from eastern Texas and other States" has much increased the value of land in Baylor County. Cameron County is fast changing from a cattle range to a farming country and values of land have doubled in three years. White potatoes and fruit orchards combined with immigration have increased land values in Camp County one-third above those of 1900. The land in Chambers County that was used for stock raising in 1900 is now used for rice growing and has increased 300 per cent without regard to buildings. The price of land near railroads in Cherokee County for fruit and vegetable raising "has gone out of sight," and some of it is selling at $100 per acre. Tomatoes, cantaloupes, and cabbages bring a gross return of $50 to $300 per acre.

The Panhandle was entirely a stock range a few years ago, but its value for agricultural purposes is now thoroughly established; cotton, wheat, and corn, among other crops, are raised, and the price of lands has advanced in five years one-third in some counties. Irrigation began within the five years under review and has enormously increased the value of the land in various counties in western Texas and also in rice counties along the Gulf.

ARKANSAS.—New railroads and the development of fruit growing are enhancing land values in many counties, and higher prices for cotton and timber and the development of vegetable and berry growing are greatly aiding. Cheap lands are attracting large numbers of immigrants, with a consequent rise in land values. New levees have much increased land values in Mississippi County, but the Red River bottom lands in Miller County are of lower value because of overflows. Land values have been kept down in Montgomery County because of cheap public lands elsewhere to which residents could migrate, but this depression is now relieved.

WESTERN GEOGRAPHIC DIVISION.

ROCKY MOUNTAIN STATES AND TERRITORIES.—In Beaverhead County, Mont., land near a railroad that has been subjected to irrigation and will raise alfalfa and oats has increased enormously in value. Sugar-beet growing in Colorado has been a prominent cause of great increases in land values and in a large degree the same may be said of fruit and vegetable farms. Everywhere farms on which alfalfa can enter into rotation with other crops are greatly gaining in value. Of course, by far the largest rates of gain in value have gone to farms with good water rights. The foregoing

observations upon Colorado apply to this entire mountain group of States and Territories.

The remarkable increase in the price of lands in eastern Colorado is, in the opinion of a correspondent, partly due to the fact that it has been found that farming can be carried on successfully under the "Campbell system of soil culture." A strong combination to raise land values is mentioned in Larimer County, Colo.: Irrigation, sugar beets, lambs for Chicago, rotation of crops—alfalfa followed by grain, potatoes, and sugar beets—ground well manured from the feeding of lambs, a better knowledge of the application of water, and a fine climate.

The immigrants who have come to San Miguel County, N. Mex., and taken up substantially all land that has a living water supply have materially increased the price of land. Grain is rapidly taking the place of cattle and hay in Boise County, Idaho, and land values are consequently gaining. Higher farm-land values in Idaho County have followed railroad building, nearer markets, higher prices of wheat, new mining camps, and the advertising of county attractions to induce immigration.

Washington.—Hop growing has multiplied the value of hop land in Clark County; prune orchards grow to be worth $500 per acre or more. Douglas County values have gained much because of recent improvements, higher prices of grain, better facilities for handling it, and the entry of all Government land.

In King County, containing Seattle, land values have been largely increased by dairying and the growing of vegetables and berries, with the aid of better railroad service and new electric railways. To this should be added much higher prices of hops, hay, and other farm products wanted in Seattle. During the last five years Washington land values have felt the effects of immigration more than those of the Pacific coast southward.

Oregon.—Hop yards in Polk County have advanced in value more than other lands. Fruit lands everywhere in the State have advanced enormously in value, particularly so in the case of the growth of orchards into bearing. Among numerous other influences upon land values are irrigation by means of wells, new dwellings and barns, better transportation facilities, larger profits of sheep raising, the benefits of alfalfa, immigration, sugar beets, and the growth of local markets.

California.—Dairying, with dependence upon alfalfa, in Colusa County has doubled the value of farms. Bottom lands subject to overflow in Contra Costa County, used for dairying or growing asparagus or other vegetables, have increased in value more than other lands. Some vegetable lands are worth as much as $500 per acre. The growth of San Francisco and suburbs and the extension of electric-car lines have combined with the foregoing to affect land values.

The conversion of an immense cattle ranch in Fresno County since 1900 into farms has enormously increased the land value. There is much demand for alfalfa land in Kern County on account of the development of dairying; even fruit orchards are displaced by alfalfa.

The remarkable extension of electric railways in Los Angeles County has much enhanced the value of all lands within 30 miles of the city. Dairying, alfalfa, walnut, and vegetable lands that have recently come under irrigation have increased enormously in value. Some lands with orchards, water rights, and other improvements have gone as high as $1,500 to $1,800 per acre, and even higher values can be found.

Wheat lands have responded to higher prices in Montgomery County. Vineyards in Napa County, worth $150 per acre in 1900, can not now be bought for less than $200. The introduction of celery growing into Orange County upon a large scale has raised the price of land so used from $20 to $1,000. Asparagus growing in Sacramento County has raised the value of land $80 to $100 or more.

Good alfalfa lands have advanced 75 per cent in value in San Joaquin County in five years; natural grape land has been raised by grape growing from a few dollars

to $300 per acre within five years. The high price of wool is giving strength to land values where sheep are kept, in Sonoma County. The subdivision of large farms of Tehama County, with more intensive agriculture, has greatly enhanced values. Sugar-beet and lima-bean lands of Ventura County have more than doubled in price in five years.

THREE BROAD OBSERVATIONS.

FUTURE CONTINUANCE OF GAIN.

Rates of advance.—The extraordinary advance in the value of farm real estate, an advancement mostly in land values, but considerably in improvement values, which has appeared during the last five years can not of course continue indefinitely at the same pace. A gain of 33.5 per cent in five years is so great as to suggest a cessation, perhaps retrogression for some parts of the country or for some years, or, more likely, on the whole, as a net result of diverse tendencies, a diminution of the rate of increase to a more steady one, which will reflect the capitalization of farm real estate that can be sustained mostly by the profits of production and by improvements.

Waves of depression and elevation.—While, apart from new land taken into cultivation, there has been a general advance in the value of farm real estate from census to census (with the exception of the disturbing effect of the civil war upon the South), it is nevertheless true that within areas sometimes much restricted and at other times much enlarged the value of the farm real estate has been subject to waves of depression and elevation, continuing sometimes no longer than one year and sometimes during a period of considerable length in case of depression.

Periods of general depression have so far been retrievable, and most localizations of depressions have so far been curable. The localized depressions of the past five years have often been of small account, and from a national point of view are thoroughly lost in the great gain in values in which every State has participated for every one of the ten classes into which the farms of the country are divided in this investigation according to principal sources of income, with minute exceptions in the North Atlantic States.

LANDLORDISM FOR INVESTMENT.

Three former classes of landlordism.—A new sort of landlordism—new to this country—seems to have grown out of the great and rapid increase in farm real-estate values in recent years. The farm landlordism of many years has mostly been of three general sorts: (1) The landlordism of the cotton plantation worked mostly by tenants under a system which, while technically constituting tenancy, often has been little more than a contract for labor at contingent wages with an element of profit-sharing; (2) the landlordism of the old farmers who have moved to town and city or gone to live with children, and that

which has followed their death, with breaking up of family; (3) the landlordism of owners temporarily holding farm titles until tenants shall have become able to buy, or until other purchasers have appeared, embracing a large class of landlords, apart from the second class.

New preferences for farms.—To these three is now added a class of landlords who have become such as a consequence of seeking investment and finding it preferably in farm lands. This class of landlord investors is more especially found in the North Central States; it is hardly apparent in the North Atlantic States, but is becoming perceptible in the South.

Founding "estates."—There has been a marked continuance of the founding of "estates" in the North Atlantic and North Central States and Virginia, and in spots throughout the rest of the country, a movement that began over half a century ago, notably in Berkshire County, Mass.; but this movement is generally without farm landlordism, in place of which there is a hiring of farm managers and laborers for wages.

GAINS WHERE MOST NEEDED.

Throughout the South.—Derived from the various degrees of advance in the values of farm real estate during the period under review, an observation that is particularly pleasing from the point of view of national welfare is the common tendency of regions with land of low values to overtake the regions with higher values. Such a movement has stimulated the entire South in a remarkable degree, and has accompanied a notable increase in prosperity.

Semiarid land.—The new lands of the semiarid regions have acquired a value almost wholly created by means of suitable cultural methods.

In the depressed East.—The farm-acre values of the East were not low enough to win the high increases of the other parts of the country during the last five years, but the long agricultural depression, against which the farmers of that region have struggled for many years, has given way on the whole to more profitable farming operations, and the East has joined the regions that were backward in advances of value in an onward and upward movement to capitalize their land with a more profitable agriculture.

RELATION OF FARMING TO OTHER VOCATIONS.

The rapid development of manufacturing, transportation, and merchandising, of professional, personal, and domestic service, and of minor vocations, with a sustained export demand, is supporting good prices for the farm products of this country. The nonagricultural vocations have made such heavy demands for labor that farm workers are not so numerous as to cause overproduction. Since the making

of the raw products of food and clothing chiefly constitutes farm industry, and since the consumption of each of these two classes of products is subject to only a limited change per capita of the total population, high prices of lands necessarily require that there shall not be too large a percentage of total population engaged in agriculture, and the nonagricultural population must be prosperous so as to pay profitable prices for agricultural products.

The balance between country inhabitants and townspeople now seems fairly well adjusted, so that there are good wages in the nonagricultural pursuits and reasonable remuneration in farming. Good prices for farm products and the absence of an oversupply of hired labor promote the continuance of the nation's homestead plan of family-sized farms, one of the important social successes that this Republic has placed before the world.

Free popular education, secondary schools, higher institutions of learning and of research devoted to nonagricultural pursuits, along with Governmental assistance in promoting marketing at home and abroad, are building up the nonagricultural classes and thus helping to enlarge home markets and raise their purchasing power for farm products.

In still another encouraging way rural schools, agricultural colleges, experiment stations, departments of agriculture, and inventors are enlarging and strengthening the technique of farm management, enabling the farmer to produce more from the acre and more per worker, and building up a class of farmers who not only produce a living, but also substantially increase their capital and its productiveness.

PROGRESS IN DRUG-PLANT CULTIVATION.

By Rodney H. True,

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INTRODUCTION.

From the most ancient times mankind has turned to the plant world not only for foods and fibers but also for medicinal substances to combat his physical ailments; and, in spite of the important contributions made by chemistry, and in later days by organ therapy, to the materia medica, the vegetable kingdom still forms the most important single source to which the physician turns for disease-counteracting substances.

An examination of the official list of crude drugs of plant origin develops the fact that a large proportion of the species represented is found growing in the United States. Many of them are weeds, often classed as noxious by the farmer; others are simply wild plants of the fields and forests of different parts of the country. A very considerable proportion of the crude-drug supply is of foreign origin and is imported from many parts of the world. Of the entire list of drug plants, those under cultivation in this country constitute but a small portion. There has been an almost complete neglect of this phase of plant economics in this country and certain results have followed: (1) Many of the most valuable of our native drug plants have been well-nigh exterminated by drug collectors; (2) several kinds of our most noxious weeds, instead of being utilized, have remained to encumber the land and impoverish the farmer; (3) millions of dollars are sent abroad annually to pay for crude drugs which are grown under conditions of soil and climate in general similar to those of our own country.

The domestication and cultivation of those valuable wild plants which are most seriously threatened are an obvious necessity if the products concerned are not to disappear from the materia medica. The proper utilization of such weeds as possess useful properties would not only tend to check their spread, but would make them the source of income sufficient at least to pay for their removal when rightly handled. It is even possible that the cultivation of some of the weeds furnishing products most in demand might prove financially profitable. The experimental cultivation of drug plants from foreign lands with the hope that some may be grown here with profit is the first necessary step if this country is to supply its own demands for crude drugs.

Experiments along these lines in the Bureau of Plant Industry have been carried on for some time and progress has been made in several directions. In these investigations the Office of Seed and Plant Introduction has cooperated with Drug-Plant Investigations.

DOMESTICATION OF WILD DRUG PLANTS.

GOLDEN SEAL.—The root known as golden seal, *Hydrastis canadensis* L., has long had a wide use in America in connection with a class of troubles against which it has an especial efficacy. Of late years this favorable action has attracted attention abroad, with the result that, in addition to an increasing domestic demand, a very considerable foreign market has been built up. The search for this plant in the forests has been carried on so persistently that it has become scarce in commercial quantities and consequently high priced. For its preservation, therefore, cultivation is necessary. For a number of years it has been under observation at the testing gardens, Washington, D. C., and certain points essential in its cultivation have been made clear. Shade, artificial or natural, and a rich loamy soil are necessary. The plant reproduces readily from buds on the underground stem and by small buds developed on the fibrous roots. It is doubtful whether it is propagated from seed to any great extent, the seed seeming frequently to be incapable of growth. It takes about two years for the young plant grown from the divided rootstock to reach a good size for market.

The demand for the dried root of golden seal continues good, the quotations indicating ready sale at from $1 to $1.50 per pound. Our experiments seem to show that the outlook for a small industry in the growing of this plant is bright. It is to be hoped, however, that overproduction may be avoided. At present several firms are growing golden seal in small areas.

CASCARA SAGRADA.—The cultivation of the cascara sagrada tree, *Rhamnus purshiana* DC. (Pl. LXVII, fig. 1), has been made a subject of study for about two years. The tree producing this useful bark, known as cascara sagrada, is a native of the upper Pacific coast region, where it chooses moist situations in the mountains. This usually small tree grows readily from seed sown in rich wood soil, and makes a fair growth the first year. It is under observation both at Washington, D. C., and at Ebenezer, S. C. In both places it seems thus far to do well. Prof. C. S. Sargent, of Harvard University, states that at the Arnold Arboretum, near Boston, the tree maintains an existence for some years after transplanting, but eventually dies. So far both the seedlings grown at Washington and the transplanted trees sent in from the Pacific coast have made a good growth and look well. It is very desirable that the cultivation of this tree on an experimental scale should be taken up in the country to which it is native. The demand

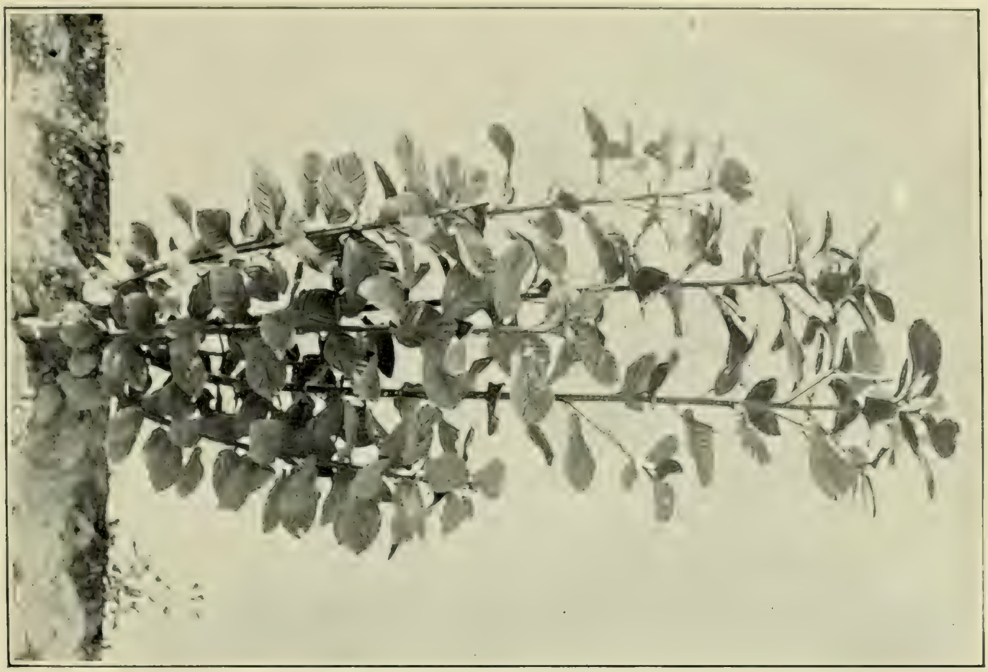

FIG. 1.—A TRANSPLANTED SEEDLING OF CASCARA SAGRADA ABOUT 3 YEARS OLD, 4 FEET HIGH. TWICE TRANSPLANTED.

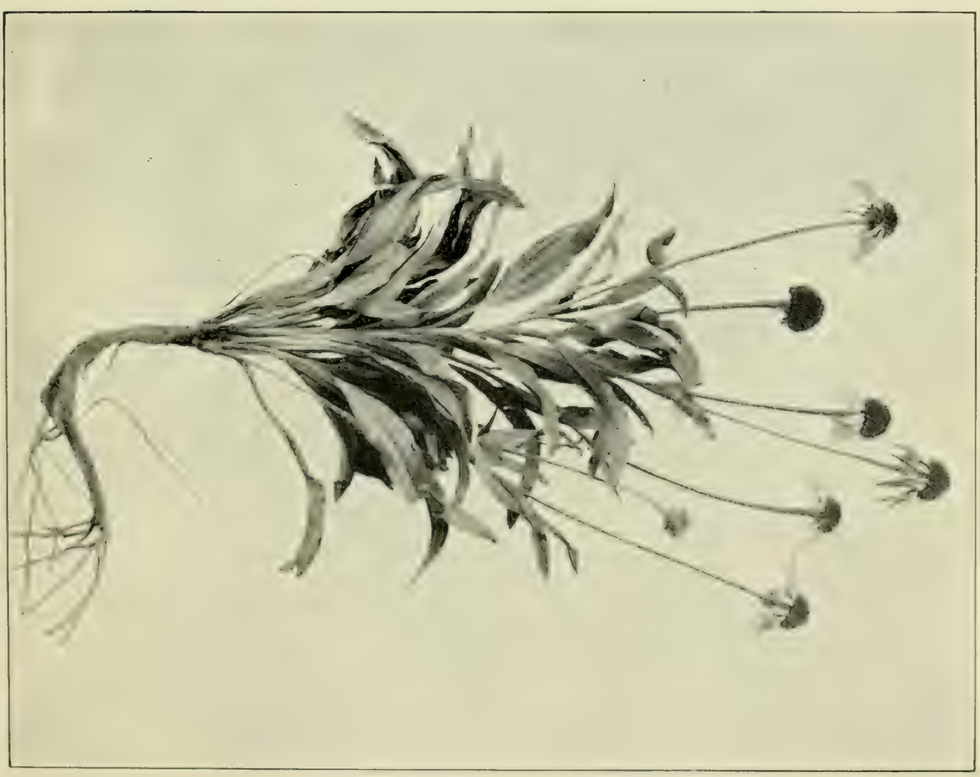

FIG. 2.—PURPLE CONEFLOWER. WHOLE PLANT AT TIME OF FLOWERING. HEIGHT ABOUT 20 INCHES.

for this bark is great, not only in America but to an increasing degree in foreign lands, and since the amount of available material wherewith to supply this demand is decreasing rapidly and considerable time is required to grow trees large enough to peel, it is apparent that in the not very distant future a shortage is inevitable.

Seneca snakeroot and purple coneflower.—Among other wild drug plants now rapidly disappearing to which attention is being given by the Bureau of Plant Industry may be mentioned Seneca snakeroot, *Polygala senega* L., and echinacea, or purple coneflower, *Brauneria angustifolia* (DC.) Heller. (Pl. LXVII, fig. 2.) The latter plant is a member of the aster family, and grows scatteringly over considerable areas of the plains in Kansas and Nebraska. This drug has come into special prominence in the last few years, and is much in demand, an increasing foreign consumption being noted in addition to the quantity necessary to satisfy home demands. Although formerly an easy drug to obtain at reasonable prices, echinacea has become increasingly rare during the last few years, with a consequent rise in price. The transplanted plants at Washington are making a very promising growth, and the outlook for successful cultivation is good.

UTILIZATION OF WEEDS.

There is a considerable number of kinds of plants occurring frequently along roadsides, in fence corners and waste places, or even among the crops, which furnish products used in greater or less quantities as crude drugs. Among these may be mentioned a few species which have received attention.

American wormseed.—The so-called American wormseed, used, as its name indicates, as a vermifuge, consists of the dried fruits of *Chenopodium anthelminticum* L. When drilled in rows and properly cultivated, a yield of 500 pounds or more to the acre was obtained under the conditions of soil and climate prevailing near Florence, S. C. It was harvested by cutting the plants near the surface of the ground while the fruit had still a bright-green color, the seed showing a bright, black surface when rubbed out, and was dried in a barn having a tight board floor. When dry the fruits were beaten off, the leaves and other débris sifted out, and the fruits bagged for market. The price obtained gave a better net return, acre for acre, than cotton on the same type of land for the same season. It is necessary to remember, however, that the annual demand for wormseed is limited and that overproduction is easily possible.

Jimson weed.—Another weed regarded with great hostility by farmers generally is the well-known jimson weed, *Datura stramonium* L. This spreading, ungainly, and ill-smelling weed, often occupying considerable areas of unused, usually rich lands about buildings and

yards, supplies the drug dealers with both leaves and seed. Although it grows frequently to great size if left to itself, when grown under cultivation in rows jimson weed needs good soil and some cultivation in order to make a good growth. It then appears also to suffer from insect pests, which are seldom seen to molest it otherwise. However, if it has a good chance, it yields a crop of leaves which, if properly cured and marketed, will equal or surpass the net yield, acre for acre, of large areas of land now growing wheat and other staple crops. The curing is best done by cutting the plant at the ground when in fullest leaf and drying it out at from 100° to 110° F. in a tobacco-curing barn of the type in use in the Carolinas for curing bright tobacco. The plants, stems and all, are cured, and when the leaves are dry they may be easily stripped from the stems. After taking on enough moisture to prevent them from being too brittle to handle without breaking to pieces, the leaves may be bagged for storage or shipment.

POKE.—Experimental plats of pokeroot, *Phytolacca americana* L., have shown on a small scale that these roots, which are dug, sliced, and cured at the close of the first year's growth, may be easily grown and handled. The fleshy branch roots of older plants, before they become too woody, are also acceptable, though less readily gotten out of the ground.

BURDOCK AND YELLOW DOCK.—Similar small experimental plats of yellow dock, *Rumex crispus* L., and of burdock, *Arctium lappa* L., gave favorable indications. These roots are now imported in part.

None of the drugs mentioned here has an unlimited demand, and any considerable overproduction would result in a decline in price.

CULTIVATION OF IMPORTED DRUGS.

The feasibility of cultivating foreign drug plants as a commercial enterprise depends on a number of factors. It is necessary, first of all, to know whether the species concerned will do well under the conditions which we have to give them. Secondly, it must be ascertained whether the resulting product has the desired properties among the new surroundings. Thirdly, the question must be faced as to whether, with the economic conditions prevailing in the region concerned, it is possible for the cultivator to realize a profit sufficient to repay him for his efforts.

To work through all these stages with a new industry requires not only patient investigation, but also considerable time. A series of cultural tests is being made on a small scale at Washington, D. C., Ebenezer, S. C., Burlington, Vt., and other points, and in some cases the behavior of important drug-producing plants of Europe and the Orient under our conditions has thus been determined.

ASIATIC POPPY.—The Asiatic poppy, *Papaver somniferum* L., grown in various parts of Europe and the Orient, has made a good growth in

FIG. 1.—CAMPHOR TREES 7 YEARS FROM SEED, GROWN AT QUINCY, FLA.

FIG. 2.—PLANT OF PAPRIKA PEPPER, GROWN FROM HUNGARIAN SEED AT WASHINGTON, D. C.

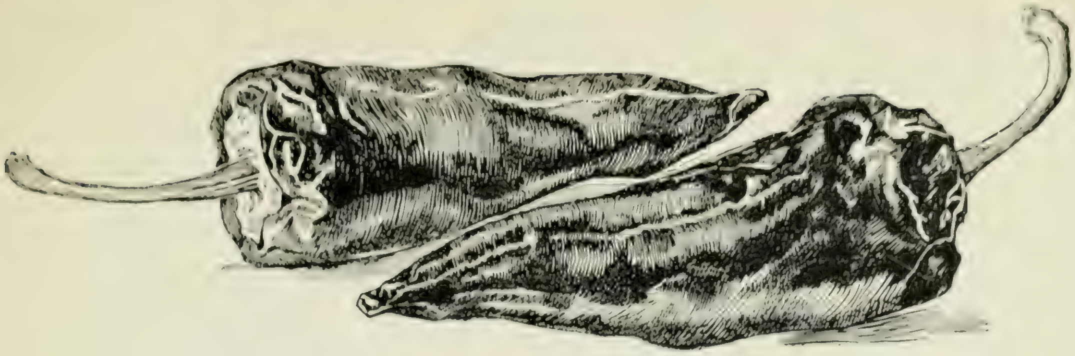

FIG. 1.—PAPRIKA PEPPERS. WHOLE DRIED FRUITS AS THEY APPEAR WHEN READY FOR MARKET.

FIG. 2.—BRANCH OF JAPANESE CHILLI PEPPER, SHOWING THE CLUSTERED ARRANGEMENT OF THE FRUIT. THREE-FIFTHS NATURAL SIZE.

FIG. 3.—ROOT OF A 2-YEAR-OLD BELLADONNA PLANT. 2 FEET DEEP. GROWN AT WASHINGTON, D. C.

the most widely separated parts of the United States. In so cold a climate as Vermont and in the warm sections of the South it has shown its ability to maintain a vigorous existence. Under unfavorable conditions of soil drainage, especially where the land is of a clayey nature, a diseased condition develops with disastrous results. This seems to be aggravated by too late planting in the spring. In July and August the plants bloom freely and produce in about four or five weeks a good crop of the large capsules characteristic of this species and its varieties. The poppy plant is traversed by an elaborate series of tubes carrying a white, milky juice, which oozes out whenever these ducts are cut or otherwise opened. The capsule after it reaches its full size contains a very liberal supply of this juice. By incising the capsule and collecting the partly dried juice a product is obtained which on further treatment becomes the commercial product from which morphine, codeine, and related alkaloids are extracted.

Mr. W. O. Richtmann, of the Bureau of Plant Industry, has at present under test on a large scale a process for separating morphine, codeine, etc., directly from the plant, which has promised well in the laboratory. Small experiments indicate the practicability of obtaining a high grade of crude morphine in fair quantity from the dried capsules of poppies grown in different parts of the country, but much further experimentation will still be necessary before the success or failure of the plan is demonstrated.

Camphor.—At the present time the world's entire supply of camphor is derived from Japan, the annexation of the island of Formosa bringing under the Japanese flag all the sources of production. This, together with the additional fact that the supply has been already seriously trenched upon, has raised the price of this commodity to a high mark and placed under the exclusive control of a single government a substance not only important medicinally, but also necessary in various technical processes connected with the manufacture of celluloid and of certain other products derived from nitrated cellulose. Our importation of camphor, crude and refined, between 1897 and 1904, has varied in value from $350,000 in 1899 to about $939,000 in 1904. This increase in value is due not only to a large increase in the number of pounds of camphor purchased, but also to an increase in the value.

At various times in the past the United States Department of Agriculture has imported camphor trees which have been distributed throughout various parts of the South (Pl. LXVIII, fig. 1), and it has been practically demonstrated that over considerable areas of the warmer portions of this country camphor will grow well. It has also been established by experimental distillations made from a good number of trees in several localities in Florida and in different seasons that the leaves and twigs obtained by pruning trees of various ages will yield from 1 to 1½ per cent of crude camphor, calculated on the

fresh weight of the clippings. That this yield can be increased materially is probable, since a very thorough opening up of the cells of the tissues to be distilled is a necessary preliminary treatment. Means for doing this most effectively were not at hand in the experiments here referred to.

A considerable area of camphor growth of various ages has been generously placed at the service of the Bureau of Plant Industry by landowners in Florida, and more thoroughgoing tests are planned. The economic possibilities of camphor growing will be experimentally tested. The readiness with which the camphor tree is propagated from seed and the rapid growth made, together with the yield of gum and oil, make the outlook one of great interest.

LICORICE.—The annual importation of licorice root and licorice paste has fallen between one and one-half and two million dollars since 1898. The sum paid for the paste—between $75,000 and $100,000—shows that the great bulk is purchased in the form of the crude root. Experiments in licorice cultivation by the Bureau of Plant Industry and by private parties show pretty clearly that although the imported article comes chiefly from the eastern end of the Mediterranean Sea, the licorice plant is hardy as far north as Pennsylvania. It will succeed best, however, in somewhat warmer regions. It maintains itself wild in some parts of California in which it has escaped from cultivation. Licorice cuttings imported from England made a good growth at Washington until interfered with by accidental conditions. In South Carolina an experimental planting has thus far made good growth. It is, however, too early for a complete report.

BELLADONNA.—Among the important minor crude-drug importations may be mentioned belladonna and digitalis. The belladonna plant, *Atropa belladonna* L., supplies the leaf and root drugs known under this name and is the source of the important principle known as atropine. Since these products are not itemized in the Government reports on imports, there is no official source from which the magnitude of the demand in America can be accurately determined. Belladonna, however, is a standard drug widely used, and a very considerable sum is paid annually for the products of this plant. Experiments with belladonna have been in progress at the Washington gardens for about four years. At first considerable difficulty was experienced in getting plants from the seeds. Two causes were operative—the bad quality of much of the seed and the too deep planting of good seed.

Belladonna does well in a good garden soil. The area to be devoted to it should be gotten into good tilth before seeding. The seed may be drilled in rows about 3 feet apart and covered very lightly. The plants if too thick may be thinned until a foot apart in the row. In the late summer of the first year the plants will reach a good size and flower

and fruit freely. The leaves are collected after the plants have begun to fruit and are cured by drying in the shade. The plant is perennial; and if unusual conditions do not interfere, the yield in leaves and fruit will be considerably greater for the succeeding years than for the first year. After the first year the roots (Pl. LXIX, fig. 3) become valuable and may be dug in the late autumn or early spring. It is desirable that they should not be allowed to become too woody before digging. They are cut up and cured. The cultivation of belladonna on a commercial scale has been taken up successfully during the past two years by an American firm using this drug.

Foxglove.—Foxglove, *Digitalis purpurea* L., furnishes a very important drug in the shape of the leaf collected from the flowering plant. It has been found easy to raise foxglove both at Washington and in South Carolina. In case the soil conditions are entirely satisfactory and the ground is clear of weeds, the very minute seed may be drilled into the garden in rows about 2½ to 3 feet apart. The seedlings are very small and are likely to be smothered if the soil contains many weed seeds. The plants may be more surely saved by planting in the early spring in a seed bed or under a cold frame. They may then be set out a foot apart in the rows. The leaf growth of the first year is not usually collected. The flowers appear in the spring or early summer of the second year. When the plant is in flower the leaves are collected, cured under shade, and baled for market.

Peppers.—At the present time a small but growing market exists in this country for ground paprika pepper prepared from the pods of a slender-fruited sort grown especially in Hungary (Pl. LXVIII, fig. 2; Pl. LXIX, fig. 1). This product is imported in both the whole and the ground condition, chiefly in the latter state. This pepper is marked by a somewhat sweet taste, a characteristic aromatic quality, and a narrow pointed outline. During the past two seasons small experimental plantings have been made at Ebenezer, S. C. Three acres grown during the past season have yielded between 3,000 and 3,500 pounds of dried pepper pods, for which a profitable price has been received. In spite of the fact that the ripe fruit was picked weekly and cured out in a tobacco barn over artificial heat, the profits resulting have been very satisfactory. At the present time, in view of the small demand for this product, the limit of overproduction could be readily reached.

The smaller forms of red peppers, known as chillies, have received some attention at Ebenezer, S. C., and the results with Japanese chillies (Pl. LXIX, fig. 2), while not as favorable as those just noted, still give good ground for hope that, with the long growing season, cheap labor, and special curing facilities of the tobacco region of South Carolina, there is the possibility of a considerably larger industry in supplying

this type of peppers. The importation for consumption into the United States of all kinds of red peppers (ground and unground) during the fiscal years 1903–1905 was as follows:

Year.	Pounds.	Value.
1903	2,835,574	$183,166
1904	3,209,623	217,042
1905	3,509,444	259,631

While it is possible that a part of this demand could only be satisfied by peppers grown in tropical climates, it seems probable that a considerable quantity of the home product will find a ready sale in the American market.

In closing, one point should be emphasized. Owing to the limited demand for any one product mentioned in this paper, the prospective drug grower is strongly advised to cultivate small areas of several kinds rather than to trust himself to the market conditions of a single crop. By dividing his risks he is more likely to avoid the full force of unfavorable seasonal effects and fluctuations of the market.

FEDERAL GAME PROTECTION—A FIVE YEARS' RETROSPECT.

By T. S. Palmer,
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INTRODUCTION.

The opening year of the twentieth century marked the beginning of a new era in game protection in the United States. The first general Federal law for the protection of game went into effect on May 25, 1900, and inaugurated a policy which was in striking contrast with that of the previous century. From colonial days the States had made repeated efforts to protect their game, and some of them had developed their laws to a comparatively high degree of complexity. Disputed points had been carried to the highest courts and in a few cases to the Supreme Court of the United States. The Federal Government, on the other hand, had done comparatively little. In 1832 Congress passed an act regulating the destruction of game in the Indian country; in 1878 a game law for the District of Columbia; in 1894 one for the Yellowstone National Park; and in 1899 a new law for the District of Columbia and one providing against the wanton destruction of fish and game in the Mount Rainier National Park. It also incorporated a few provisions in the tariff acts affecting the importation of birds and mammals, and inserted in the criminal code of Alaska a section prohibiting the destruction or export of eggs of cranes and waterfowl. It had done nothing, however, to prevent the introduction of noxious animals and birds from abroad, had never exercised its functions in regulating interstate commerce in game, and had made no general provision for protecting game in national parks or reservations.

PASSAGE OF THE LACEY ACT.

A decision rendered by the Supreme Court in 1896 in the case of Geer *v.* Connecticut held that game was the property of the State; that it could be protected in such manner as prescribed by the legislature, and that its export to other States could be prohibited without conflict with the interstate-commerce clause of the Constitution. This decision gave a new impetus to game legislation throughout the country and encouraged the States to incorporate nonexport provisions in their laws. Its effect on Federal legislation is largely a matter of speculation, but it is worthy of note that within a few months three bills were introduced in Congress.

On July 1, 1897, Hon. John F. Lacey, of Iowa, introduced in the House of Representatives a bill to encourage the introduction of new or valuable birds, which was destined finally to assume much broader scope than was then contemplated. This work, by the provisions of the bill, was placed in charge of the United States Commission of Fish and Fisheries, which it authorized to introduce, propagate, and distribute game or other wild birds and to collect and publish useful information concerning them. On the following day Hon. Henry M. Teller, of Colorado, introduced in the Senate a bill to prevent the illegal export of big game from the States of Colorado, Utah, and Wyoming. Six months later he reintroduced this bill in a form which broadened its scope, shaping it so as to prohibit interstate commerce in big game and certain game birds shipped in violation of local laws, to require the proper marking of packages of game, and to give the Interstate Commerce Commission jurisdiction over transportation of game from one State to another. On March 14, 1898, a bill was introduced in the Senate by Hon. George F. Hoar, of Massachusetts, with the object of restricting the traffic in birds or feathers, particularly those used for millinery purposes. This bill prohibited importation, shipment from one State to another, and sale in the Territories or the District of Columbia of birds or feathers for ornamental purposes. All of these measures failed of passage and were reintroduced in the next Congress. Without going into the details of the history of these bills[a] it will be sufficient to say that the Teller bill failed to pass either branch of Congress, the Hoar bill passed the Senate twice, but failed to pass the House, and the Lacey bill passed both House and Senate twice before it became a law.[b]

PROVISIONS OF THE LACEY ACT.

Between the dates of introduction and approval of the Lacey bill nearly three years had intervened. The measure had been introduced at least four times, with more or less modification each time; had been freely discussed by the press and by sportsmen and game protectionists, and had been under consideration simultaneously with the Hoar and Teller bills. All these circumstances left their impress on its final form. From a simple measure to authorize a new line of work in the Fish Commission it had developed into a general bill to provide for introduction of foreign birds, prevent importation of noxious species, regulate interstate traffic in game, and place the supervision of Federal game protection under the direction of the Secretary of Agricul-

[a] See Bull. No. 12, Biological Survey, U. S. Dept. of Agriculture, pp. 49–54, 1900.

[b] The first time it passed the House December 19, 1898, and the Senate January 6, 1899. It had, however, been amended in the Senate by the addition of the Hoar bill, and the combined Lacey-Hoar bill was lost in conference in the closing days of the session. It was reintroduced on January 3, 1900, and again on January 17, passed the House April 30, and the Senate May 18, and was approved May 25, 1900.

ture. It was intended also to supplement State laws and to settle the vexed question as to jurisdiction over imported game. In effect it was intended to form a Federal capstone resting on an uneven foundation of State legislation cemented as far as possible into one solid structure. Its five sections were derived from different sources and drawn for different purposes. Section 1, relating to introduction and propagation of game and publication of information concerning game, was the original bill modified and enlarged. Section 2, regulating importation of all foreign species and prohibiting introduction of those known to be injurious, was modeled after a law passed in Western Australia in 1893. Section 3, relating to interstate commerce in game, incorporated the principal provisions of the revised Teller bill. Section 4, in so far as it provided for marking of packages of game, was also modeled after the Teller bill. Section 5, making imported game subject to State laws, was copied from the Wilson original-package act. Even the final provision, that the bill should not prevent importation, transportation, or sale of plumage manufactured from the feathers of the barnyard fowl, may be regarded as an echo of the opposition to the Hoar bill, which had once prevented the Lacey bill from becoming law. This provision had been inserted, during the passage of the measure through the House, to insure that the bill should not be construed as affecting in any way the sale of so-called fancy feathers.

IMPORTATION OF FOREIGN BIRDS AND MAMMALS.

In regulating the importation of foreign birds and mammals the United States has undertaken a task of greater magnitude than that attempted by any other nation. The governments of Cape Colony, New Zealand, and some of the States of Australia restrict the importation of species which are considered pests, but no country with such extensive coast lines and so many ports of entry has hitherto attempted a supervision of all imported species in order to protect its agricultural interests. With the cordial cooperation of the Secretary of the Treasury and the officers of the customs service, the Secretary of Agriculture is now able to supervise importations which arrive at any of the ports on the Atlantic or Pacific coast, on the Canadian or Mexican borders, or in the Territory of Hawaii. Persons desiring to import wild animals or birds from abroad must first make application to the Department of Agriculture for a permit, setting forth the number and kind of each animal or bird, the port of entry, the date of probable arrival, and the purpose for which the importation is made. A permit is then issued which, when presented to the collector of customs at the port designated, authorizes the entry of the shipment. When necessary the consignment is subjected to expert examination in order to determine the identity of the species and so prevent the

entry of certain injurious species, the importation of which is prohibited. As a rule, special inspections are made only at the ports of New York, Philadelphia, San Francisco, and Honolulu, but they can also be made, when required, at Boston, Baltimore, Washington, and New Orleans.

When the law went into effect it was thought by some that it would be impossible to enforce its provisions; that the requirement of permits would cause serious delay and loss and endless criticism; that the placing of the work under two Departments would result in friction and prevent the accomplishment of the desired objects. Experience, however, has proved that such fears were groundless. The law has worked smoothly and effectively, without causing delay, loss, or friction. As its provisions have become better known its restrictions have been cheerfully complied with and its inconvenience to importers has been reduced to a minimum. Permits are obtained in advance but when for any reason this is impracticable a telegraphic request forwarded upon arrival usually secures an order for inspection or release of the consignment with the delay of only an hour or two. Parrots are admitted without permit or examination, and passengers bringing with them not more than five cage birds are allowed to declare them with their personal baggage without the formality of securing a regular permit.

Besides accomplishing the main object of preventing the importation of dangerous pests, this simple system gives a permanent record of every importation, affords the means of collecting valuable statistics concerning the trade in foreign birds and animals, and enables the Department to follow intelligently the various experiments which are made in introducing new species from abroad. It has already brought to light many facts of interest concerning the extensive trade in canaries from Germany, pheasants from Canada, and quail from China; the history of the introduction of new game birds, like the capercailzie, black cock, and Scandinavian ptarmigan, and numerous species of pheasants, waterfowl, and cage birds brought in for aviary purposes. When it is considered that one consignment of foreign birds arrives on an average nearly every day in the year, that in busy seasons as many as 10,000 birds have come into New York on one steamer, and that in the course of a year the importations aggregate more than 200,000 canaries and 40,000 miscellaneous birds, some idea can be formed of the extent of the foreign trade in live birds.

During the five years ending June 30, 1905, 1,563 permits were issued, covering the entry of 2,841 mammals, 819,970 canaries, and 185,765 miscellaneous birds, of which 30,837 were game birds. In addition to these, 19 permits were issued for the entry of 7,128 eggs of game birds brought in for propagation. The record for each fiscal year is shown in the table following.

Importations of mammals and birds, 1901–1905.

Year ending June 30—	Permits.	Mammals.	Canaries.	Game birds.	Miscellaneous birds.	Total birds.
1901	186	350	(a)	6,584	3,416	10,000
1902	287	214	182,361	5,281	47,791	235,433
1903	382	629	201,527	9,126	43,980	254,633
1904	318	1,470	205,400	6,307	35,323	247,030
1905	390	178	230,682	3,539	24,418	258,639
Total [b]	1,563	2,841	[a] 819,970	30,837	154,928	1,005,735

[a] The number of canaries imported in 1901 is not known, but it was probably not less than 180,000. This would increase the total number of canaries to about 1,000,000, and the total number of birds to about 1,186,000.

[b] These figures are somewhat less than those given on page 87, owing chiefly to the omission in this table of a few permits which were issued to replace others not used.

Comparatively few attempts have been made to import any of the mammals or birds prohibited by law. During the last five years admission has been denied to 7 specimens of the mongoose, 54 flying foxes, 1 kohlmeise (*Parus major*), 15 blaumeisen (*Parus cæruleus*), and 2 European starlings (*Sturnus vulgaris*). In the case of the mongoose 3 examples arrived at San Francisco (1 in 1901, 1 in 1902, and 1 in 1903), and 3 at Philadelphia (1 in 1901 and 2 in 1903), all of which were promptly destroyed. The seventh specimen was brought in at some port on the Gulf coast and was discovered at Los Angeles, Cal., where it died a few months after arrival. At the present time the only living specimens known to be in the United States are those in the zoological gardens in Philadelphia and Washington, and these are safely kept in confinement. Of the flying foxes 2 were brought to San Francisco in 1903 and were destroyed; the others, which arrived at New York in 1902, were refused entry and were promptly reshipped to Hamburg, Germany.

The importation feature of the law has been made elastic so that the Secretary of Agriculture can, when necessary, add to the list of prohibited species of birds or mammals which he has reason to suppose may become injurious if introduced into the United States. Should the mongoose once gain a foothold in the South, it would probably repeat its record in Jamaica and exterminate quail, grouse, and other ground-nesting birds, destroy poultry, and otherwise do immense damage. In short, it would in all probability become the worst pest which could be introduced into this country. Since the passage of the Lacey Act every mongoose known to have arrived at any of the ports of the United States, as just explained, has been promptly destroyed. So well has the law worked in practice that notwithstanding the fact that the Territories of Hawaii and Porto Rico, which were both overrun with the pest, were annexed while the bill was pending in Congress, the provision forbidding shipment from one State to another of species the entry of which is prohibited has thus far prevented the animals from securing a foothold. In the strict enforcement of this law lies the protection of the United States in future from the

repetition of such a costly experiment as the introduction of the English sparrow and from the danger of acclimatization of the mongoose or other pests capable of doing immense damage.

INTERSTATE COMMERCE IN GAME.

Development of cold storage and extension of railroads in the West in the early seventies made accessible to the markets of eastern cities a supply of game which at first seemed inexhaustible. So rapidly did this trade increase that some of the western States in self-defense were compelled to take steps to restrict shipments of game beyond their borders. Minnesota was one of the pioneers in this movement and as early as 1871 prohibited export of game for market, while in 1877 it prohibited export of all game birds, except pheasants, for any purpose. Several of the States in the Southwest soon followed with laws regulating market hunting, but progress was comparatively slow. In 1896, however, a decision of the Supreme Court of the United States (Geer *v.* Connecticut, 161 U. S., 519) finally established the right of a State to prohibit export of game. This decision had the effect of rendering nonexport laws more popular, and four years later they were in force in 41 States. But, in spite of all legislative restrictions, the trade in game continued to increase. Difficulty was experienced in detecting consignments of game before they crossed the border, and statutory prohibitions, while restricting, failed to prevent the growth of the trade through which large quantities of game were annually swept into cold storage in the larger cities.

Until recently Chicago and St. Louis were the largest game markets in the West. The conditions in these cities illustrate clearly the difficulties encountered in protecting game, and at the same time show the progress recently made in game-law enforcement. In 1900, nonexport laws were on the statute books of all the States of the Northwest except Nebraska and Montana. In Missouri the local law did not affect shipment or sale of game from other States, while in Illinois imported game could be sold without restriction as late as February 1. Under these conditions the game trade in Chicago and St. Louis flourished in spite of State laws, and enormous quantities of deer, grouse, prairie chickens, quail, and ducks were handled each season. Quail and grouse were received by the barrel and ducks and venison in larger quantities. A single consignment of game from Nebraska received at Chicago in 1900 contained no less than 87 barrels of prairie chickens, and a rough estimate of the number of these birds killed in Nebraska that year placed it at about 5 millions, of which 1 million were killed for local consumption and 4 millions for shipment beyond the State.

The enactment of the Federal law infused new life into State laws and made possible the enforcement of provisions which previously had been of little effect. When its operation began to be felt the changed conditions caused shippers to seek means by which they could continue

their trade undisturbed. Every advantage was taken of defects in State laws, and various devices, technical or otherwise, were adopted to evade the provisions of the Federal law requiring marking of packages. Quail and other game birds were concealed in trunks, barrels, egg cases, and similar misleading packages, and were marked "butter," "dressed poultry," or "household goods." Special shipping tags were devised for the purpose of concealing the identity of the shipper and minimizing the risk which he assumed in forwarding shipments to market. But these devices have been rendered more and more futile. All the States in the Union except Mississippi now prohibit export (see fig. 113), and several of them have stopped the sale of all or certain kinds of game. Stringent laws prohibiting sale and shipment have been enacted in Missouri and Nebraska. These

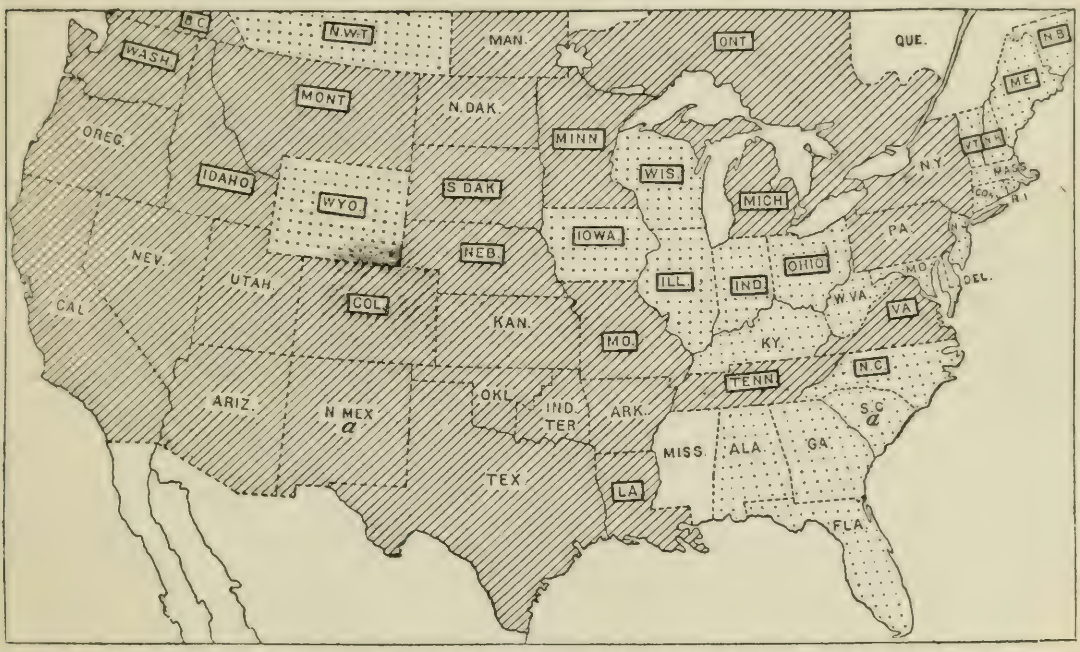

FIG. 113.—States and Provinces which prohibited export of game in 1905. Ruled areas indicate those which prohibited export of any game; dotted areas, those which prohibited export of certain kinds of game; blank areas, those which did not prohibit export. Inclosed names indicate special exceptions permitting nonresident hunters to take out a limited amount of game. The letter *a* indicates prohibition of export for sale only.

and the equally sweeping legislation of Michigan, Minnesota, and Wisconsin can be and are rigidly enforced through the cooperative influence of the Federal law and the support their enforcement secures from the strong public sentiment that caused their adoption. In Chicago alone thousands of birds illegally shipped have been seized, and from the evidence thus secured many of the shippers in other States have been brought to justice. Under the Federal law more than 50 convictions have been secured, and in nearly half of these cases fines of $100 or more have been imposed. In each of three cases they amounted to $150, in two to $200, and in two others to $400.

In consequence of the impulse given to State legislation and public sentiment by the Lacey Act, conditions in 1905 presented a marked

contrast to those prevailing in 1900. Prairie chickens had almost entirely disappeared from the markets of Chicago; venison, quail, and grouse were received in greatly diminished quantities, and even ducks, which formerly were shipped from Illinois, Missouri, Arkansas, and Texas by thousands, were offered for sale in comparatively small numbers. Cottontails and jack rabbits were almost the only kinds of game received in large quantities. In St. Louis the anti-sale provision in the Missouri law had practically driven all game, except rabbits, from the market; the wholesale trade in game was a thing of the past, and game birds were no longer freely offered for sale throughout the year in hotels and restaurants.

Even more striking are the changes which have taken place in methods of shipment. Until recently most of the game was forwarded to market by express, but the rigid inspection to which express matter is now subjected in Chicago and St. Louis has resulted in detection of many of the devices formerly resorted to with success and has rendered the ordinary methods of evading the law unsafe. As a result comparatively little game was received at these two cities by express during the past year, and shippers have been driven to the adoption of other means of transportation which, being more or less unsatisfactory and expensive, are likely to prevent a resumption of the trade in violation of law. Conditions similar to those now existing in Chicago and St. Louis may be found also in Milwaukee, Minneapolis, St. Paul, Omaha, Kansas City, and other important points in the West. This marked contrast between the present state of the game trade in these cities and that of a few years ago serves to illustrate the progress made possible by stringent laws coupled with effective and intelligent cooperation in enforcement.

INFORMATION CONCERNING GAME.

In accordance with the provision of the Lacey Act requiring the Secretary of Agriculture to "collect and publish useful information as to the propagation, uses, and preservation of birds," the collection of data has been carried on steadily and systematically. Notes and observations have been brought together from every available source on the food habits, distribution, and migration of game birds; on methods of hunting; on the restrictions placed on killing game (see figs. 114, 115), as well as on its export (see fig. 113) and sale (see fig. 116); on licenses, game preserves, and many other topics connected with game protection. The results which have attended the wide dissemination of such information bid fair to render this feature one of the most important in the law and the one of most general interest. Distribution of publications on the habits and uses of birds constitutes a prominent educational factor and is of great service in creating a sentiment in favor of game preservation, while the result of placing before the pub-

lic a summary of the game laws enacted in the several States each year has had much influence in securing greater uniformity in State laws.

Among the bulletins issued by the Biological Survey relating to habits and uses of birds may be mentioned two illustrated reports on upland game—one devoted to the "Bobwhite and other Quails of the United States," the other to "Grouse and Wild Turkeys;" a third

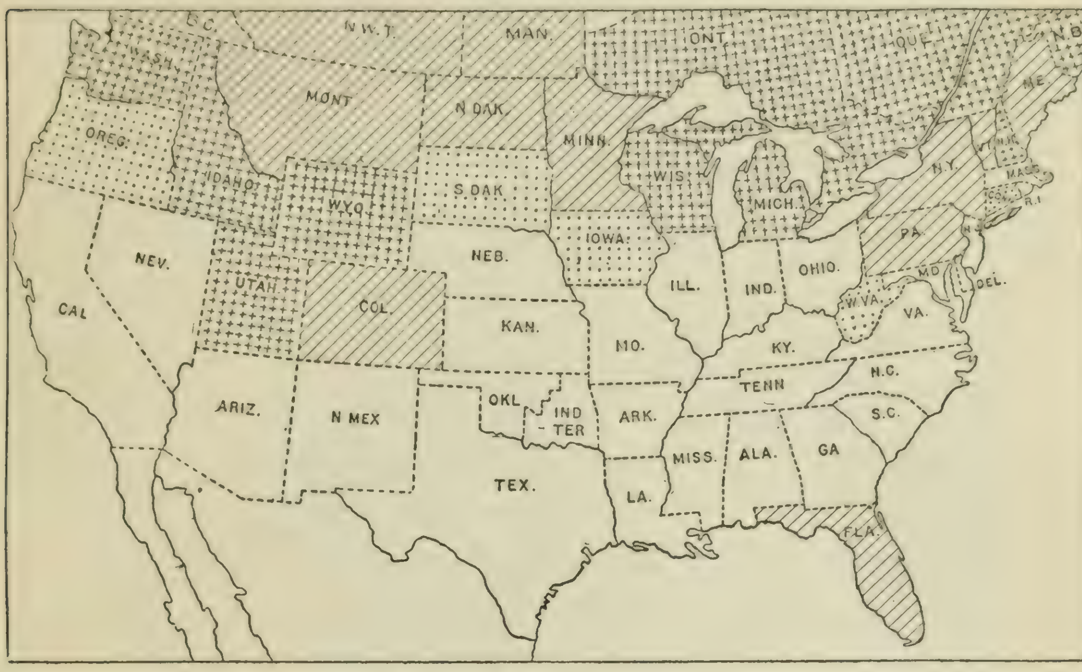

FIG. 114.—Bag limits in 1900.

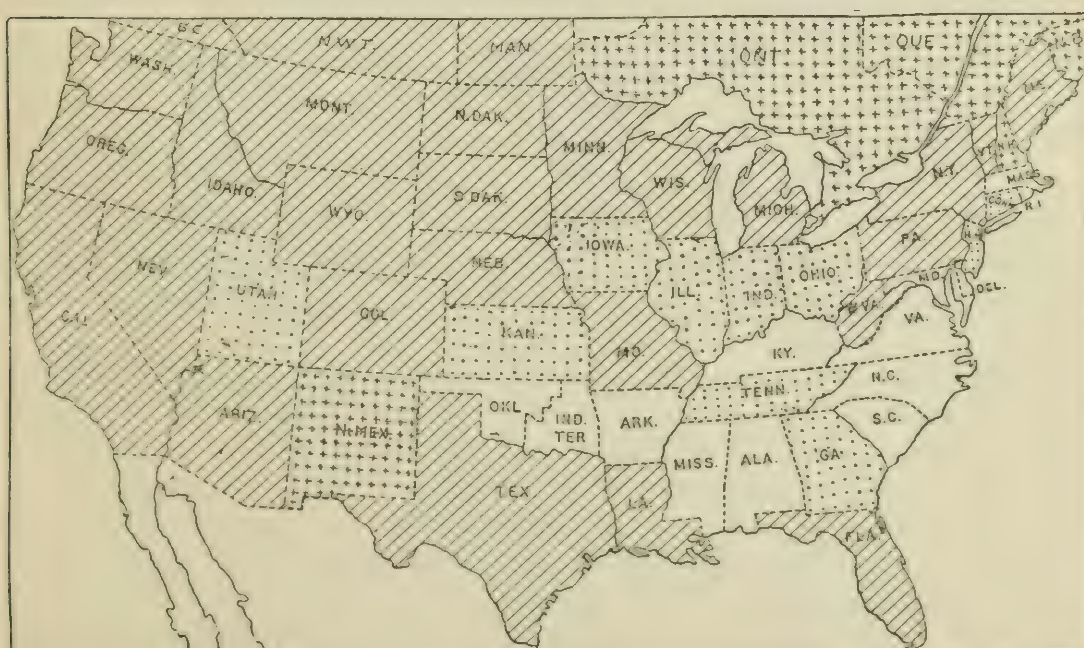

FIG. 115.—Bag limits in 1905.

Ruled areas indicate States and Provinces which limit the bag of both big and small game; crossed areas, those which limit the number of big game only; dotted areas, those which limit the bag of small game only.

PROGRESS IN LEGISLATION RESTRICTING THE KILLING OF GAME.

bulletin of the same general class deals with the "Importation of Game Birds and Eggs for Propagation," and a fourth report, devoted to the "Distribution and Migration of Ducks, Geese, and Swans," is now ready for publication. This last report has been prepared to aid in an understanding of the underlying conditions which should govern legislation for the protection of wild fowl. It should be of special service in connection with the movement to prohibit spring shooting, a much needed form of protection for waterfowl which has recently made some progress (see figs. 117, 118), and one which is destined to receive more consideration in future.

Three series of publications on the game laws have been undertaken: (1) A bulletin containing in full the laws relating to nongame birds, first issued in 1900 and revised in 1902. (2) An annual summary of

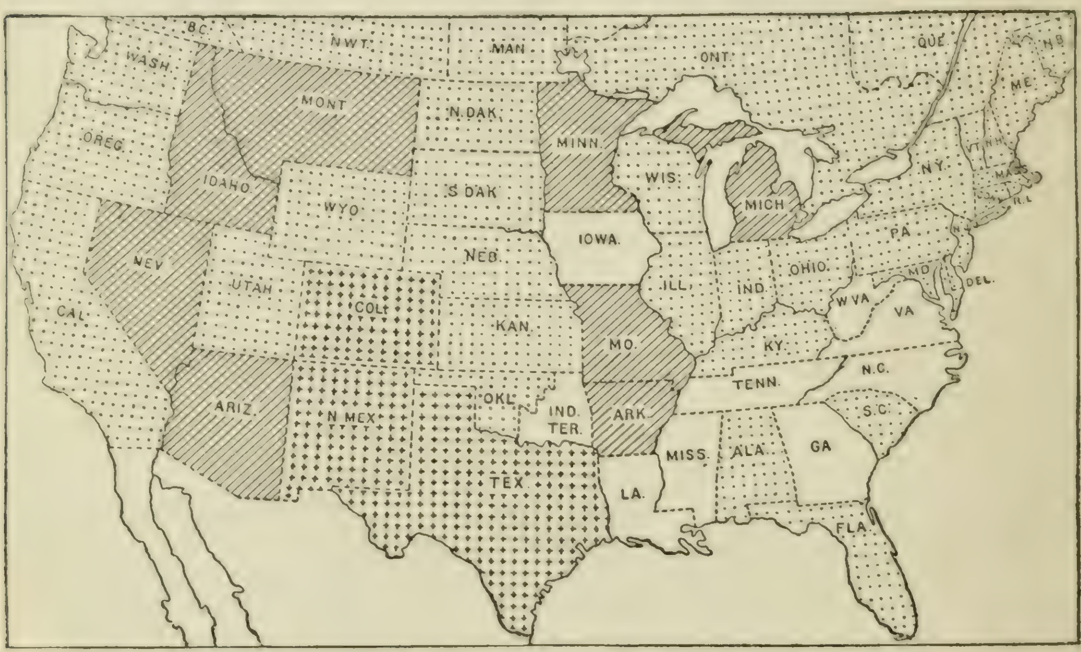

FIG. 116.—States and Provinces which prohibited sale of game throughout the year in 1905.

Ruled areas indicate those which prohibited sale (resale in Nevada) of all protected game; crossed areas, those which prohibited sale of all protected game taken within the State; dotted areas, those which prohibited sale (resale in Delaware) of certain game; and blank areas, those which had no sale prohibitions (except a few local provisions in North Carolina and Virginia).

the game laws relating to seasons, shipment, sale, and licenses, for wide distribution to wardens, officers of transportation companies, and other persons interested in game protection. This summary is supplemented each year by two sets of posters, one showing in tabular form the close seasons for game in each State and in each of the Provinces of Canada; the other, close seasons for game under local laws in Maryland and North Carolina, which have separate statutes for many of the counties. (3) A bulletin relating to enforcement of the game laws, which is still in course of preparation, will, when completed, contain a history of the development of the warden system, a summary of the provisions relating to the duties and powers of wardens, and extracts from the statutes relating to the details of enforcing the game laws. This series will be supplemented by an index and digest

of game decisions, containing references to about 200 of the most important cases, and accompanied by alphabetical and chronological lists and a subject index, which will show at a glance the decisions rendered in a given State, in a given year, or on a specific topic.

From time to time information on special subjects has been published in the form of circulars and articles in the Yearbook. Among these may be mentioned "Definitions of Close Seasons for Game,"

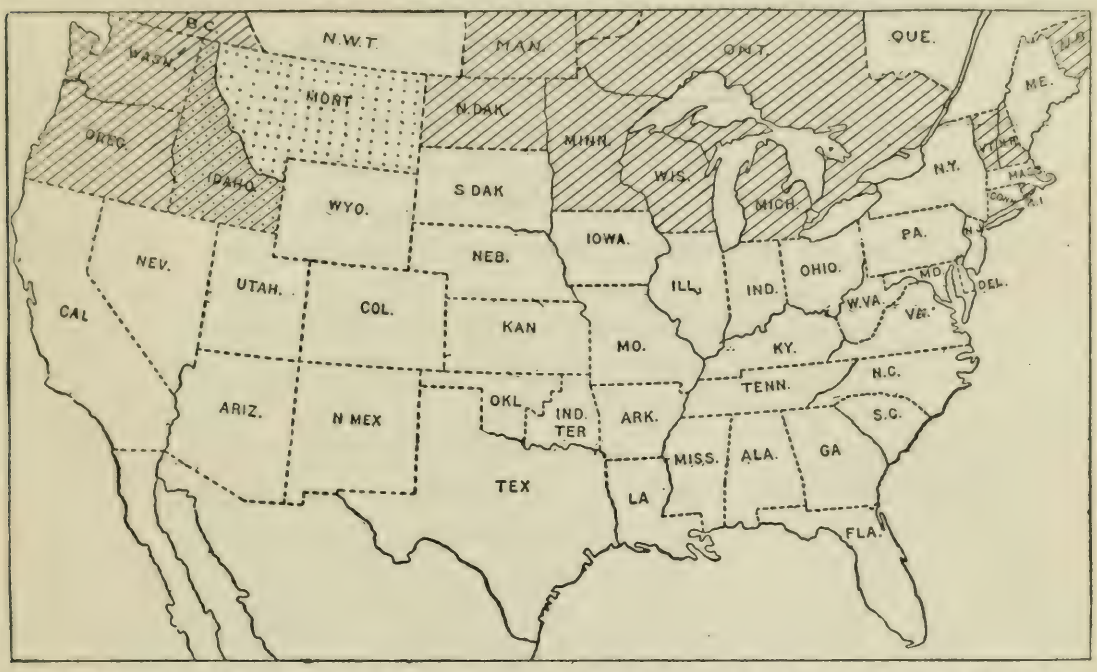

FIG. 117.—States and Provinces which prohibited spring shooting and sale of waterfowl in 1900.

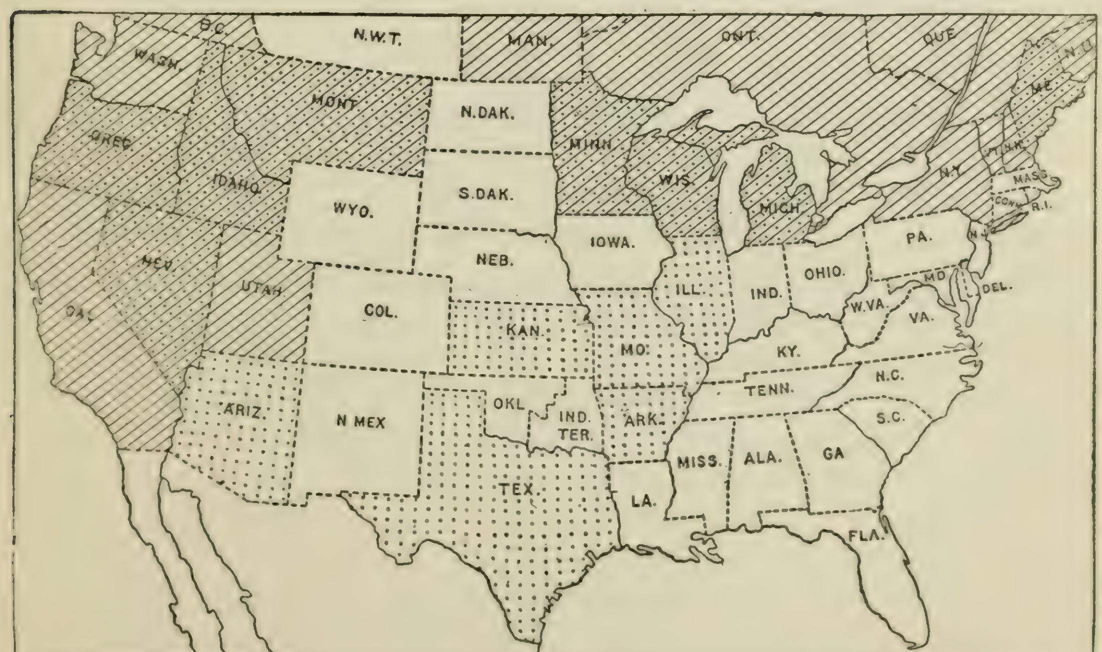

FIG. 118.—States and Provinces which prohibited spring shooting and sale of waterfowl in 1905.

Ruled areas indicate prohibition of spring shooting; dotted areas, prohibition of sale throughout the year.

PROGRESS IN LEGISLATION FOR THE PROTECTION OF WATERFOWL.

"Recommendations of State Wardens for 1905," "Relation of Audubon Societies to the Farmer," "Economic Value of the Bobwhite," and "Some Benefits the Farmer may Derive from Game Protection." A brief summary of the progress of game protection in the United States is published annually in the Yearbook of the Department; and a directory containing the names and addresses of the various State and Provincial wardens in the United States and Canada is issued as a special circular each year.

The license system has formed the subject of a comprehensive investigation and report. Five years ago comparatively few States had adopted the system of hunting licenses. (See fig. 119.) Now 36 States require nonresident (see fig. 120), and 16 require resident hunters to secure licenses. Prompt publication of information on this subject has had much influence in hastening and shaping this progress. The adoption of the resident license system has practically solved the question of raising funds for enforcing game laws, or at least has shown how game protection may be made self-supporting. In nine States—Idaho, Illinois, Michigan, Missouri, North Carolina, North Dakota, Kansas, Washington, and Wisconsin—the game-warden department is at present maintained without special appropriation or the cost of a dollar to the general taxpayers of the State, and in some cases the receipts from licenses are more than sufficient for the ordinary expenses of the department. Thus at the close of the year 1905 the balance in the game-protection fund of Missouri was more than $40,000, while that of Illinois was nearly $100,000.

RECENT LEGISLATION.

Since 1900 four acts relating to game protection have been passed by Congress: An amendment to the game law of the District of Columbia, in 1901; an act regulating importation of eggs of game birds, approved June 3, 1902; a comprehensive game law for Alaska, approved June 7, 1902; and an act authorizing the establishment of a game refuge on the Wichita Forest Reserve, in Oklahoma, approved January 24, 1905. The last three may be considered as an indirect outcome of the passage of the Lacey Act and of the interest in Federal legislation which it aroused. The egg act was in effect an amendment to the tariff act and authorized the importation of eggs of game birds for propagation under regulations of the Secretary of Agriculture. It was rendered necessary by the fact that a provision had been incorporated in the tariff acts of 1893 and 1897 absolutely prohibiting the importation of eggs of game birds. This was an anomalous provision, the result of an ill-advised attempt to protect game birds by prohibiting the importation of eggs of wild ducks and other waterfowl, which were supposed to be largely used in the manufacture of egg

albumen. Careful investigation failed to show the existence of such traffic, and as the prohibition in the tariff act prevented experiments in the introduction of pheasants and partridges by means of imported eggs, the provision was modified.

The main objects of the Alaska game law were to prevent the wholesale export of deer skins and to regulate the traffic in big-game heads

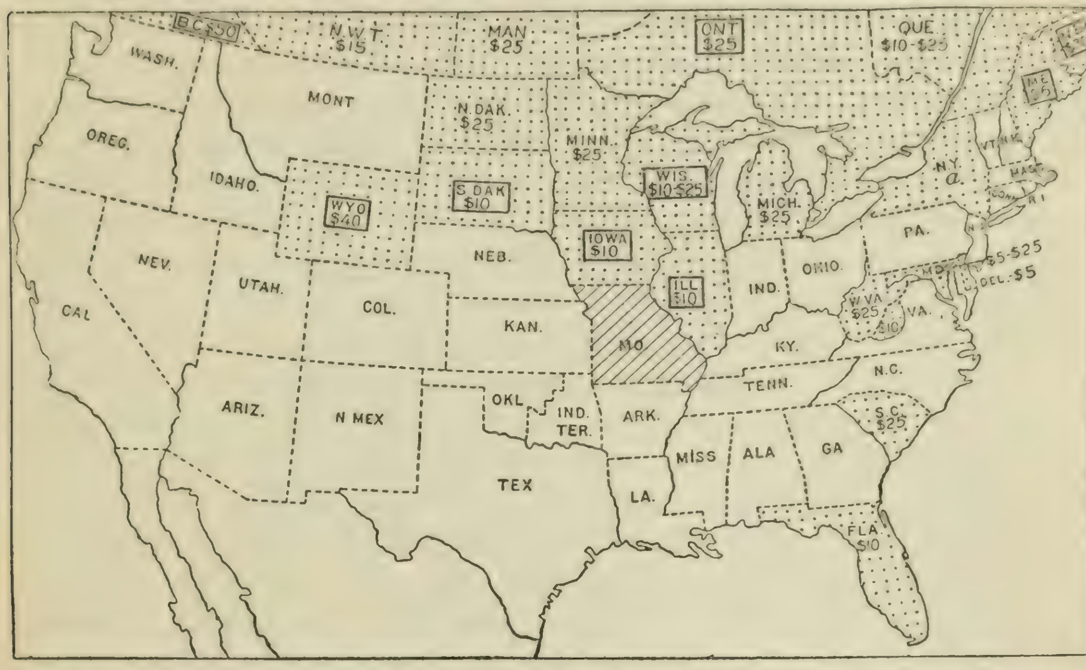

FIG. 119.—States and Provinces which required nonresidents to obtain hunting licenses in 1900.

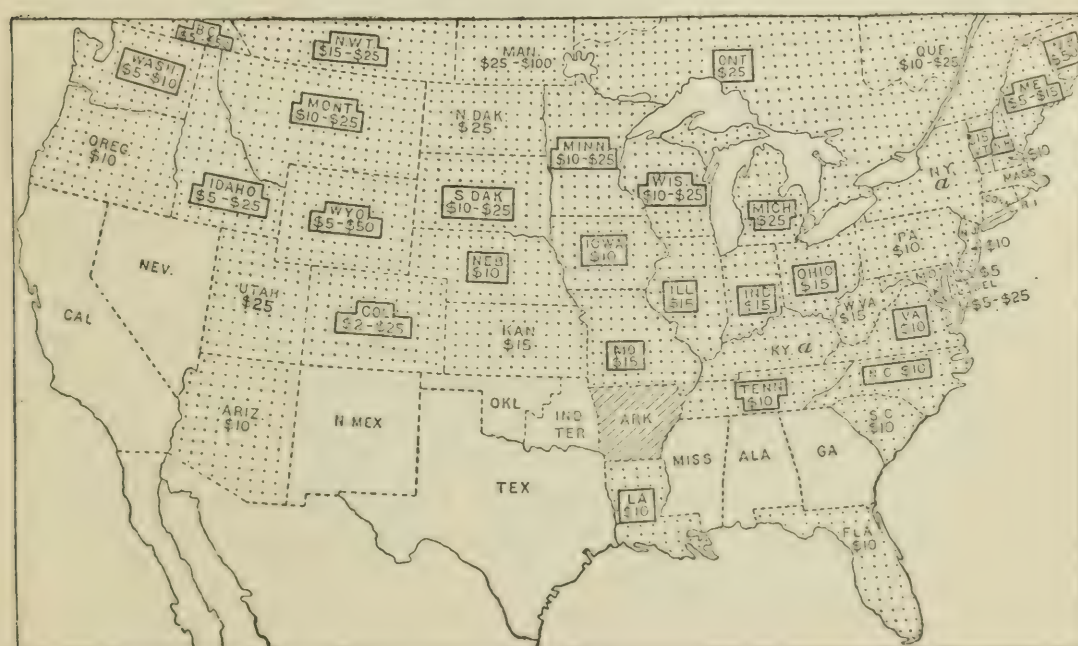

FIG. 120.—States and Provinces which required nonresidents to obtain hunting licenses in 1905.

Dotted areas indicate States which issued nonresident hunting licenses; ruled areas those which did not permit nonresidents to hunt. Inclosed names indicate that special privileges were granted for taking a limited amount of game out of the State. Massachusetts required unnaturalized foreign-born residents to secure licenses at $15, and Washington issued nonresident alien licenses at $50. States marked *a* have no definite fee.

PROGRESS IN LICENSE LEGISLATION.

by restricting the shipment of trophies. In both of these directions the statute has accomplished its purpose, but its other provisions can not be properly enforced until available funds permit the establishment of warden service in localities where illegal killing is most likely to be carried on. The Wichita game refuge bill marks the first step toward utilizing the forest reserves as game refuges. It authorized the President to set aside such portion of the Wichita Forest Reserve as he deemed advisable for a game preserve. The hearty cooperation of the President in this movement was shown by his action in setting aside the entire reserve of 57,000 acres for the proposed game refuge.

Some idea of the volume of State game legislation enacted during the same period may be gained from the following rough estimate: In 1901 the number of game laws enacted exceeded 100; in 1902 it amounted to about 50; in 1903 it exceeded 100; in 1904 it was about 70; and in 1905 about 180, making a total, in round numbers, of 500 laws in five years. A large proportion of these were local laws passed in three or four States. Thus Maryland passed 24 in 1902 and 17 in 1904, or a total of 41; and North Carolina passed 38 in 1901, 54 in 1903, and 67 in 1905, or a total of 159. On many of these statutes the Federal law had an indirect effect, through its provision requiring collection and publication of information. The important measures enacted by each State thus were made available to all the other States, and in consequence many provisions which were new or seemed to be an improvement over those already in force were adopted.

COOPERATION WITH STATE OFFICIALS.

One of the most important features of the work under the Federal law has been cooperating with State officials and aiding them, so far as possible, in their efforts to secure more effective laws and solve the numerous problems which constantly arise in game-law enforcement. The Department has kept in close touch with officials of the various States (see figs. 121, 122), has furnished information to practically every State and Territory, and in many cases has rendered special aid. Thus in Massachusetts the game commission has been placed in possession of facts relating to the protection of nongame birds and the restriction of sale of birds for millinery purposes; in Pennsylvania the secretary of the game commission has been supplied with information on various matters of legislation and game protection; in Delaware the State Game Protective Association has been aided in securing more effective laws; and in Maryland and North Carolina the State authorities have been furnished summaries of the local laws and annual posters showing the close seasons for game in each of the counties of these States.

In New York cooperation has taken the form of assistance in maintaining the law prohibiting spring shooting of waterfowl; in West Virginia, of aid, whereby the State warden was enabled to prevent the export of a number of illegal consignments of ruffed grouse and

other game; in Ohio, of aid in the enforcement of the law restricting the sale of birds for millinery purposes by identifying specimens and in other ways. In Texas assistance has been rendered in frustrating attempts to nullify the nonexport law and in maintaining, with the aid of the express companies, close supervision over game shipments, and thus preventing wholesale export of ducks from the State. In California aid has been given the board of fish commissioners in

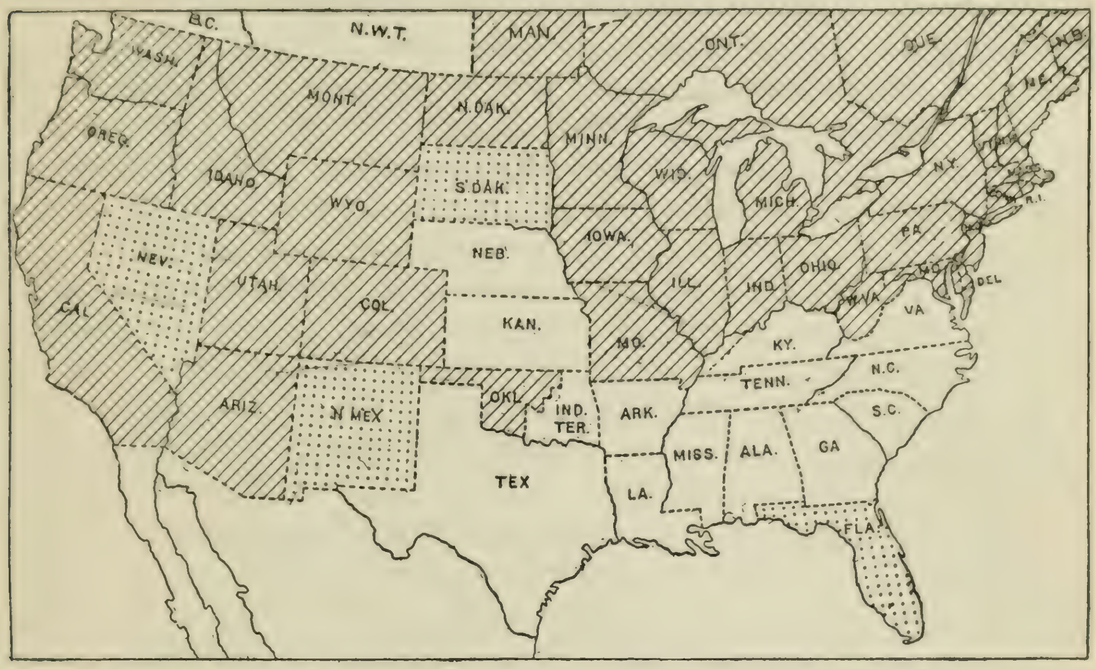

Fig. 121.—States and Provinces which had game commissioners or wardens in 1900.

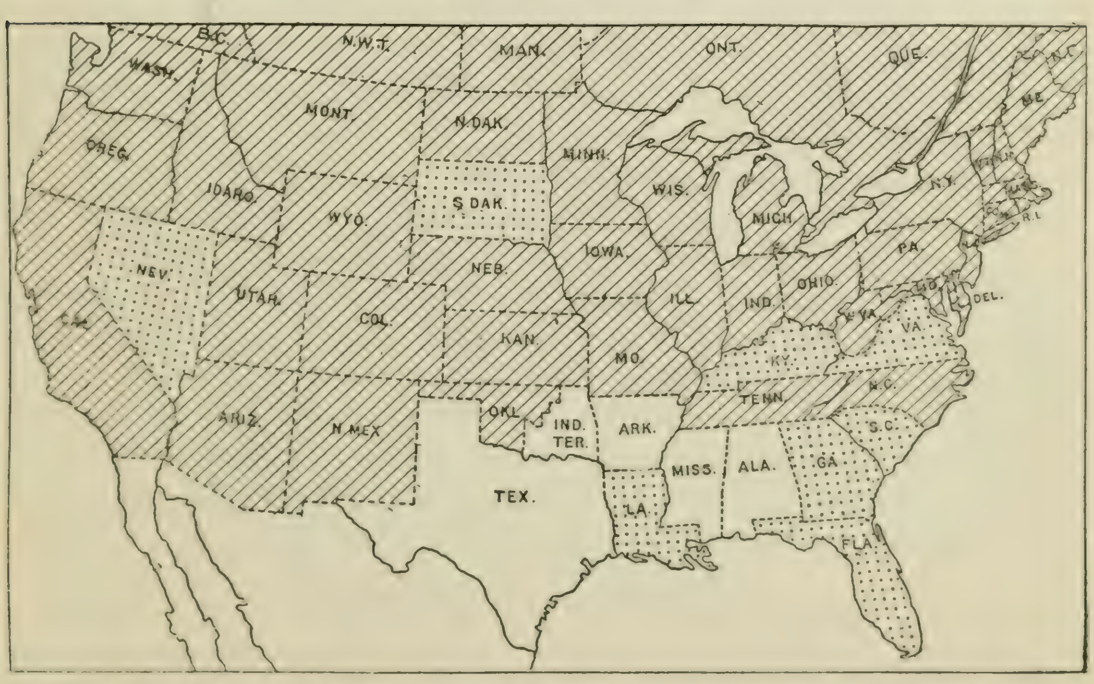

Fig. 122.—States and Provinces which had game commissioners or wardens in 1905.

Ruled areas indicate States and Provinces which had State or Provincial wardens; dotted areas those which had county wardens only, and blank areas those which had no special officers.

PROGRESS IN LEGISLATION FOR THE ENFORCEMENT OF GAME LAWS.

restricting illegal sale and possession of Chinese quail; and in Washington joint action with the local authorities at Seattle has frequently been necessary in matters relating to shipment of big game from Alaska and in the enforcement of the State law.

Through the cordial cooperation of the game commissioner of Illinois and of the local wardens, evidence has been collected in Chicago each year which has thrown a flood of light on illegal shipments from the West and South, and brought about convictions in six or eight different States. With evidence secured at this point the Department has been enabled to detect new methods of shipment, locate centers of unlawful market hunting, and devise means of meeting the constantly changing problems connected with the game trade. From Chicago as a base it has been possible to collect information which led to conviction in an important case in Indiana; to place in the hands of the State warden of Iowa evidence of numerous violations of the nonexport law which he had no means of obtaining after the game had crossed the Iowa boundary; to secure convictions in several important cases in South Dakota, Kansas, and Oklahoma; and to obtain information which opened the way to restricting wholesale shipments from the Indian Territory.

In some cases it has been necessary to collect evidence under peculiar difficulties and to bring witnesses long distances. Thus a case arose in Minnesota in 1902 involving the shipment of a package of game birds from St. Paul to Portland, Oreg. With the cooperation of the game commission of Minnesota and the State warden of Oregon, the necessary evidence was collected and a witness was brought from Portland to St. Paul, where a conviction was secured. More recently, in 1904, witnesses from New York were taken to Tampa, Fla., in order to secure conviction for a violation of the Federal law which had occurred in the southern part of Florida.

Mere enumeration of these facts conveys but a partial idea of the numerous ways in which efforts have been made to aid State authorities and through cooperation with them to insure more effective enforcement of the Federal law. Personal conference, attendance at gatherings of game officials, examination of conditions, constant correspondence, aid in prosecutions, and various other lines of activity have been the means of keeping in close touch with officers intrusted with enforcement of game laws and of strengthening the hands of those working to secure better and more efficient protection of game.

COOPERATION WITH AUDUBON SOCIETIES.

The most important factor in the protection of nongame birds in the United States has been the work of the Audubon societies. Since 1896 local societies have been organized in 36 States, and in 1905 the movement was given greater permanence by the incorporation of the

National Association. In educating the general public in the economic value of birds and in creating public sentiment in favor of bird protection, these organizations have met with remarkable success and their educational work has paved the way for still more successful efforts in securing the adoption and enforcement of uniform laws and in specific measures for bird protection. In 1900 comparatively few States had laws protecting all nongame birds (see fig. 123), but in 1905 the number had increased to 34, and now all the States east of the Mississippi (except West Virginia, Maryland, and Alabama) and 10 of those in the West have such laws (see fig. 124).

However successful the Audubon societies may have been in their efforts to secure legislation, their practical work of enforcement has been even more effective. Through the aid of funds, raised chiefly by popular subscription, protection has been extended to all the important colonies of sea birds breeding along the Atlantic coast from Maine to Chesapeake Bay, on the coasts of North Carolina, Florida, and Louisiana, and at certain points in Oregon. Wardens paid by the society have patrolled these colonies during the breeding season and insured the birds against molestation. The National Association has also caused various localities to be examined, and has in each case taken the initial steps which have led to the establishment of the six Federal reservations thus far set aside by Executive proclamation (see fig. 125, p. 560). In the maintenance of the warden service on these reservations it has also taken an important part.

One of the far-reaching results of the movement for the protection of nongame birds has been the elimination of the plumage of native species from the millinery trade. This has been accomplished partly by legislation prohibiting possession and sale of such plumage, and partly by cooperation between the Audubon societies and the principal wholesale milliners of the country. In 1903, agreements were made between the Audubon societies of several of the Eastern States and the Merchants' Millinery Protective Association of New York, and also between several of the societies in the West and the Western Jobbers' Association, whereby the sale of plumage of gulls, terns, grebes, and other native birds was discontinued. These agreements originally ran for three years, but in 1905 those of the Western association were renewed. At the present time practically no native birds are killed in the United States for millinery purposes, and the radical change from the well-known conditions of a few years ago has been brought about without serious loss to the trade.

A third line of effort with which these societies have been prominently identified has been the restriction of the traffic in native cage birds. Thousands of mockingbirds, cardinals, indigo birds, and other bright-plumaged species were formerly trapped for sale in this country and abroad, and so assiduously did the bird trappers ply their vocation

that in some localities these species were almost exterminated. New Orleans was one of the chief centers of shipment, but with the passage of a law in Louisiana in 1904 prohibiting sale and shipment of birds this source of supply was cut off and the effect of the law has been felt in several of the larger cities of the country. How great the progress has been can readily be understood by comparison with conditions abroad. No other country at present extends such complete protection to its nongame birds or has restricted the traffic in native birds more effectively than the United States.

In this work the Department has cooperated in every way possible. It has distributed publications in large numbers to further the educational work of the different societies, has disseminated information by correspondence and otherwise, and has lent its assistance from time to time in the enforcement of laws. Through the cooperation of the Department of Justice it has caused proceedings to be instituted in the Federal courts against dealers in remote parts of Texas and Florida who were illegally shipping gulls, terns, and other nongame birds, and secured convictions which have discouraged plume-hunting in these States. It has taken an active part in the negotiations with the millinery trade and has maintained a close supervision over the traffic in cage birds.

PRESERVES.

Previous to 1900 the General Government had set aside only three reservations for the protection of animals and birds—the Yellowstone Park in Wyoming in 1872, the National Zoological Park in the District of Columbia in 1890, and Afognak Island, on the southern coast of Alaska, in 1892. The first two were national parks established by acts of Congress, and Afognak Island, intended as a preserve for the sea otter, was set aside by Executive proclamation and placed under the jurisdiction of the Bureau of Fisheries. Other Government reservations, such as the General Grant, Sequoia, and Yosemite national parks in California, the Mount Rainier National Park in Washington, the naval stations on the Dry Tortugas, Florida, and on Midway Islands in the Pacific; the light-house reservations on the Farallone Islands, California, on Sand Key, near Key West, Florida, and at various points along the Atlantic coast, constitute important breeding grounds where various native species are protected; but they were not set apart especially as preserves for birds and game, and consequently they are merely mentioned in this connection.

Since 1900 eight additional preserves have been established—two in Florida, two in Michigan, and one each in Louisiana, North Dakota, Oklahoma, and Alaska. All except those in Oklahoma and Alaska comprise small islands of little or no agricultural value, but occupied as breeding grounds by large colonies of birds, and hence of far greater value than might appear from their acreage.

FIG. 1.—TERNS ON SOUTHWEST HARBOR KEY IN THE BRETON ISLAND RESERVATION.
[Photograph by Frank M. Miller.]

FIG. 2.—BROWN PELICANS ON PELICAN ISLAND RESERVATION.
[Photograph by Frank M. Chapman.]

FEDERAL BIRD RESERVATIONS.

The best known of these reservations is Pelican Island, in Indian River, Florida, not far from Sebastian. It is little more than a mud flat, with only a few black mangroves, one or two cabbage palms, and large patches of grass to conceal its expanse of something less than 4 acres. For many years it has been the home of a large colony of brown pelicans, the only breeding grounds of the species thus far known on the east coast of Florida (see Pl. LXX, fig. 1). Prior to

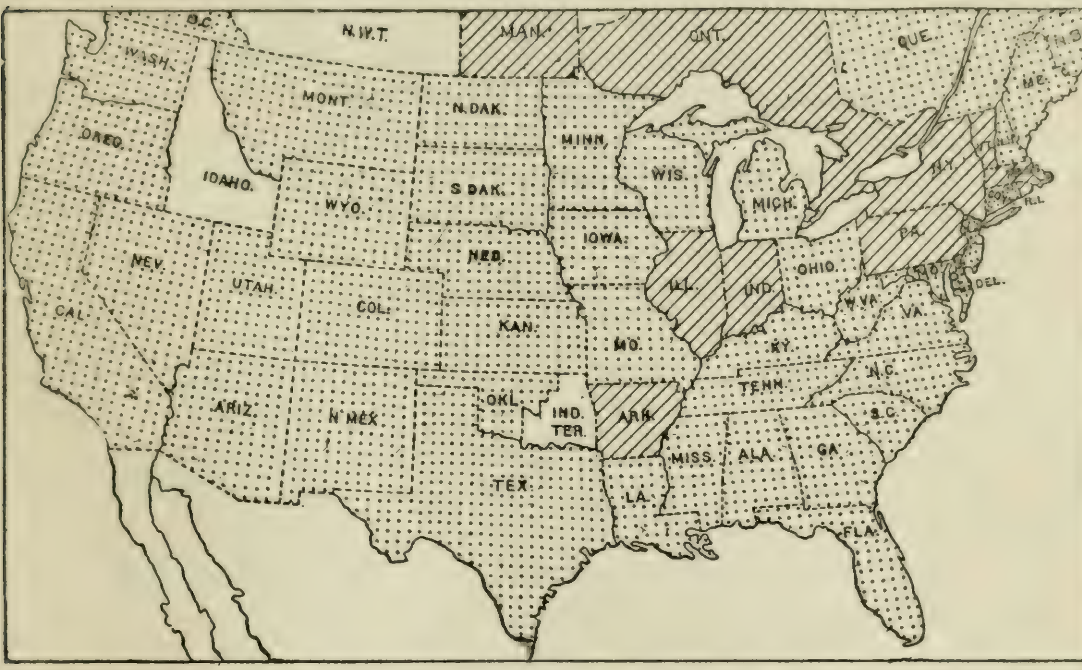

FIG. 123.—Protection of nongame birds in 1900.

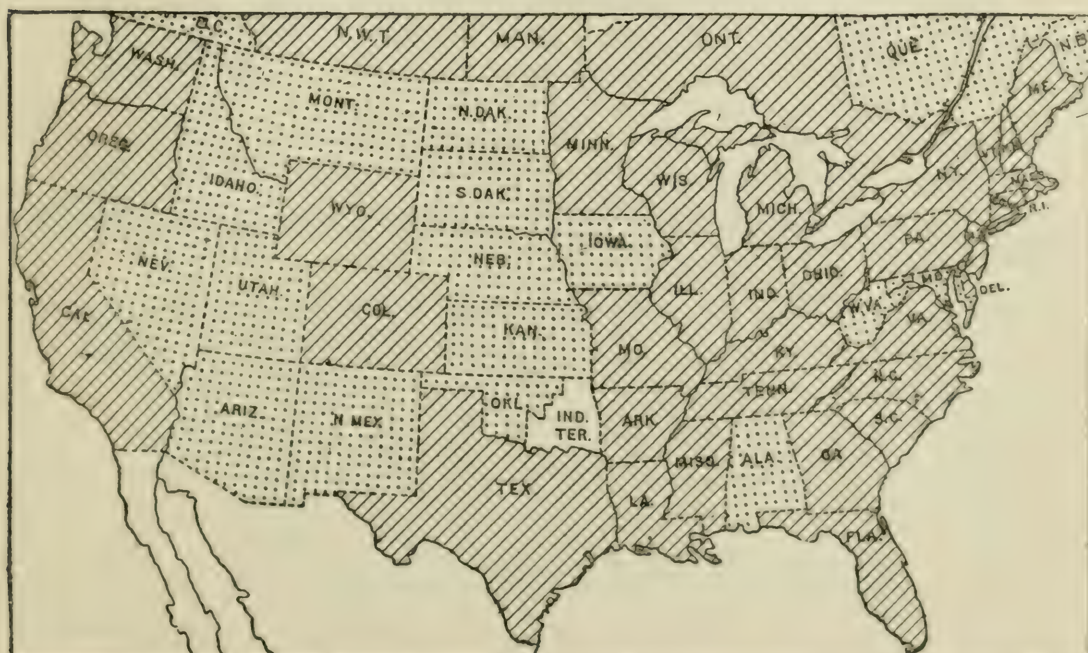

FIG. 124.—Protection of nongame birds in 1905.

Ruled areas indicate States and Provinces which protect all nongame birds except certain injurious species, dotted areas those which protect only a part of their nongame birds.

PROGRESS IN LEGISLATION FOR THE PROTECTION OF NONGAME BIRDS.

1901, when the State passed a comprehensive law protecting nongame birds, their nests and eggs, and the Audubon societies placed a warden in charge of the island, the colony was in danger of extermination. Plume hunters could easily destroy the birds for their quills, which were then in fashion as trimmings for ladies' hats, and egg collectors could carry away large numbers of eggs. One collector who visited the island in April, 1894, records the fact that in about an hour he gathered some 125 sets,[a] which must have represented a very considerable proportion of the eggs then in the nests. Even tourists often did considerable harm by shooting at the pelicans merely because they furnished an easy mark, or drove them from their nests, thus exposing the young to the scorching, often fatal, rays of the sun. All this

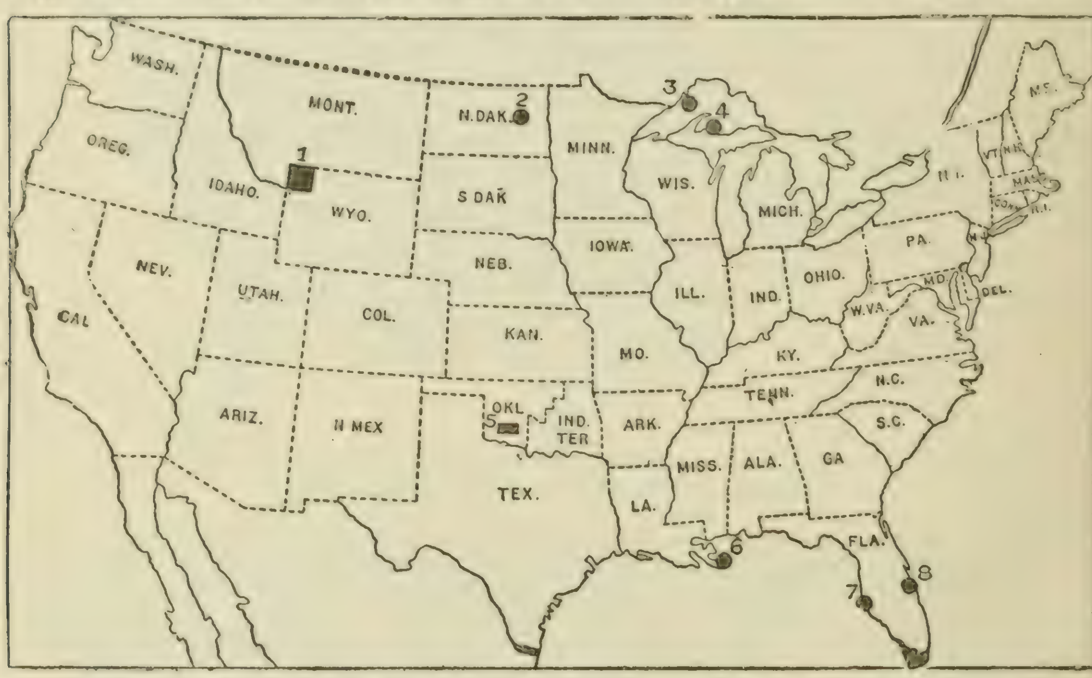

FIG. 125.—Federal parks and reservations for the protection of birds and game in 1905.

1, Yellowstone National Park; 2, Stump Lake Reservation; 3, Siskiwit Islands Reservation; 4, Huron Islands Reservation; 5, Wichita Forest Reserve and Game Preserve; 6, Breton Island Reservation; 7, Passage Key Reservation; 8, Pelican Island Reservation.

is now changed. For the last four years the birds have enjoyed the protection of the State law. In 1903 the island was made a Government reservation by Executive order and placed in charge of the Department of Agriculture, and the warden was duly commissioned as an officer of the Department. For several seasons the birds have bred free from molestation, and the colony is now in flourishing condition. The island has been visited by naturalists, who have made careful studies of the birds;[b] data never before available are being collected regarding their food, moulting, and nesting habits, and the reservation

[a] Osprey, III, p. 70.

[b] F. M. Chapman, Bird Studies with a Camera, pp. 191–214, 1900; the Century Mag., Vol. LXXI, pp. 199–211, December, 1905; H. K. Job, Wild Wings, pp. 1–18, 1905.

is fast becoming a point of interest for visitors and students of nature, who are attracted by the exceptional opportunities afforded for observing the birds and studying their habits.

The second reservation in Florida, Passage Key, was not established until October, 1905, but already bids fair to become an important refuge for both land and sea birds. Within three months after its establishment more than 50 species of birds were found on the island, and among these were noted 200 common terns, 200 Cabot terns, 500 royal terns, 150 laughing gulls, 600 herring gulls, 800 brown pelicans, and about 5,000 red-breasted mergansers.

Even more important as a breeding ground for terns are the keys included in the Breton Island Reservation off the mouth of the Mississippi, which were set aside as a Federal reserve on October 4, 1904. A photograph taken on July 2, 1905, shows thousands of terns which were then breeding on Southwest Harbor Key, one of the Old Harbor Islands (see Pl. LXX, fig. 2). These included Cabot, common, and royal terns. During the winter months this reservation becomes the refuge for thousands of ducks of various species, especially mallards.

Of the northern preserves, suffice it to say that the Huron and Siskiwit reservations, in Lake Superior, Michigan, form the largest breeding grounds of the herring gull thus far discovered in the interior; and that Stump Lake Reservation, in North Dakota, although small in extent, is in the midst of the extensive breeding grounds for ducks in that State and during the autumn forms a haven of refuge for migratory waterfowl on their way south.

The Wichita game preserve, in Oklahoma, was created by Executive proclamation of June 2, 1905, under the terms of an act approved in January of the same year. It includes 57,000 acres and is the first large game refuge of the kind in the United States. While its area is only one-tenth that of the State game preserve established by Wyoming in 1905 and but a fraction of that of the Yellowstone Park, it has great possibilities as a preserve for the propagation of quail, prairie chickens, and turkeys, and several kinds of big game, including deer, elk, antelope, and bison.

In this connection reference should be made to the herd of elk recently established in the Sequoia National Park, California. Several years ago Miller & Lux, who own a large cattle ranch at Buttonwillow, Kern County, Cal., presented to the Government, through the Biological Survey, a number of the small San Joaquin Valley elk (*Cervus nannodes*) which had been protected on their ranch for some time. These elk belong to a species which was formerly abundant and ranged over the southern San Joaquin Valley, but which now numbers less than 150 individuals. In 1904, upon application of the Secretary of Agriculture to the Secretary of the Interior, permission

was granted to place a small herd in the Sequoia National Park, and a preserve was inclosed for them on the Kaweah River. An unsuccessful attempt to capture the animals by driving them into a corral was made in November of that year, but in the autumn of 1905 about 20 were caught and safely transferred to their new quarters. Here in a National park, where they are safe from molestation, it is hoped they will increase, and that their transfer will thus insure the preservation of this interesting species.

In the Yellowstone National Park a striking example is afforded of how much can be accomplished in a comparatively short time at moderate expense under intelligent supervision. Although the park was established in 1872, it was not until several years later that a military patrol was provided, and no law to protect the animals in the park was enacted until 1894. In the meantime the big game had been exposed to indiscriminate slaughter and the herd of bison reduced to a mere handful. In 1902 Congress made an appropriation of $15,000 for the purpose of starting a new herd of bison in the park. With this fund the necessary inclosures were built and 18 cows were purchased in Montana and 3 bulls in Texas. One of these bulls was turned out with the wild bison with a view to introducing new blood in that herd. The domesticated herd of 20 animals has increased rapidly since 1902, and, with the addition of 3 wild calves caught in the park, numbered 44 at the close of 1905. The wild bison still ranging near the head of Pelican Creek now number about 30. Under the successful administration of the present superintendent the condition of the big game in the park is flourishing. Beaver are increasing, mountain sheep number about 100, and antelope about 1,500. Deer, elk, and black bears are abundant. The elk are by far the most numerous of all the big game, but it is difficult to tell even approximately how many there are. During the summer they find abundant feed, but in the winter probably half of them leave the park and pass into the neighboring States in search of suitable range at lower altitudes. During the last two or three years feed has been provided in winter, and this fact, together with the complete protection afforded, has rendered the game remarkably tame, so that several different kinds come close about the buildings and even on the parade ground at Fort Yellowstone. The experience of the past decade in the park demonstrates how readily the big game of the West may be saved from extermination by proper protection when Congress shall have authorized the utilization of certain parts of the forest reserves as game refuges.

APPENDIX.

ORGANIZATION OF THE DEPARTMENT OF AGRICULTURE.[a]

SECRETARY OF AGRICULTURE, James Wilson.

The Secretary of Agriculture is charged with the supervision of all public business relating to the agricultural industry. He makes such regulations for interstate traffic in live stock as may be necessary to prevent transmission of contagious diseases, and has charge of all interstate quarantine. He directs the admission or exclusion of live animals from foreign countries, and has charge of quarantine stations for importing cattle. He conducts the inspection and regulates the conditions of shipment of live stock and of meat products exported from American ports. He exercises advisory supervision over the agricultural experiment stations deriving support from the National Treasury.

ASSISTANT SECRETARY OF AGRICULTURE, Willet M. Hays.

The Assistant Secretary performs such duties as may be required by law or prescribed by the Secretary, and becomes Acting Secretary of Agriculture in the absence of the Secretary. He has charge of the Bureau of Statistics.

CHIEF CLERK, S. R. Burch.

The Chief Clerk has the general supervision of the clerks and employees; he is charged with the enforcement of the internal regulations of the Department; and is, by law, superintendent of the buildings occupied by the Department of Agriculture. He represents the Department on the Government board of the Lewis and Clark Centennial Exposition, Portland, Oreg.

APPOINTMENT CLERK, Joseph B. Bennett.

The Appointment Clerk prepares all papers involved in the making of appointments, transfers, promotions, reductions, details, furloughs, and removals for the entire Department, and decides all questions relating to the civil-service regulations affecting the same. He has charge of all correspondence of the Department with the Civil-Service Commission, and of all certifications and communications issued by the Commission to the Department. He keeps the personal records of all employees of the Department, and is custodian of their oaths of office and efficiency reports. He is also custodian of the Department seal.

CHIEF OF SUPPLY DIVISION, Cyrus B. Lower.

The Supply Division has charge of purchases of supplies and materials paid for from the general funds of the Department.

BUREAUS, DIVISIONS, AND OFFICES.

WEATHER BUREAU (corner Twenty-fourth and M streets NW.).—*Chief*, Willis L. Moore; *Assistant Chief*, Henry E. Williams; *Chief Clerk*, Daniel J. Carroll; *Private Secretary to Chief*, Edgar B. Calvert; *Editor Weather Review*, Cleveland Abbe; *In charge Special Researches*, F. H. Bigelow; *In charge Instrument Division*, Charles F. Marvin; *In charge Forecast Division*, Edward B. Garriott; *Assigned as Official Forecasters*, Alfred J. Henry and Harry C. Frankenfield; *Chief of Climatological Division*, James Berry; *Chief of Division of Meteorological Records*, William B. Stockman; *Chief of Publications Division*, John P. Church; *Chief of Telegraph Division*, Jesse H. Robinson; *In charge of Division of Ocean Meteorology*, James Page; *Chief of Division of Supplies*, Frank M. Cleaver; *Librarian and Climatologist*, Herbert H. Kimball.

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[a] The organization of the Department here given is in accordance with the act approved March 3, 1905, making appropriations for the fiscal year ending June 30, 1906, and shows changes in personnel to April 1, 1906.

The Weather Bureau has charge of the forecasting of weather; the issue of storm warnings; the display of weather and flood signals for the benefit of agriculture, commerce, and navigation; the gaging and reporting of river stages; the maintenance and operation of seacoast telegraph lines, and the collection and transmission of marine intelligence for the benefit of commerce and navigation; the reporting of temperature and rainfall conditions for the cotton, rice, sugar, and other interests; the display of frost and cold-wave signals; the distribution of meteorological information in the interests of agriculture and commerce; and the taking of such meteorological observations as may be necessary to establish and record the climatic conditions of the United States, or as are essential for the proper execution of the foregoing duties.

Bureau of Animal Industry.—*Chief*, A. D. Melvin; *Assistant Chief*, A. M. Farrington; *Chief Clerk*, E. B. Jones; *Chief of Inspection Division*, Rice P. Steddom; *Chief of Quarantine Division*, Richard W. Hickman; *Chief of Pathological Division*, John R. Mohler; *Chief of Biochemic Division*, M. Dorset; *Chief of Dairy Division*, Ed. H. Webster; *Scientific Assistant in charge of Zoological Laboratory*, B. H. Ransom; *Superintendent of Experiment Station*, E. C. Schroeder; *Editor*, James M. Pickens; *Animal Husbandman*, George M. Rommel.

The Bureau of Animal Industry makes investigations as to the existence of dangerous communicable diseases of live stock, superintends the measures for their control and extirpation, makes original investigations as to the nature and prevention of such diseases, and reports on the condition and the means of improving the animal industries of the country. It conducts feeding and breeding experiments. It has charge of the inspection of import and export animals, of the inspection of vessels for the transportation of export cattle, and of the quarantine stations for imported neat cattle, supervises the interstate movement of cattle, and inspects live stock and their products when offered for food consumption; it also has supervision of the manufacture, interstate commerce, and export of renovated butter.

Bureau of Plant Industry.—*Pathologist and Physiologist and Chief*, Beverly T. Galloway; *Pathologist and Physiologist and Assistant Chief*, A. F. Woods; *Chief Clerk*, James E. Jones; *Editor*, J. E. Rockwell; *Pathologist in charge of Laboratory of Plant Pathology*, Erwin F. Smith; *Pathologist in charge of Diseases of Fruits*, Merton B. Waite; *Physiologist in charge of Plant Breeding Investigations*, Herbert J. Webber, *Physiologist in charge of Plant Life History Investigations*, Walter T. Swingle; *Physiologist in charge of Soil Bacteriology and Water Purification Investigations*, Karl F. Kellerman; *Bionomist in charge of Bionomic Investigations of Tropical and Subtropical Plants*, Orator F. Cook; *Physiologist in charge of Drug and Poisonous Plant Investigations and Tea Culture Investigations*, Rodney H. True; *Physicist in charge of Physical Laboratory*, Lyman J. Briggs; *Botanist in charge of Economic Collections*, Frederick V. Coville; *Agriculturist in charge of Farm Management Investigations*, William J. Spillman; *Cerealist in charge of Cereal Investigations*, Mark A. Carleton; *Horticulturist in charge of Arlington Experimental Farm*, Lee C. Corbett; *Pathologist in charge of Sugar-Beet Investigations*, Charles O. Townsend; *Agriculturist in charge of Western Agricultural Extension Investigations*, Carl S. Scofield; *Expert in charge of Dry Land Agriculture Investigations*, E. Channing Chilcott; *Pomologist in charge of Pomological Collections*, Gustavus B. Brackett; *Pomologists in charge of Field Investigations in Pomology*, William A. Taylor and G. Harold Powell; *Superintendent of Gardens and Grounds*, Edward M. Byrnes; *Botanist, and Agricultural Explorer in charge of Seed and Plant Introduction and Distribution*, Adrian J. Pieters and David G. Fairchild; *Botanist in charge of Seed Laboratory*, Edgar Brown.

The Bureau of Plant Industry studies plant life in all its relations to agriculture. Its work is classified under the general subjects of Pathological Investigations, Physiological Investigations, Taxonomic Investigations, Agronomic Investigations, Horticultural Investigations, and Seed and Plant Introduction Investigations.

Forest Service (Atlantic Building, 928-930 F street, NW.).—*Forester and Chief*, Gifford Pinchot; *Associate Forester*, Overton W. Price; *In charge of Forest Management*, Thomas H. Sherrard; *In charge of Dendrology*, George B. Sudworth; *In charge of Forest Extension*, Ernest A. Sterling; *In charge of Forest Products*, William L. Hall; *Special Fiscal Agent*, James B. Adams.

The Forest Service has charge of the administration of the National forest reserves, and conducts examinations on the public lands to determine the propriety of making changes in the boundaries of existing National forest reserves and of withdrawing other areas suitable for new reserves; gives practical assistance in the

conservative handling of State and private forest lands; investigates methods of planting and kinds of trees for planting, and gives practical assistance to tree planters; studies commercially valuable trees to determine the best means of using and reproducing them; tests the strength and durability of construction timbers, railroad ties, and poles, and determines the best methods of extending their life through preservative treatment; and studies forest fires, the effects of grazing on forest land, turpentine orcharding, and other forest problems.

Bureau of Chemistry (corner Fourteenth and B streets SW.).—*Chemist and Chief*, Harvey W. Wiley; *Chief, Division of Foods*, W. D. Bigelow; *Sugar Laboratory*, Under direction of Chief of Bureau; *Chief, Miscellaneous Laboratory*, J. K. Haywood; *Chief, Dairy Laboratory*, G. E. Patrick; *Chief, Plant Analysis Laboratory*, C. C. Moore; *Chief, Drug Laboratory*, L. F. Kebler; *Chief, Contracts Laboratory*, L. S. Munson; *Chief, Leather and Paper Laboratory*, F. P. Veitch; *Chief, Microchemical Laboratory*, B. J. Howard; *Chief Clerk*, M. T. Read.

The Bureau of Chemistry investigates methods proposed for the analysis of plants, fertilizers, and agricultural products, and makes such analyses as pertain in general to the interests of agriculture. The work on foods includes the analysis of adulterated products, experiments to determine the effect of adulterants on the human organism, and the investigation of food products imported into the United States. The Bureau does chemical work for some of the other Bureaus and Divisions of the Department, and for other Departments of the Government which apply to the Secretary of Agriculture for such assistance.

Bureau of Soils (208–214 Thirteenth street SW.).—*Chief*, Milton Whitney, *Chief Clerk*, A. G. Rice; *In charge of Soil Laboratories*, Frank K. Cameron; *In charge of Soil Survey*, Jay A. Bonsteel; *In charge of Alkali Reclamation Investigations*, Clarence W. Dorsey; *In charge of Tobacco Investigations*, George T. McNess; *In charge of Soil Management*, Frank D. Gardner; *In charge of Fertility Investigations*, Oswald Schreiner.

The Bureau of Soils is intrusted with the investigation, survey, and mapping of soils; the investigation of the cause and prevention of the rise of alkali in the soil, and the drainage of soils; and the investigation of the methods of growing, curing, and fermentation of tobacco in the different tobacco districts.

Bureau of Entomology.—*Entomologist and Chief*, L. O. Howard; *Entomologist and Acting Chief in absence of Chief*, C. L. Marlatt; *Chief Clerk*, R. S. Clifton; *In charge of Breeding Experiments*, F. H. Chittenden; *In charge of Forest Insect Investigations*, A. D. Hopkins; *In charge of Cotton Boll Weevil Investigations*, W. D. Hunter; *In charge of Cereal and Forage-plant Insect Investigations*, F. M. Webster; *In charge of Deciduous-fruit Insect Investigations*, A. L. Quaintance; *In charge of Apicultural Investigations*, Frank Benton.

The Bureau of Entomology obtains and disseminates information regarding injurious insects affecting field crops, fruits, small fruits, and truck crops, forests and forest products, and stored products; studies insects in relation to diseases of man and other animals and as animal parasites; experiments with the introduction of beneficial insects and with the fungous and other diseases of insects; and conducts experiments and tests with insecticides and insecticide machinery. It is further charged with investigations in apiculture and sericulture. The information gained is disseminated in the form of general reports, bulletins, and circulars. Museum work is done in connection with the Division of Insects of the National Museum, and insects are identified for experiment stations and other public institutions and for private individuals.

Bureau of Biological Survey.—*Biologist and Chief*, C. Hart Merriam; *Administrative Assistant and Acting Chief in absence of Chief*, H. W. Henshaw; *Assistant in charge of Economic Investigations*, A. K. Fisher; *Assistant in charge of Game Preservation*, T. S. Palmer; *Assistant in charge of Geographic Distribution*, Vernon Bailey.

The Division of Biological Survey studies the geographic distribution of animals and plants, and maps the natural life zones of the country; it also investigates the economic relations of birds and mammals, and recommends measures for the preservation of beneficial and the destruction of injurious species. It is charged with carrying into effect the provisions of the Federal law for the importation and protection of birds and certain provisions of the law for the protection of game in Alaska.

Division of Accounts and Disbursements.—*Chief and Disbursing Clerk*, Frank L. Evans; *Assistant Chief* (in charge of Weather Bureau disbursements), A. Zappone; *Cashier*, M. E. Fagan.

The Division of Accounts and Disbursements audits, adjusts, and pays all accounts and claims against the Department; decides questions involving the expenditure of public funds; prepares advertisements, schedules, contracts for annual supplies, leases, agreements, bonds, and letters of authority; writes, for the signature of the Secretary, all letters to the Treasury Department pertaining to fiscal matters and all letters to the Department of Justice; attends to litigation in which the Department is interested; issues requisitions for the purchase of supplies and requests for passenger and for freight transportation; prepares the annual estimates of appropriations; and transacts all other business relating to the financial interests of the Department.

Division of Publications.—*Editor and Chief*, Geo. Wm. Hill; *Associate Editor*, Joseph A. Arnold; *Assistant Editor*, B. D. Stallings; *Assistant in charge of Document Section*, R. B. Handy; *Chief Clerk*, A. I. Mudd; *Assistant in charge of Indexing*, Charles H. Greathouse; *Assistant in charge of Illustrations*, Louis S. Williams.

The Division of Publications exercises general supervision of the Department printing and illustrations, edits all publications of the Department (with the exception of those of the Weather Bureau), has charge of the printing and Farmers' Bulletin funds, and distributes all Department publications with the exception of those issued by the Weather Bureau and those turned over by law to the Superintendent of Documents for sale at the price affixed by him; it issues, in the form of press notices, official information of interest to agriculturists, and distributes to agricultural publications and writers notices and synopses of Department publications; and has charge of all correspondence with the Government Printing Office.

Bureau of Statistics.—*Statistician and Chief*, W. M. Hays, *Assistant Secretary, in Charge; Associate Statistician*, Victor H. Olmsted; *Assistant Statistician and Assistant Chief*, C. C. Clark; *Chief Clerk*, E. J. Lundy; *Chief, Division of Foreign Markets*, George K. Holmes; *Acting Chief, Division of Domestic Crop Reports*, C. C. Clark.

The Statistician collects information as to the condition, production, etc., of the principal crops and the status of farm animals through State agents, each of whom is assisted by a corps of local reporters, through separate corps of county, township, and cotton correspondents, through traveling agents, and through a special foreign correspondent, assisted by consular, agricultural, and commercial authorities. He records, tabulates, and coordinates statistics of agricultural production, distribution, and consumption, the authorized data of governments, institutes, societies, boards of trade, and individual experts; prepares special statistical bulletins upon domestic and foreign agricultural subjects, and issues a monthly crop report for the information of producers and consumers. Special bulletins are published giving information of domestic and foreign trade, of the conditions under which foreign trade may be extended. Investigations are made of land tenures, cost of producing farm products, country-life education, transportation, and other lines of rural economics.

Library.—*Librarian*, Josephine A. Clark; *Assistant Librarian*, Claribel R. Barnett.

The Librarian has charge of the Library and supervises the arrangement and cataloguing of books, the preparation of bibliographies and similar publications, and the purchase of new books. The mailing lists for the distribution of Department publications to foreign countries are under the supervision of the Librarian.

Office of Experiment Stations.—*Director*, A. C. True; *Assistant Director and Editor of Experiment Station Record*, E. W. Allen; *Chief of Editorial Division*, W. H. Beal; *Chief of Division of Insular Stations*, W. H. Evans; *Special Agent, Alaska*, C. C. Georgeson; *Special Agent, Hawaii*, Jared G. Smith; *Special Agent, Porto Rico*, D. W. May; *Expert in Nutrition Investigations*, C. F. Langworthy; *In charge of Respiration Calorimeter Experiments*, F. G. Benedict; *Chief of Irrigation and Drainage Investigations*, Elwood Mead; *Farmers' Institute Specialist*, John Hamilton; *Chief Clerk*, Mrs. C. E. Johnston.

The Office of Experiment Stations represents the Department in its relation to the experiment stations, which are now in operation in all the States and Territories, and directly manages the experiment stations in Alaska, Porto Rico, and Hawaii. It seeks to promote the interests of agricultural education and investigation throughout the United States. It collects and disseminates general information regarding agricultural schools, colleges, and stations, and publishes accounts of agricultural investigations at home and abroad. It also indicates lines of inquiry for the stations, aids in the conduct of cooperative experiments, reports upon their expenditures and

work, and in general furnishes them with such advice and assistance as will best promote the purposes for which they were established. In a similar way it aids in the development of the farmers' institutes throughout the United States. It is charged with investigations on the nutritive value and economy of human foods. It conducts investigations of the laws and institutions relating to irrigation in different regions, the use of irrigation waters, the removal of seepage and surplus waters by drainage, and the use of different kinds of power and machinery for irrigation and other agricultural purposes.

OFFICE OF PUBLIC ROADS.—*Director*, Logan Waller Page; *Assistant Director*, Allerton S. Cushman; *Highway Engineer*, Vernon M. Peirce; *Chief of Records*, Maurice O. Eldridge; *Testing Engineer*, Philip L. Wormley, jr.; *Chief Clerk*, James Edmund Pennybacker, jr.

The Office of Public Roads collects and disseminates information concerning systems of road management throughout the United States; conducts investigations and experiments regarding road-building materials and methods of road construction; makes chemical and physical tests of road materials and materials of construction relating to agriculture; gives expert advice on road administration and road construction, and demonstrates the best methods of construction; and prepares publications on these subjects.

APPROPRIATIONS FOR THE DEPARTMENT OF AGRICULTURE FOR THE FISCAL YEARS ENDING JUNE 30, 1904, 1905, AND 1906.

Object of appropriation.	1904.	1905.	1906.
Salaries, Department of Agriculture	$471,080.00	$482,300.00	$814,970.00
Library, Department of Agriculture	10,000.00	10,000.00	8,040.00
Contingent Expenses, Department of Agriculture	37,000.00	37,000.00	37,000.00
Collecting Agricultural Statistics	109,200.00	139,500.00	98,800.00
Botanical Investigations and Experiments	65,000.00	67,500.00	63,840.00
Entomological Investigations	65,500.00	70,000.00	68,060.00
Vegetable Pathological Investigations	130,000.00	150,000.00	155,640.00
Grain Investigations, 1906			25,000.00
Rent of Quarters, Plant Bureau (deficiency act)		2,500.00	
Biological Investigations	34,000.00	34,000.00	44,420.00
Pomological Investigations	37,000.00	43,500.00	35,640.00
Laboratory, Department of Agriculture	70,500.00	135,000.00	130,920.00
Forestry Investigations	312,860.00	388,000.00	793,180.00
Testing Timbers, Louisiana Purchase Exposition, St. Louis, Mo. (deficiency act)		10,000.00	
Experimental Gardens and Grounds, Department of Agriculture	25,000.00	25,000.00	20,320.00
Soil Investigations	170,000.00	170,000.00	170,000.00
Grass and Forage Plant Investigations	35,000.00	42,500.00	39,660.00
Greenhouses, Department of Agriculture, 1904–1905		25,000.00	
Agricultural Experiment Stations [for stations under Hatch Act, $810,000, 1904; $810,000, 1905; $794,660, 1906]	[a]90,000.00	[a]90,000.00	74,660.00
Nutrition Investigations	20,000.00	20,000.00	20,000.00
Public Road Inquiries	35,000.00	35,000.00	37,660.00
Cotton Boll Investigations	170,000.00	250,000.00	190,000.00
Publications, Department of Agriculture	[b]200,000.00	[b]210,000.00	132,250.00
Sugar Investigations	5,000.00	7,500.00	7,500.00
Purchase and Distribution of Valuable Seeds	290,000.00	290,000.00	242,920.00
Salaries and Expenses, Bureau of Animal Industry	1,450,000.00	1,525,000.00	1,456,520.00
Bureau of Animal Industry (deficiency act)			63,000.00
Irrigation Investigations	65,000.00	67,500.00	74,500.00
Tea Culture Investigations	10,000.00	10,000.00	8,500.00
Arlington Experimental Farm	15,000.00	20,000.00	20,000.00
Foreign Market Investigations	7,500.00		
Building, Department of Agriculture	250,000.00	250,000.00	950,000.00
Total	4,179,610.00	4,606,800.00	5,719,700.00
WEATHER BUREAU.			
Salaries, Weather Bureau	175,440.00	180,440.00	191,340.00
Fuel, Lights, and Repairs, Weather Bureau	6,000.00	8,000.00	10,000.00
Contingent Expenses, Weather Bureau	8,000.00	10,000.00	10,000.00
General Expenses, Weather Bureau	969,080.00	1,064,300.00	1,093,565.00
Buildings, Weather Bureau	50,000.00	48,000.00	53,000.00
Cables and Land Lines, Weather Bureau	40,000.00	27,000.00	35,000.00
Total, Weather Bureau	1,248,520.00	1,337,740.00	1,392,990.00
Grand total	5,428,160.00	5,944,540.00	7,112,690.00

[a] Expenses of Office of Experiment Stations.
[b] Does not include $300,000 for Yearbook and $185,000 in general printing fund.

AGRICULTURAL COLLEGES AND OTHER INSTITUTIONS IN THE UNITED STATES HAVING COURSES IN AGRICULTURE.[a]

College instruction in agriculture is given in the colleges and universities receiving the benefits of the acts of Congress of July 2, 1862, and August 30, 1890, which are now in operation in all the States and Territories, except Alaska, Hawaii, and Porto Rico. The total number of these institutions is 65, of which 63 maintain courses of instruction in agriculture. In 21 States the agricultural colleges are departments of the State universities. In 15 States and Territories separate institutions having courses in agriculture are maintained for the colored race. All of the agricultural colleges for white persons and several of those for negroes offer four-year courses in agriculture and its related sciences leading to bachelors' degrees, and many provide for graduate study. About 45 of these institutions also provide special, short, and correspondence courses in the different branches of agriculture, including agronomy, horticulture, animal husbandry, poultry raising, cheese making, dairying, sugar making, rural engineering, farm mechanics, and other technical subjects. The officers of the agricultural colleges engage quite largely in conducting farmers' institutes and various other forms of college extension. The agricultural experiment stations with very few exceptions are departments of the agricultural colleges. The total number of persons engaged in the work of education and research in the land-grant colleges and the experiment stations in 1905 was 5,406; the number of students in these colleges, 59,812; the number of students (white) in the four-year college courses in agriculture, 2,638; in short and special courses, 3,885. There were also 1,624 students in agriculture in the separate institutions for negroes. With a few exceptions each of these colleges offers free tuition to residents of the State in which it is located. In the excepted cases scholarships are open to promising and energetic students; and, in all, opportunities are found for some to earn part of their expenses by their own labor. The expenses are from $125 to $300 for the school year.

Agricultural colleges and other institutions in the United States having courses in agriculture.

State or Territory.	Name of institution.	Location.	President.
Alabama	Alabama Polytechnic Institute.	Auburn	C. C. Thach, LL. D.
	Agricultural and Mechanical College for Negroes.	Normal	W. H. Councill, Ph. D.
Arizona	University of Arizona	Tucson	K. C. Babcock, Ph. D.
Arkansas	University of Arkansas	Fayetteville	J. N. Tillman, B. LL.
California	University of California	Berkeley	B. I. Wheeler, Ph. D., LL. D.
Colorado	The State Agricultural College of Colorado.	Fort Collins	B. O. Aylesworth, LL. D., Litt. D.
Connecticut	Connecticut Agricultural College.	Storrs	R. W. Stimson, A. M.
Delaware	Delaware College	Newark	G. A. Harter, Ph. D.
	State College for Colored Students.	Dover	W. C. Jason, M. A.
Florida	University of Florida	Lake City	Andrew Sledd, Ph. D., LL. D.
	Florida State Normal and Industrial College.	Tallahassee	N. B. Young, M. A.
Georgia	Georgia State College of Agriculture and Mechanic Arts.	Athens	H. C. White, Ph. D.
	Georgia State Industrial College.	Savannah	R. R. Wright, LL. D.
Idaho	University of Idaho	Moscow	J. A. MacLean, Ph. D.
Illinois	University of Illinois	Urbana	E. J. James, Ph. D., LL. D.
Indiana	Purdue University	Lafayette	W. E. Stone, Ph. D.
Iowa	Iowa State College of Agriculture and the Mechanic Arts.	Ames	A. B. Storms, D. D., LL. D.
Kansas	Kansas State Agricultural College.	Manhattan	E. R. Nichols, A. M.
Kentucky	Agricultural and Mechanical College of Kentucky.	Lexington	J. K. Patterson, Ph. D., LL. D.
	The Kentucky Normal and Industrial Institute for Colored Persons.	Frankfort	J. S. Hathaway, M. A., M. D.
Louisiana	Louisiana State University and Agricultural and Mechanical College.	Baton Rouge	T. D. Boyd, LL. D.
	Southern University and Agricultural and Mechanical College.	New Orleans	H. A. Hill.
Maine	The University of Maine	Orono	G. E. Fellows, Ph. D., LL. D.

[a] Including only institutions established under the land-grant act of July 2, 1862.

Agricultural colleges and other institutions in the United States having courses in agriculture—Continued.

State or Territory.	Name of institution.	Location.	President.
Maryland	Maryland Agricultural College.	College Park	R. W. Silvester, M. S.
	Princess Anne Academy, Eastern Branch, Md. Agr. Coll.	Princess Anne	F. Trigg, M. A.
Massachusetts	Massachusetts Agricultural College.	Amherst	W. P. Brooks, Ph. D.[a]
Michigan	Michigan State Agricultural College.	Agricultural College.	J. L. Snyder, Ph. D.
Minnesota	The University of Minnesota	St. Anthony Park.	C. Northrop, LL. D.
Mississippi	Mississippi Agricultural and Mechanical College.	Agricultural College.	J. C. Hardy, LL. D.
	Alcorn Agricultural and Mechanical College.	Lorman	L. J. Rowan, B. S.
Missouri	The University of Missouri	Columbia	R. H. Jesse, LL. D.
	Lincoln Institute	Jefferson City	B. F. Allen, LL. D.
Montana	The Montana College of Agriculture and Mechanic Arts.	Bozeman	J. M. Hamilton, M. S.
Nebraska	The University of Nebraska	Lincoln	E. B. Andrews, LL. D.
Nevada	Nevada State University	Reno	J. E. Stubbs, D. D., LL. D.
New Hampshire	The New Hampshire College of Agriculture and the Mechanic Arts.	Durham	W. D. Gibbs, M. S.
New Jersey	Rutgers Scientific School, the New Jersey State College for the Benefit of Agriculture and the Mechanic Arts.	New Brunswick	W. H. S. Demarest.
New Mexico	The New Mexico College of Agriculture and Mechanic Arts.	Agricultural College.	Luther Foster, M. S. A.
New York	Cornell University	Ithaca	J. G. Schurman, D.Sc., LL.D.
North Carolina	The North Carolina College of Agriculture and Mechanic Arts.	West Raleigh	G. T. Winston, LL. D.
	The Agricultural and Mechanical College for the Colored Race.	Greensboro	J. B. Dudley, LL. D.
North Dakota	North Dakota Agricultural College.	Agricultural College.	J. H. Worst, LL. D.
Ohio	Ohio State University	Columbus	W. O. Thompson, D.D., LL.D.
Oklahoma	Oklahoma Agricultural and Mechanical College.	Stillwater	A. C. Scott, LL. M.
	Agricultural and Normal University.	Langston	I. E. Page, M. A.
Oregon	Oregon State Agricultural College.	Corvallis	T. M. Gatch, Ph. D.
Pennsylvania	The Pennsylvania State College.	State College	G. W. Atherton, LL. D.
Rhode Island	Rhode Island College of Agriculture and Mechanic Arts.	Kingston	K. L. Butterfield, A. M.
South Carolina	Clemson Agricultural College of South Carolina.	Clemson College	P. H. Mell, Ph. D., LL. D.
	The Colored Normal, Industrial, Agricultural, and Mechanical College of South Carolina.	Orangeburg	T. E. Miller, LL. D.
South Dakota	South Dakota Agricultural College.	Brookings	R. L. Slagle.
Tennessee	University of Tennessee	Knoxville	Brown Ayres, Ph. D., LL. D.
Texas	Agricultural and Mechanical College of Texas.	College Station	H. H. Harrington, M. S.
	Prairie View State Normal and Industrial College.	Prairie View	E. L. Blackshear.
Utah	The Agricultural College of Utah.	Logan	W. J. Kerr, D. Sc.
Vermont	University of Vermont and State Agricultural College.	Burlington	M. H. Buckham, D. D., LL. D.
Virginia	The Virginia Agricultural and Mechanical College and Polytechnic Institute.	Blacksburg	J. M. McBryde, Ph. D., LL. D.
	The Hampton Normal and Agricultural Institute.	Hampton	H. B. Frissell, D. D., LL. D.
Washington	The State College of Washington.	Pullman	E. A. Bryan, LL. D.
West Virginia	West Virginia University	Morgantown	D. B. Purinton, Ph. D., LL. D.
	The West Virginia Colored Institute.	Institute	J. McH. Jones, A. M.
Wisconsin	University of Wisconsin	Madison	C. R. Van Hise, Ph. D.
Wyoming	University of Wyoming	Laramie	F. M. Tisdel, Ph. D.

[a] Acting president.

AGRICULTURAL EXPERIMENT STATIONS OF THE UNITED STATES, THEIR LOCATIONS, DIRECTORS, AND PRINCIPAL LINES OF WORK.

Station, location, and director.	Principal lines of work.
Alabama (College), Auburn: J. F. Duggar	Chemistry; botany; soils; analysis of fertilizers and food materials; agronomy; horticulture; plant breeding; diseases of plants and animals; animal husbandry; dairying.
Alabama (Canebrake), Uniontown: J. M. Richeson [a]	Agronomy; horticulture; floriculture; diseases of plants and animals.
Alabama (Tuskegee), Tuskegee Institute: G. W. Carver	Agronomy; horticulture; diseases of plants; animal industry; dairying.
Arizona, Tucson: R. H. Forbes	Chemistry; botany; agronomy; horticulture; plant breeding; animal husbandry; dairying; irrigation.
Arkansas, Fayetteville: W. G. Vincenheller	Chemistry; agronomy; horticulture; plant breeding; diseases of plants and animals; animal husbandry; dairying; entomology.
California, Berkeley: E. W. Hilgard	Chemistry; soils; bacteriology; fertilizer control; agronomy; horticulture, including viticulture and zymology; botany; meteorology; entomology; animal husbandry; dairying; poultry experiments; irrigation and drainage; silviculture; reclamation of alkali lands; animal and plant pathology; nutrition investigations.
Colorado, Fort Collins: L. G. Carpenter	Chemistry; meteorology; agronomy; horticulture; forestry; plant breeding; diseases of plants; animal husbandry; entomology; irrigation.
Connecticut (State), New Haven: E. H. Jenkins	Chemistry; inspection of fertilizers, foods, feeding stuffs, Babcock test apparatus, and nurseries; diseases of plants; plant breeding; forestry; agronomy; entomology.
Connecticut (Storrs), Storrs: L. A. Clinton	Food and nutrition of man and animals; dairy bacteriology; agronomy; horticulture; poultry culture; dairying.
Delaware, Newark: A. T. Neale	Chemistry; bacteriology; agronomy; horticulture; plant breeding; diseases of plants and animals; animal husbandry; dairying; entomology.
Florida, Lake City: P. H. Rolfs	Chemistry; agronomy; horticulture; diseases of plants; feeding experiments; veterinary science; entomology.
Georgia, Experiment: R. J. Redding	Agronomy; horticulture; plant breeding; entomology; animal husbandry; dairying.
Idaho, Moscow: H. T. French	Chemistry; physics; botany; agronomy; horticulture; plant breeding; diseases of plants; entomology; animal husbandry.
Illinois, Urbana: E. Davenport	Chemistry; bacteriology; agronomy; horticulture; forestry; plant breeding; diseases of plants and animals; animal husbandry; dairying.
Indiana, Lafayette: Arthur Goss	Chemistry; agronomy; horticulture; plant breeding; animal husbandry; dairying; diseases of plants and animals; entomology.
Iowa, Ames: C. F. Curtiss	Chemistry; botany; agronomy; horticulture; plant breeding; forestry; diseases of plants; animal husbandry; dairying; entomology; rural engineering; good roads investigations.
Kansas, Manhattan: J. T. Willard	Chemistry; soils; horticulture; plant breeding; agronomy; animal husbandry; poultry experiments; diseases of animals; dairying; entomology; extermination of prairie dogs and gophers; irrigation.
Kentucky, Lexington: M. A. Scovell	Chemistry; soils; inspection of fertilizers, foods, feeding stuffs, orchards, and nurseries; agronomy; horticulture; plant breeding; animal husbandry; dairying; diseases of plants; entomology; apiculture.
Louisiana (Sugar), New Orleans: W. R. Dodson	Chemistry; bacteriology; soils; agronomy; horticulture; sugar making; drainage; irrigation.
Louisiana (State), Baton Rouge: W. R. Dodson	Geology; botany; bacteriology; soils; inspection of fertilizers and Paris green; agronomy; horticulture; animal husbandry; diseases of animals; entomology.

[a] Assistant director.

Agricultural experiment stations of the United States, their locations, directors, and principal lines of work—Continued.

Station, location, and director	Principal lines of work.
Louisiana (North), Calhoun: W. R. Dodson	Chemistry; soils; fertilizers; agronomy; horticulture; animal husbandry; stock raising; dairying.
Maine, Orono: C. D. Woods	Chemistry; botany; inspection of foods, fertilizers, commercial feeding stuffs, seeds, and creamery glassware; horticulture; plant breeding; diseases of plants and animals; food and nutrition of man and animals; poultry raising, and entomology.
Maryland, College Park: H. J. Patterson	Chemistry; agronomy; horticulture; diseases of plants and animals; breeding of plants; animal husbandry; dairying; entomology.
Massachusetts, Amherst: W. P. Brooks	Chemistry; meteorology; inspection of fertilizers, commercial feeding stuffs, creamery glassware, and nurseries; agronomy; horticulture; diseases of plants and animals; animal husbandry; dairying; entomology; effect of electricity on plant growth.
Michigan, Agricultural College: C. D. Smith	Chemistry; analysis and control of fertilizers and feeding stuffs; bacteriology; agronomy; horticulture; plant breeding; diseases of plants and animals; animal husbandry; stable hygiene; entomology.
Minnesota, St. Anthony Park, St. Paul: W. M. Liggett	Chemistry; fertilizers; agronomy; horticulture; forestry; diseases of plants and animals; food and nutrition investigations; animal breeding; animal husbandry; dairying; entomology; farm management; farm statistics.
Mississippi, Agricultural College: W. L. Hutchinson	Soils; fertilizers; agronomy; horticulture; plant breeding; animal husbandry; diseases of animals; poultry culture; dairying; entomology.
Missouri (College), Columbia: H. J. Waters	Chemistry; soil survey; botany; agronomy; horticulture; diseases of plants and animals; animal husbandry; plant breeding; dairying; entomology.
Missouri (Fruit), Mountain Grove: Paul Evans	Horticulture; entomology; inspection of orchards and nurseries.
Montana, Bozeman: F. B. Linfield	Chemistry; meteorology; botany; agronomy; dry farming; horticulture; animal husbandry; poultry experiments; dairying; entomology; irrigation.
Nebraska, Lincoln: E. A. Burnett	Chemistry; botany; meteorology; soils; agronomy; horticulture; plant breeding; diseases of plants and animals; forestry; animal husbandry; dairying; entomology; irrigation; extermination of prairie dogs.
Nevada, Reno: J. E. Stubbs	Chemistry; botany; soils; agronomy; horticulture; forestry; animal diseases; animal husbandry; entomology; irrigation.
New Hampshire, Durham: W. D. Gibbs	Chemistry; agronomy; horticulture; plant breeding; forestry; animal husbandry; dairying; entomology.
New Jersey (State), New Brunswick: E. B. Voorhees New Jersey (College), New Brunswick: E. B. Voorhees	Chemistry; oyster culture; botany; analysis of fertilizers, foods, and commercial feeding stuffs; agronomy; horticulture; plant breeding; diseases of plants and animals; dairy husbandry; entomology; soil bacteriology; irrigation.
New Mexico, Mesilla Park: Luther Foster	Chemistry; botany; agronomy; horticulture; animal husbandry; entomology; irrigation.
New York (State), Geneva: W. H. Jordan	Chemistry; bacteriology; meteorology; inspection of creamery glassware, feeding stuffs, fertilizers, and Paris green; agronomy; horticulture; plant breeding; diseases of plants; animal husbandry; poultry experiments; dairying; entomology; irrigation.
New York (Cornell), Ithaca: L. H. Bailey	Chemistry; fertilizers; agronomy; horticulture; plant breeding; diseases of plants and animals; animal husbandry; poultry experiments; dairying; entomology.
North Carolina, Raleigh: B. W. Kilgore	Chemistry; soils; agronomy; horticulture; animal husbandry; diseases of animals and plants; poultry experiments; dairying; tests of farm machinery.
North Dakota, Agricultural College: J. H. Worst	Chemistry; botany; agronomy; plant breeding; horticulture; forestry; diseases of plants and animals; food analysis; animal husbandry; dairying; farm mechanics.

Agricultural experiment stations of the United States, their locations, directors, and principal lines of work—Continued.

Station, location, and director.	Principal lines of work.
Ohio, Wooster: C. E. Thorne	Agronomy; horticulture; plant breeding; forestry; diseases of plants; animal husbandry; entomology.
Oklahoma, Stillwater: John Fields	Chemistry; agronomy; horticulture; plant breeding; forestry; botany; bacteriology; diseases of plants and animals; animal husbandry; entomology.
Oregon, Corvallis: J. Withycombe	Chemistry; bacteriology; agronomy; horticulture; plant selection; diseases of plants; animal husbandry; poultry experiments; dairying; entomology; irrigation.
Pennsylvania State College: H. P. Armsby	Chemistry; meteorology; horticulture; agronomy; animal husbandry; dairying.
Rhode Island, Kingston: H. J. Wheeler	Chemistry; meteorology; soils; inspection of fertilizers and feeding stuffs; agronomy; horticulture; plant breeding; poultry experiments.
South Carolina, Clemson College: J. N. Harper	Chemistry; inspection of fertilizers; botany; agronomy; horticulture; plant breeding; diseases of plants; animal husbandry; dairying; veterinary science; entomology.
South Dakota, Brookings: J. W. Wilson	Chemistry; botany; agronomy; horticulture; plant breeding; diseases of plants and animals; animal husbandry; entomology.
Tennessee, Knoxville: H. A. Morgan	Chemistry; inspection of fertilizers; agronomy; horticulture; plant breeding; seeds; weeds; diseases of plants; animal husbandry; dairying; entomology.
Texas, College Station: J. A. Craig	Chemistry; soils; agronomy; horticulture; animal husbandry; diseases of animals; irrigation; seed testing; feed inspection.
Utah, Logan: P. A. Yoder	Chemistry; alkali soil investigations; agronomy; horticulture; diseases of plants; animal husbandry; dairying; poultry experiments; entomology; irrigation; arid farming.
Vermont, Burlington: J. L. Hills	Chemistry; botany; bacteriology; inspection of fertilizers, feeding stuffs, and creamery glassware; agronomy; horticulture; diseases of plants; animal husbandry; dairying.
Virginia, Blacksburg: A. M. Soule	Chemistry; geology; biology; agronomy; horticulture; plant breeding; bacteriology; analysis of foods and soils; inspection of orchards; animal husbandry; veterinary science; dairying; entomology; cider and vinegar making; ferments.
Washington, Pullman: E. A. Bryan	Chemistry; botany; bacteriology; agronomy; horticulture; plant breeding; diseases of plants; animal husbandry; veterinary science; dairying; entomology; irrigation.
West Virginia, Morgantown: J. H. Stewart	Chemistry; inspection of fertilizers, orchards, and nurseries; agronomy; horticulture; diseases of plants; animal husbandry; poultry experiments; entomology.
Wisconsin, Madison: W. A. Henry	Chemistry; bacteriology; soils; agronomy; horticulture; plant breeding; animal husbandry; dairying; irrigation, drainage, and agricultural engineering.
Wyoming, Laramie: B. C. Buffum	Botany; meteorology; soils; range improvement; fertilizers; agronomy; plant selection; food analysis; animal husbandry; irrigation.

ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

President, M. H. Buckham, president of the University of Vermont, Burlington, Vt.; secretary-treasurer, J. L. Hills, director Vermont Experiment Station, Burlington, Vt.

OFFICIALS IN CHARGE OF FARMERS' INSTITUTES.

Farmers' Institute Specialist, Department of Agriculture.

John Hamilton, Washington, District of Columbia.

State superintendents.

State or Territory.	Name of official.	Post-office.
Alabama	C. A. Cary, Alabama Polytechnic Institute	Auburn.
	G. W. Carver, Director Agricultural Experiment Station	Tuskegee Institute.
Alaska	C. C. Georgeson, Agricultural Experiment Station	Sitka.
Arizona	R. H. Forbes, Director Agricultural Experiment Station	Tucson.
Arkansas	J. M. Tillman, President University of Arkansas	Fayetteville.
California	E. J. Wickson, University of California	Berkeley.
Colorado	W. L. Carlyle, State Agricultural College	Fort Collins.
Connecticut	J. F. Brown, Secretary State Board of Agriculture	N. Stonington.
	J. G. Schwink, Sec'y Connecticut Dairymen's Association	Hartford.
	H. C. C. Miles, Secretary Connecticut Pomological Society	Milford.
Delaware	Wesley Webb, Director of Farmers' Institutes	Dover.
	A. T. Neale, Director Agricultural Experiment Station	Newark.
Florida	C. M. Conner, University of Florida	Lake City.
Georgia	H. C. White, President State College of Agriculture	Athens.
	Harvie Jordan, Director of Farmers' Institutes	Atlanta.
Hawaii	J. G. Smith, Agricultural Experiment Station	Honolulu.
Idaho	H. T. French, Director Agricultural Experiment Station	Moscow.
Illinois	Frank H. Hall, Secretary Farmers' Institutes	Springfield.
Indiana	W. C. Latta, Purdue University	Lafayette.
Iowa	J. C. Simpson, Secretary State Board of Agriculture	Des Moines.
Kansas	J. H. Miller, Superintendent of Farmers' Institutes	Manhattan.
Kentucky	Hubert Vreeland, Commissioner of Agriculture	Frankfort.
Louisiana	Charles Schuler, Commissioner of Agriculture	Baton Rouge.
Maine	A. W. Gilman, Commissioner of Agriculture	Augusta.
Maryland	W. L. Amoss, Director of Farmers' Institutes	Benson.
Massachusetts	J. L. Ellsworth, Secretary State Board of Agriculture	Boston.
Michigan	L. R. Taft, Superintendent of Farmers' Institutes	Agricultural College.
Minnesota	O. C. Gregg, Director of Farmers' Institutes	Lynd.
Mississippi	J. C. Hardy, President Ag'l and Mechanical College	Agricultural College.
Missouri	Geo. B. Ellis, Secretary State Board of Agriculture	Columbia.
Montana	F. B. Linfield, Director Agr. Experiment Station	Bozeman.
Nebraska	E. A. Burnett, Director Agricultural Experiment Station	Lincoln.
Nevada	J. E. Stubbs, President Nevada State University	Reno.
New Hampshire	N. J. Bachelder, Secretary State Board of Agriculture	Concord.
New Jersey	Franklin Dye, Secretary State Board of Agriculture	Trenton.
New Mexico	Luther Foster, President Ag'l and Mechanical College	Agricultural College.
New York	F. E. Dawley, Director of Farmers' Institutes	Fayetteville.
North Carolina	S. L. Patterson, Commissioner of Agriculture	Raleigh.
North Dakota	E. E. Kaufman, Director of Farmers' Institutes	Bismarck.
Ohio	T. L. Calvert, Secretary State Board of Agriculture	Columbus.
Oklahoma	C. A. McNabb, Secretary Board of Agriculture	Guthrie.
Oregon	J. Withycombe, Director Agricultural Experiment Station	Corvallis.
Pennsylvania	A. L. Martin, Deputy Secretary of Agriculture	Harrisburg.
Porto Rico	D. W. May, Agricultural Experiment Station	San Juan.
Rhode Island	John G. Clarke, Secretary State Board of Agriculture	Providence.
South Carolina	J. N. Harper, Director Agricultural Experiment Station	Clemson College.
South Dakota	M. F. Greeley, Superintendent of Farmers' Institutes	Gary.
Tennessee	W. W. Ogilvie, Commissioner of Agriculture	Nashville.
Texas	J. W. Carson, Director of Farmers' Institutes	College Station.
Utah	P. A. Yoder, Director Agr. Experiment Station	Logan.
Vermont	Geo. Aitken, Secretary State Board of Agriculture	Woodstock.
Virginia	G. W. Koiner, Commissioner of Agriculture	Richmond.
	A. M. Soule, Director Agricultural Experiment Station	Blacksburg.
Washington	E. A. Bryan, President Agriculture College	Pullman.
	E. E. Elliott, Agricultural College	Do.
West Virginia	H. E. Williams, Assistant Secretary of Agriculture	Sunlight.
Wisconsin	G. McKerrow, Director of Farmers' Institutes	Madison.
Wyoming	B. C. Buffum, Director Agricultural Experiment Station	Laramie.

AMERICAN ASSOCIATION OF FARMERS' INSTITUTE WORKERS.

President, G. C. Creelman, president of the Ontario Agricultural College, Guelph, Ontario; secretary-treasurer, John Hamilton, Farmers' Institute Specialist, U. S. Department of Agriculture, Washington, D. C

STATE OFFICIALS IN CHARGE OF AGRICULTURE.[a]

Commissioners of Agriculture.

State or Territory.	Name of official.	Post-office.
Alabama	R. R. Poole	Montgomery.
Arkansas	H. T. Bradford	Little Rock.
Florida	B. E. McLin	Tallahassee.
Georgia	O. B. Stevens	Atlanta.
Idaho	Allen Miller, Com'r of Immigration, etc	Boise.
Kentucky	Hubert Vreeland	Frankfort.
Louisiana	Charles Schuler	Baton Rouge.
Maine	A. W. Gilman	Augusta.
Montana	J. A. Ferguson	Helena.
New York	Chas. A. Wieting	Albany.
North Carolina	S. L. Patterson	Raleigh.
North Dakota	W. C. Gilbreath	Bismarck.
New Mexico	J. W. Raynolds, Secretary of State	Santa Fe.
Pennsylvania	N. B. Critchfield, Secretary of Agriculture	Harrisburg.
Philippine Islands	W. C. Welborn, Chief, Bureau of Agriculture	Manila.
Porto Rico	Wm. H. Elliott, Commissioner of the Interior	San Juan.
South Carolina	E. J. Watson	Columbia.
Tennessee	W. W. Ogilvie	Nashville.
Texas	W. J. Clay	Austin.
Virginia	Geo. W. Koiner	Richmond.
Washington	A. W. Frater, Deputy Secretary of State	Olympia.

Secretaries of State boards of agriculture.

State or Territory.	Name of official.	Post-office.
California	Albert Lindley	Sacramento.
Colorado	A. M. Hawley	Fort Collins.
Connecticut	J. F. Brown	North Stonington.
Delaware	Wesley Webb	Dover.
Hawaii	C. S. Holloway	Honolulu.
Illinois	W. C. Garrard	Springfield.
Indiana	Chas. Downing	Indianapolis.
Iowa	J. C. Simpson	Des Moines.
Kansas	F. D. Coburn	Topeka.
Maryland	Wm. T. P. Turpin, Supt. of Immigration	Centerville.
Massachusetts	J. L. Ellsworth	Boston.
Michigan	Addison M. Brown	Agricultural College.
Minnesota	E. W. Randall, Sec. State Ag'l Society	St. Paul.
Missouri	George B. Ellis	Columbia.
Nebraska	Robt. W. Furnas	Brownville.
Nevada	Louis Bevier	Carson City.
New Hampshire	N. J. Bachelder	Concord.
New Jersey	Franklin Dye	Trenton.
North Carolina	T. K. Bruner	Raleigh.
Ohio	T. L. Calvert	Columbus.
Oklahoma	C. A. McNabb	Guthrie.
Oregon	M. D. Wisdom	Portland.
Rhode Island	John G. Clarke	Providence.
South Dakota	Walter B. Dean	Yankton.
Vermont	George Aitken	Woodstock.
West Virginia	J. B. Garvin	Charleston.
Wisconsin	John M. True	Madison.
Wyoming	C. T. Johnston, State Engineer	Cheyenne.

NATIONAL DAIRY ASSOCIATIONS.

Name of organization.	Secretary.	Post-office.
National Association of State Dairy and Food Departments.	R. M. Allen	Lexington, Ky.
National Dairy Union	Charles Y. Knight	154 Lake st., Chicago.
National Creamery Buttermakers' Association	E. Sudendorf	Clinton, Ill.
Boston Cooperative Milk Producers' Association	W. A. Hunter	10 Florence st., Worcester, Mass.
Five States Milk Producers' Association	H. T. Coon	Homer, N. Y.

[a] Officials of Territories and island dependencies are included. So far as learned, Arizona, Mississippi, New Mexico, and Utah have no State official charged with agricultural interests, but letters addressed to the Secretary of State would probably receive attention.

AMERICAN NATIONAL LIVE STOCK ASSOCIATION.

President, Murdo Mackenzie, Trinidad, Colo.; secretary, W. M. Tomlinson, Denver.

AMERICAN ASSOCIATION OF LIVE STOCK HERD BOOK SECRETARIES.

President, C. R. Thomas, Independence, Mo.; secretary, Charles F. Mills, Springfield, Ill.

NATIONAL WOOL GROWERS' ASSOCIATION.

President, Francis E. Warren, Cheyenne; secretary, George S. Walker, Cheyenne.

THE CORN BELT MEAT PRODUCERS' ASSOCIATION.

President, A. L. Ames, Buckingham, Iowa; secretary, H. C. Wallace, Des Moines, Iowa.

PROTECTION AGAINST CONTAGION FROM FOREIGN CATTLE.

An act of Congress of August 28, 1894, prohibits the importation of cattle and cattle hides, but by the act of March 2, 1895, making appropriations for the Department of Agriculture, it is provided that the prohibition may be suspended by the President whenever the Secretary of Agriculture shall certify to the President what countries or parts of countries are free from contagious or infectious diseases of domestic animals. The President, by proclamation of November 8, 1895, lifted the embargo with reference to Norway, Sweden, Holland, Great Britain, Ireland, the Channel Islands, and the countries of North, Central, and South America so as to admit cattle under sanitary regulations prescribed by the Secretary of Agriculture; also from all countries so as to admit hides under regulations prescribed by the Secretary of the Treasury.

STOCK BREEDERS' ASSOCIATIONS.[a]

Names and addresses of stock association secretaries, with breeds and numbers of registered live stock in United States, December 31, 1905.

CATTLE.

Breed.	Secretary.	Post-office.	Number registered.		Number living.	
			Male.	Female.	Male.	Female.
Aberdeen Angus	Thos. McFarlane	Union Stock Yards, Chicago, Ill.	38,188	48,604	27,496	34,994
Ayrshire	C. M. Winslow	Brandon, Vt.	9,689	20,883	(b)	(b)
Devon	L. P. Sisson	Newark, Ohio	8,084	13,717	3,500	10,000
Dutch Belted	H. B. Richards	Easton, Pa.	573	1,265	(b)	(b)
Galloway	C. W. Gray	Union Stock Yards, Chicago, Ill.	16,620	11,080	8,370	6,480
Guernsey	Wm. H. Caldwell	Peterboro, N. H.	10,683	19,889	6,000	12,000
Hereford	C. R. Thomas	225 W. 12th st., Kansas City, Mo.	112,780	115,620	45,000	60,000
Holstein Friesian	Frederick L. Houghton.	Brattleboro, Vt.	46,031	95,037	14,199	31,756
Jersey	J. J. Hemingway	8 W. 17th st., New York, N. Y.	71,907	193,978	(b)	(b)
Polled Durham	Fletcher S. Hines	Indianapolis, Ind.	5,403	6,460	3,935	4,845
Red Polled	H. A. Martin	Gotham, Wis	14,601	25,006	5,500	10,500
Shorthorn	John W. Groves	Union Stock Yards, Chicago, Ill.	249,800	391,600	87,430	176,220
Sussex	Overton Lea	Nashville, Tenn	78	185	50	100
Swiss, Brown	C. D. Nixon	Owego, N. Y	2,159	3,150	300	1,500

[a] Under the provisions of paragraph 473 of the act of July 24, 1897, amended March 3, 1903, any animal imported specially for breeding purposes shall be admitted free, provided that no such animal shall be admitted free unless pure bred, of a recognized breed, and duly registered in the book of record established for that breed. The Secretary of the Treasury, upon the advice of the Secretary of Agriculture, issued April 24, 1903, regulations for the importation of animals under this law, and designated the recognized breeds and the books of record established for these breeds.

[b] No data.

Names and addresses of stock association secretaries, with breeds and numbers of registered live stock in United States, December 31, 1905—Continued.

HORSES.

Breed.	Secretary.	Post-office.	Number registered.		Number living.	
			Male.	Female.	Male.	Female.
Cleveland Bay	R. P. Stericker	80 Chestnut ave., W. Orange, N. J.	1,236	502	1,050	400
Clydesdale	R. B. Ogilvie	Union Stock Yards, Chicago, Ill.	[a]12,370		(b)	(b)
Coach, French	Chas. C. Glenn	Columbus, Ohio	130	4	125	4
Coach, German	J. Crouch	Lafayette, Ind	1,656	246	1,500	225
Coach, German (Oldenburg).	C. E. Stubbs	Fairfield, Iowa	260	23	190	14
Draft, Belgian	J. D. Connor, jr	Wabash, Ind	2,056	266	2,055	265
Draft, French	C. E. Stubbs	Fairfield, Iowa	9,000	5,000	(b)	(b)
Hackney	A. H. Godfrey	Box 111, Madison Square, New York City.	[c]726	[c]1,542	[c]684	[c]1,416
Morgan	H. T. Cutts	Middlebury, Vt	[c]5,021	[c]2,800	[c]3,765	[c]2,100
Percheron	Geo. W. Stubblefield.	Union Stock Yards, Chicago, Ill.	1,640	1,460	19,000	12,000
Percheron	Charles C. Glenn	Columbus, Ohio	928	102	913	94
Saddle Horse, American.	I. B. Nall	Louisville, Ky	[d]2,529	3,549	(b)	(b)
Shetland Pony	Mortimer Levering.	Lafayette, Ind	2,300	3,500	2,000	2,500
Shire	Charles Burgess	Wenona, Ill	6,062	2,148	(b)	(b)
Suffolk	Alex. Galbraith	Janesville, Wis	159	88	[a]150	
Thoroughbred	James E. Wheeler	571 Fifth ave., New York, N. Y.	[a]45,309		(b)	(b)
Trotter, American.	Wm. H. Knight	355 Dearborn st., Chicago, Ill.	42,597	[c]152,700	(b)	(b)
Jacks and Jennies.	J. W. Jones	Columbia, Tenn	1,000	750	750	500

SHEEP.

Breed.	Secretary.	Post-office.	Number registered.		Number living.	
			Male.	Female.	Male.	Female.
Cheviot	F. E. Dawley	Fayetteville, N. Y	[a]10,700		575	2,650
Cotswold	F. W. Harding	Waukesha, Wis	[a]36,610		[a]14,000	
Dorset Horn	J. E. Wing	Mechanicsburg, Ohio.	1,395	3,703	1,000	2,800
Hampshire Down	Comfort A. Tyler	Nottawa, Mich	5,573	12,844	3,000	9,000
Leicester	A. J. Temple	Cameron, Ill	3,538	5,437	2,972	4,567
Lincoln	Bert Smith	Charlotte, Mich	5,754	8,246	4,100	5,900
Merino (Delaine)	H. G. McDowell	Canton, Ohio	[a]9,401		[a]6,900	
Merino (Delaine)	George A. Henry	R. F. D. 8, Bellefontaine, Ohio.	8,000	14,300	2,500	8,000
Merino (Delaine)	R. P. Berry	R. F. D. 3, Eighty-four, Pa.	[c]5,054	[c]11,259	[c]1,500	[c]3,000
Merino (Delaine)	J. B. Johnson	248 W. Pike st., Canonsburg, Pa.	6,805	11,599	1,500	5,000
Merino (French)	Dwight Lincoln	Milford Center, Ohio.	[a]34,075		(b)	(b)
Merino (German)	E. M. Moore	Orchard Lake, Mich.	162	191	105	175
Merino (Spanish)	E. N. Ball	Ann Arbor, Mich	12,550	37,700	400	4,300
Merino (Spanish)	Wesley Bishop	R. F. D. 1, Delaware, Ohio.	16,691	33,384	2,842	8,035
Merino (Spanish)	J. H. Earll	Skaneateles, N. Y	7,916	11,912	280	1,875
Merino (Spanish)	J. P. Ray	R. F. D. 3, E. Bloomfield, N. Y.	1,275	1,500	100	200
Merino (Spanish)	C. A. Chapman	Middlebury, Vt	[a]217,850		(b)	(b)
Oxford Down	W. A. Shafor	Hamilton, Ohio	[c]32,798		(b)	(b)
Shropshire	Mortimer Levering.	Lafayette, Ind	100,000	134,000	20,000	40,000
Southdown	Frank S. Springer.	Springfield, Ill	[a]19,933		[a]10,200	
Suffolk	George W. Franklin.	Des Moines, Iowa	[a]1,013		[a]550	

[a] Total of males and females. [b] No data. [c] Estimate for 1904. [d] Includes geldings.

Names and addresses of stock association secretaries, with breeds and numbers of registered live stock in United States, December 31, 1905—Continued.

HOGS.

Breed.	Secretary.	Post-office.	Number registered.		Number living.	
			Male.	Female.	Male.	Female.
Berkshire	Frank S. Springer	510 E. Monroe st., Springfield, Ill.	[a] 88,080		[a] 33,060	
Cheshire	Ed S. Hill	Freeville, N. Y	1,225	2,115	275	575
Chester White	Ernest Freigau	Columbus, Ohio	5,665	8,912	600	2,000
Chester Ohio Improved.	J. C. Hiles	Cleveland, Ohio	3,403	9,000	1,800	6,200
Duroc Jersey	T. B. Pearson	Thorntown, Ind	8,026	18,450	([b])	([b])
Duroc Jersey	Robert J. Evans	Peoria, Ill	21,800	55,000	[a] 30,000	
Hampshire (Thin Rind).	E. C. Stone	Armstong, Ill	294	540	155	387
Poland China	W. M. McFadden	Union Stock Yards, Chicago, Ill.	52,331	130,620	27,000	68,000
Poland China	A. M. Brown	Drawer 16, Winchester, Ind.	32,000	72,060	10,000	23,000
Poland China	Geo. F. Woodworth	Maryville, Mo	39,008	93,234	2,000	18,000
Poland China	H. P. Wilson	Gadsden, Tenn	691	1,030	400	600
Tamworth	E. N. Ball	Ann Arbor, Mich	[c] 1,949		[c] 1,200	
Yorkshire	Harry G. Krum	White Bear Lake, Minn.	2,860	3,640	2,000	3,200

[a] Total of males and females. [b] No data. [c] Estimate for 1904.

SANITARY OFFICERS IN CHARGE OF LIVE STOCK INTERESTS.

State or Territory.	Name and post-office.	Official position.
Alabama	C. A. Cary, Auburn	Professor of veterinary science.
Arizona	J. D. Carter, Prescott	Secretary live stock sanitary commission.
	J. C. Norton, Phoenix	Veterinarian.
Arkansas	R. R. Dinwiddie, Fayetteville	State veterinarian.
California	Chas. Keane, Sacramento	Do.
Colorado	L. B. Sylvester, Denver	President State board of stock inspection.
	Charles G. Lamb, Denver	State veterinary surgeon.
Connecticut	Heman O. Averill, Hartford	Commissioner for domestic animals.
Delaware	Alex. Lowber, Wilmington	Secretary State board of health.
	H. P. Eves, Newark	Instructor in veterinary science, Delaware College.
Florida	Chas. F. Dawson, Lake City	Professor of veterinary science.
Georgia	O. B. Stevens, Atlanta	Commissioner of agriculture.
Idaho	George E. Noble, Boise	State veterinarian.
Illinois	H. E. Wadsworth, Springfield	Secretary board of live stock commissioners.
	C. P. Lovejoy, Princeton	State veterinarian.
Indiana	A. W. Bitting, Lafayette	Do.
Iowa	Paul O. Koto, Forest City	State veterinary surgeon.
Kansas	John D. Baker, Peabody	Live stock sanitary commissioner.
Kentucky	F. T. Eisenman, Louisville	State veterinarian.
Louisiana	W. H. Dalrymple, Baton Rouge	Veterinarian State experiment station.
Maine	John M. Deering, Saco	State cattle commissioners.
	F. S. Adams, Bowdoinham	
Maryland	G. Allen Jarman, Chestertown	Chief veterinary inspector.
	Wade H. D. Warfield, Baltimore	Secretary live stock sanitary board.
Massachusetts	Austin Peters, Boston	Chief of the cattle bureau of State board of agriculture.
Michigan	F. C. Wells, Saline	State veterinarian.
	H. H. Hinds, Stanton	President State live stock sanitary commission.
Minnesota	C. E. Cotton, Minneapolis	Veterinarian live stock sanitary board.
	H. M. Bracken, St. Paul	Secretary State board of health.
Mississippi	J. C. Robert, Agricultural College	Professor of veterinary science.
Missouri	D. F. Luckey, Columbia	State veterinarian.
	Geo. B. Ellis, Columbia	Secretary State board of agriculture.
Montana	W. G. Preuitt, Helena	Secretary live stock commission.
	M. E. Knowles, Helena	State veterinarian.
Nebraska	W. A. Thomas, Lincoln	Do.
Nevada	I. W. O'Rourke, Reno	Do.
New Hampshire	N. J. Bachelder, Concord	Secretary board of cattle commissioners.

Sanitary officers in charge of live stock interests—Continued.

State or Territory.	Name and post-office.	Official position.
New Jersey	Franklin Dye, Trenton	Secretary tuberculosis commission.
New Mexico	W. C. Barnes, Las Vegas	Secretary cattle sanitary board.
	Harry F. Lee, Albuquerque	Secretary sheep sanitary board.
New York	C. A. Wieting, Albany	Commissioner department of agriculture.
	W. H. Kelly, Albany	Chief veterinarian.
North Carolina	Tait Butler, Raleigh	State veterinarian.
	S. L. Patterson, Raleigh	Commissioner of agriculture.
North Dakota	L. Van Es, Fargo	Chief State veterinarian.
Ohio	T. L. Calvert, Columbus	Secretary State live stock commission.
	Paul Fischer, Columbus	State veterinarian.
Oklahoma	Thomas Morris, Guthrie	Secretary live stock sanitary commission.
	L. D. Brown, Guthrie	Territorial veterinarian.
Oregon	Wm. McLean, Portland	State veterinarian.
Pennsylvania	Leonard Pearson, Philadelphia	Do.
Rhode Island	John G. Clarke, Providence	Secretary State board of agriculture.
	John S. Pollard, Providence	Veterinarian, State board of agriculture.
South Carolina	Louis A. Klein, Clemson College	State veterinarian.
South Dakota	J. P. Foster, Huron	Do.
Tennessee	R. H. Kittrell, Murfreesboro	State live stock commissioner.
Texas	R. J. Kleberg, Corpus Christi	Secretary live stock commission.
Utah	John Austin, Heber City	President State board of sheep commissioners.
Vermont	G. H. Terrill, Morrisville	Secretary cattle commission.
Virginia	J. G. Ferneyhough, Blacksburg	State veterinarian.
Washington	S. B. Nelson, Pullman	Do.
West Virginia	J. B. Garvin, Charleston	Secretary board of agriculture.
Wisconsin	Evan D. Roberts, Janesville	State veterinarian.
	John M. True, Madison	Secretary State sanitary board.
Wyoming	Geo. T. Seabury, Cheyenne	State veterinarian.
	George S. Walker, Cheyenne	Secretary State board of sheep commissioners.

FORESTRY ASSOCIATIONS.

American Forestry Association.—President, Hon. James Wilson, Secretary of Agriculture; vice-presidents, Edward Everett Hale, F. E. Weyerhaeuser, James W. Pinchot, B. E. Fernow, John L. Kaul; secretary, H. M. Suter, Washington, D. C.

International Society of Arboriculture.—President, Gen. William J. Palmer, Colorado Springs, Colo.; vice-president, Henry John Elwes, F. R. S., Colesborne, Cheltenham, England; secretary, J. P. Brown, Connersville, Ind.

Society of American Foresters.—President, Gifford Pinchot, Washington, D. C.; secretary, George B. Sudworth, Washington, D. C.

SCHOOLS OF FORESTRY.

Yale Forest School, Yale University, New Haven, Conn.—A two-year graduate course, leading to the degree of Master of Forestry. The junior year begins in July, the first term being conducted at Milford, Pike County, Pa. Under the direction of the officers of the Yale Forest School a two-month popular course, July and August, also is conducted at Milford, Pa. Prof. Henry S. Graves, Director.

Biltmore Forest School, Biltmore, N. C.—An undergraduate course, covering one year, without vacation. Dr. C. A. Schenck, Director.

University of Michigan Forest School, part of the general Department of Literature, Science, and the Arts, Ann Arbor, Mich.—A two-year graduate course, leading to the degree of Master of Science in Forestry. Filibert Roth, Professor of Forestry.

Harvard University Forest School, Cambridge, Mass.—A four-year undergraduate course, in connection with the Lawrence Scientific School. R. T. Fisher, in charge of curriculum.

Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa.—A four-year course in forestry and horticulture, in which particular attention is paid to farm forestry, leading to the degree of Bachelor of Science. A course is also given adapted to students in the civil engineering department. H. P. Baker, Assistant Professor, in charge of forestry.

University of Maine, Department of Forestry, Orono, Me.—A four-year undergraduate course, leading to the degree of Bachelor of Science in Forestry. Gordon E. Tower, in charge of department.

Michigan Agricultural College, Department of Forestry, Agricultural College, Mich.—A four-year undergraduate course, leading to the degree of Bachelor of Science. E. E. Bogue, Professor of Forestry.

University of Minnesota, Forest School, St. Anthony Park, Minn.—A four-year undergraduate course, leading to the degree of Bachelor of Science in Forestry. Prof. Samuel B. Green, in charge of school.

University of Nebraska, Forest Department, connected with the Industrial College, Lincoln, Nebr.—A four-year undergraduate course, leading to the degree of Bachelor of Science in Forestry. Frank G. Miller, Professor of Forestry.

NATIONAL BEE KEEPERS' ASSOCIATION.

President, J. U. Harris, Grand Junction, Colo.; secretary, W. Z. Hutchinson, Flint, Mich.; general manager and treasurer, N. E. France, Platteville, Wis.

NATIONAL ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

President, H. Garman, Lexington, Ky.; secretary, H. E. Summers, Ames, Iowa.

ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS.

President, C. G. Hopkins, Agricultural Experiment Station, Urbana, Ill.; secretary, H. W. Wiley, Chemist, Department of Agriculture, Washington, D. C.

NATIONAL HORTICULTURAL AND KINDRED SOCIETIES.

Name of organization.	Secretary.	Post-office.
American Apple Growers' Congress	T. C. Wilson	Hannibal, Mo.
American Association of Nurserymen	George C. Seager	Rochester, N. Y.
American Carnation Society	Albert M. Herr	Lancaster, Pa.
American Cranberry Growers' Association	A. J. Rider	Hammonton, N. J.
American Federation of Horticultural Societies	Chas. E. Bassett	Fennville, Mich.
American Institute Farmers' Club	Wm. A. Eagleson	19-21 West 44th street, New York, N. Y.
American Institute, Horticultural Section	Leonard Barron	Do.
American Nurserymen's Protective Association	Thomas B. Meehan	Dreshertown, Pa.
American Pomological Society	John Craig	Ithaca, N. Y.
American Retail Nurserymen's Protective Association.	Guy A. Bryant	Princeton, Ill.
American Rose Society	Wm. J. Stewart	11 Hamilton place, Boston, Mass.
Cider and Cider-Vinegar Makers' Association of the Northwest.	George Miltenberger	213 N. 2d street, St. Louis, Mo.
Chrysanthemum Society of America	David Fraser	Penn and Homewood ave., Pittsburg, Pa.
Eastern Nurserymen's Association	Wm. Pitkin	Rochester, N. Y.
International Apple Shippers' Association	A. Warren Patch	17 N. Market street, Boston, Mass.
Mississippi Valley Apple Growers' Association	James Handly	Quincy, Ill.
Missouri Valley Horticultural Society	A. V. Wilson	R. F. D., Muncie, Kans.
National League of Commission Merchants of the United States.	A. Warren Patch	17 N. Market street, Boston, Mass.
National Nut Growers' Association	J. F. Wilson	Poulan, Ga.
Northwestern Fruit Growers' Association	C. D. Huffman	Lagrande, Oreg.
Nurserymen's Mutual Protection Association	Geo. C. Seager	Rochester, N. Y.
Peninsula Horticultural Society	Wesley Webb	Dover, Del.
Society of American Florists and Ornamental Horticulturists.	Wm. J. Stewart	11 Hamilton place, Boston, Mass.
Southwestern Nurserymen's Association	J. A. Taylor	Wynnewood, Ind. T.
Western Association of Nurserymen	E. J. Holman	Leavenworth, Kans.

ORGANIZATIONS FOR PROTECTION OF BIRDS AND GAME.

Name of organization.	Secretary.	Post-office.
American Ornithologists' Union, Committee on Protection of North American Birds.	A. K. Fisher, chairman.	Department of Agriculture, Washington, D. C.
Bird Protective Society of America	Edward C. Pease	28 Stafford Building, Buffalo, N. Y.
Boone and Crockett Club	Madison Grant	11 Wall street, New York, N. Y.
League of American Sportsmen	Arthur F. Rice	155 Pennington avenue, Passaic, N. J.
National Association of Audubon Societies	William Dutcher, president.	141 Broadway, New York, N. Y.
National Association of Game and Fish Wardens.	George L. Carter	Lincoln, Nebr.
National Game, Bird, and Fish Protective Association.	do	Do.
New York Zoological Society	Madison Grant	11 Wall street, New York, N. Y.
North American Fish and Game Protective Association.	E. T. D. Chambers	Quebec, Canada.

FARMERS' NATIONAL CONGRESS.

President, John M. Stahl, Chicago, Ill.; first vice-president, B. Cameron, Stagville, N. C.; second vice-president, Joshua Strange, Marion, Ind.; treasurer, A. H. Judy, Greenville, Ohio; secretary, George M. Whittaker, Boston, Mass.; first assistant secretary, A. C. Fuller, Dows, Iowa; second assistant secretary, Luther H. Tucker, Albany, N. Y.; third assistant secretary, John H. Kimball, Port Deposit, Md.; executive committee, W. L. Ames, Oregon, Wis.; E. W. Wickey, East Chicago, Ind.; Levi Morrison, Greenville, Pa.

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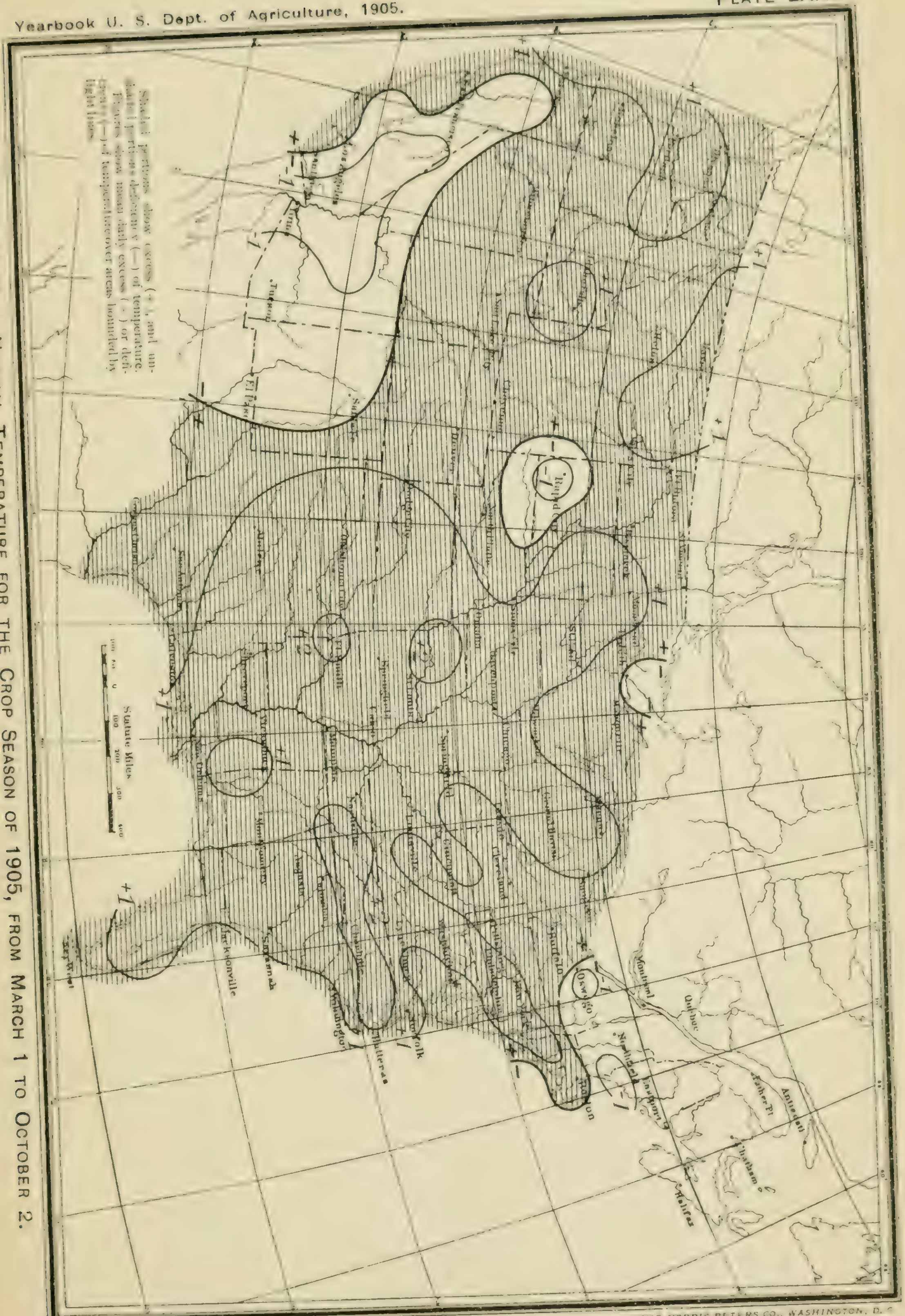
REVIEW OF WEATHER AND CROP CONDITIONS, SEASON OF 1905.

By James Berry, *Chief, Climate and Crop Division, Weather Bureau.*

The accompanying illustrations (see figs. 126–128 and Plates LXXI–LXXIII and tables, pp. 600 to 602,) show how the temperature and rainfall over the United States during the crop season of 1905, from week to week, compare with normal conditions of corresponding periods of former years. The diagrams exhibit the departure from normal by districts, and the maps show, respectively, the departures from normal temperature, the total precipitation, and the departures from normal precipitation during the crop season.

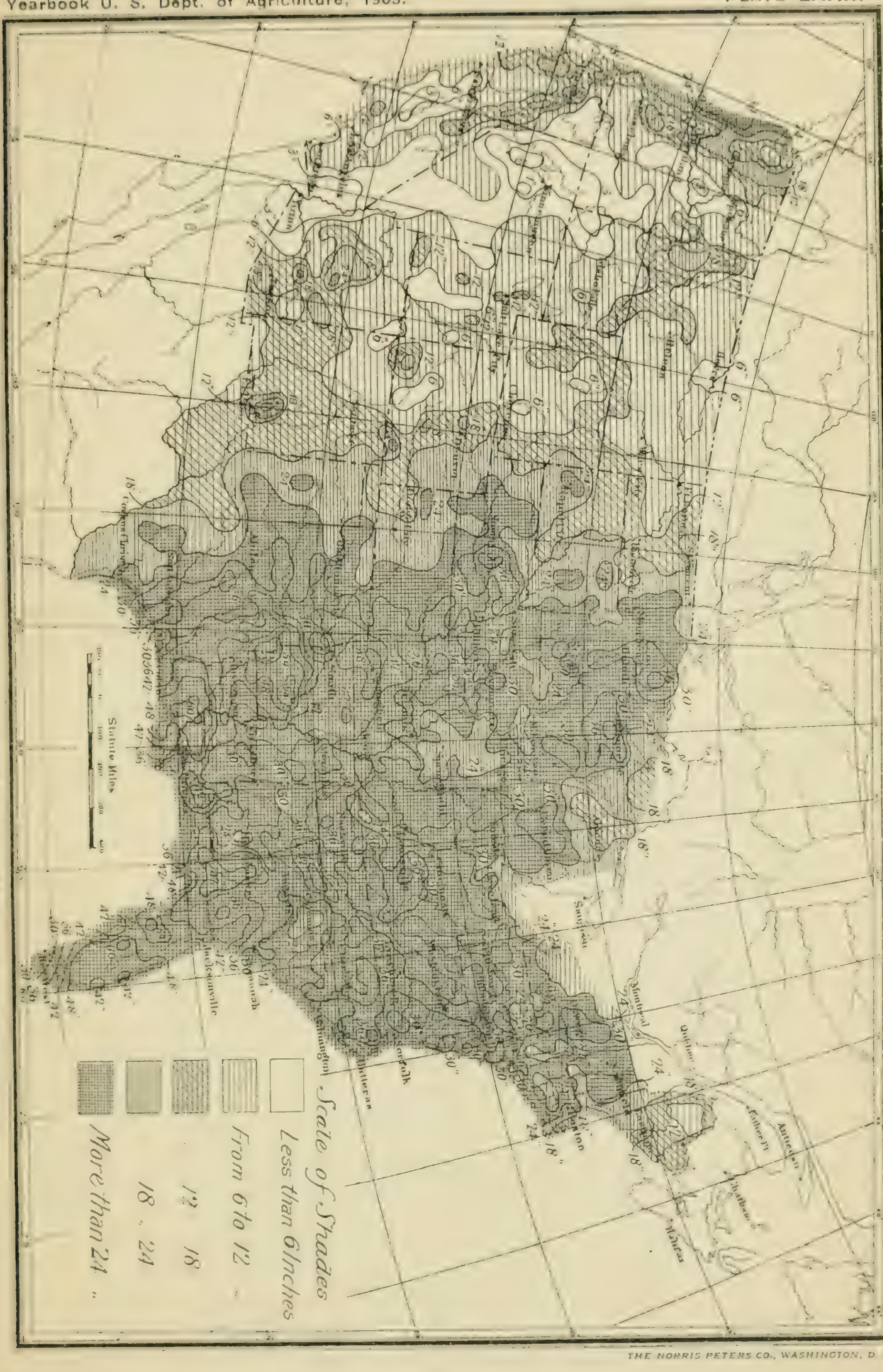
January.

East of the Rocky Mountains the month was colder than the average, with light precipitation in most districts. In the Rocky Mountain region and to the westward the temperature was milder than usual, with more than the average precipitation in the southern plateau region and southern California and much less than the average precipitation as a whole. The most marked feature of the month was the cold wave of the 25th to 28th, which carried freezing temperatures into extreme southern Florida. Portions of the central and west Gulf districts suffered from excessive rains, which, with the severe cold periods throughout the Southern States during the second and third decades, made the month unfavorable for the agricultural interests in that section.



DEPARTURES FROM NORMAL TEMPERATURE FOR THE CROP SEASON OF 1905, FROM MARCH 1 TO OCTOBER 2.

THE NORRIS PETERS CO., WASHINGTON, D. C.



THE NORRIS PETERS CO., WASHINGTON, D

TOTAL PRECIPITATION FOR THE CROP SEASON OF 1905, FROM MARCH 1 TO OCTOBER 2.

DEPARTURES FROM NORMAL PRECIPITATION FOR THE CROP SEASON OF 1905, FROM MARCH 1 TO OCTOBER 2.

THE NORRIS PETERS CO., WASHINGTON, D. C.

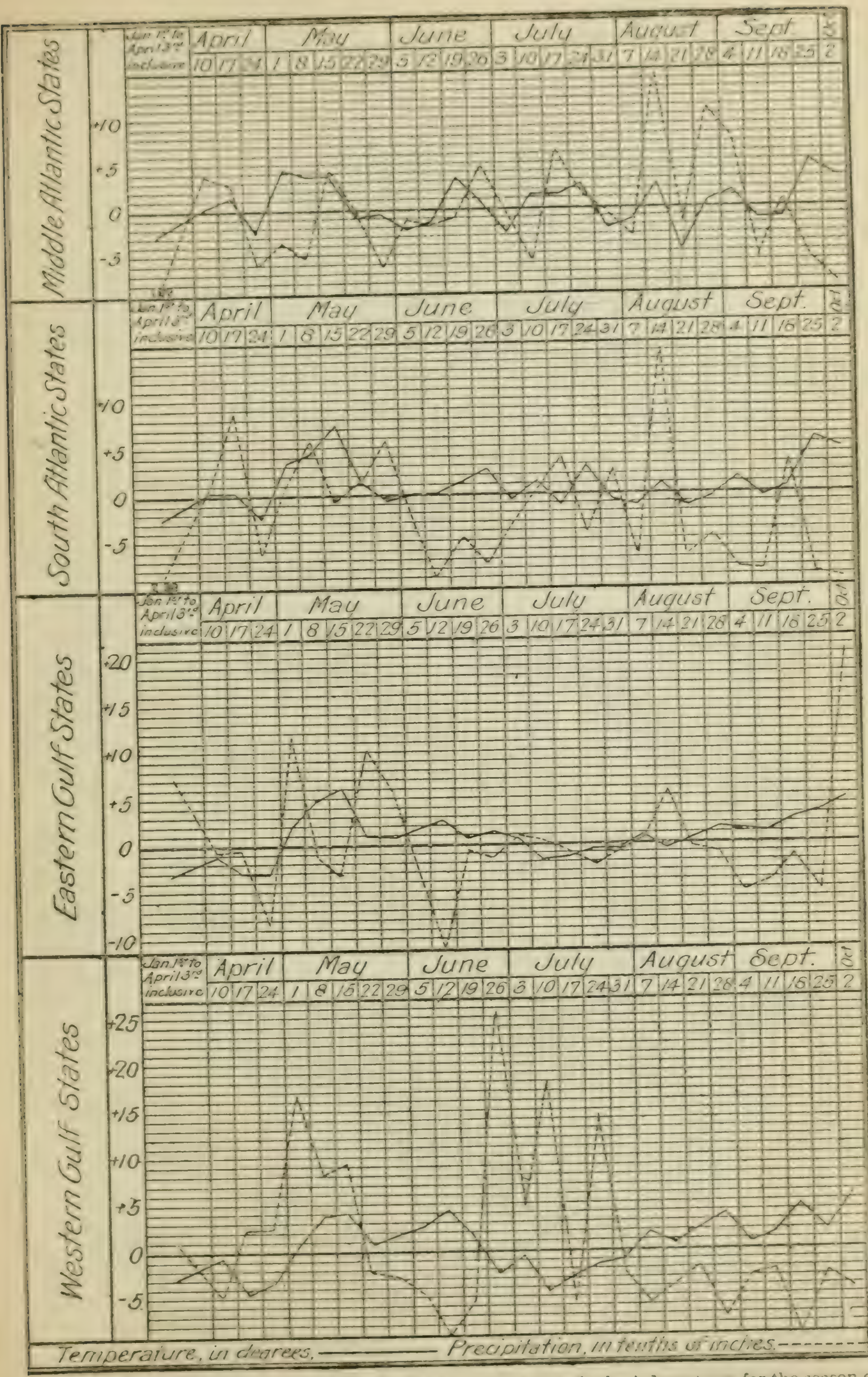


FIG. 126.—Temperature (degrees Fahrenheit) and precipitation (inches) departures for the season of 1905 from the normal of many years for the Middle and South Atlantic States, and Gulf States.

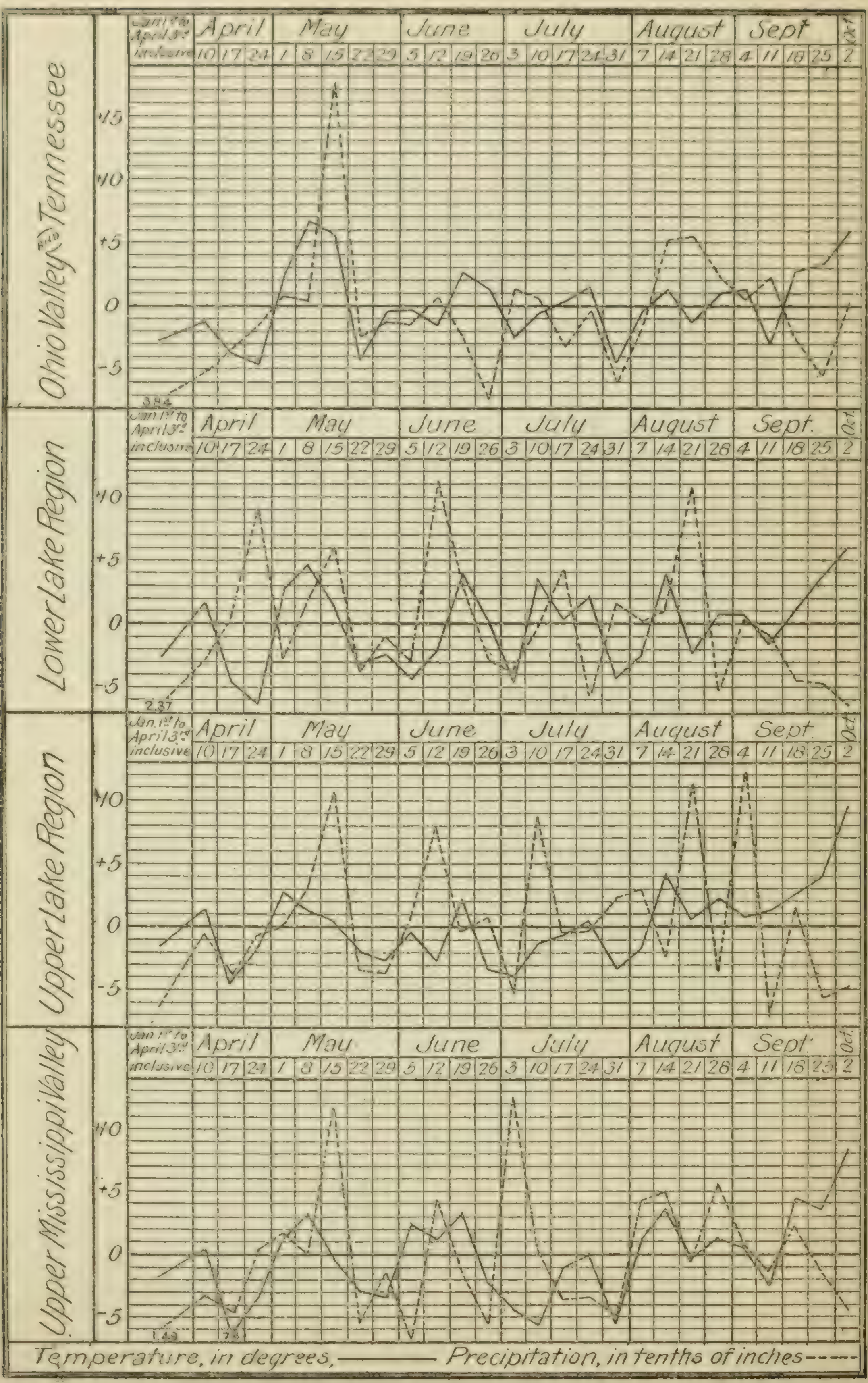


FIG. 127.—Temperature (degrees Fahrenheit) and precipitation (inches) departures for the season of 1905 from the normal of many years for the Lake Region, the Upper Mississippi Valley, the Ohio Valley, and Tennessee.

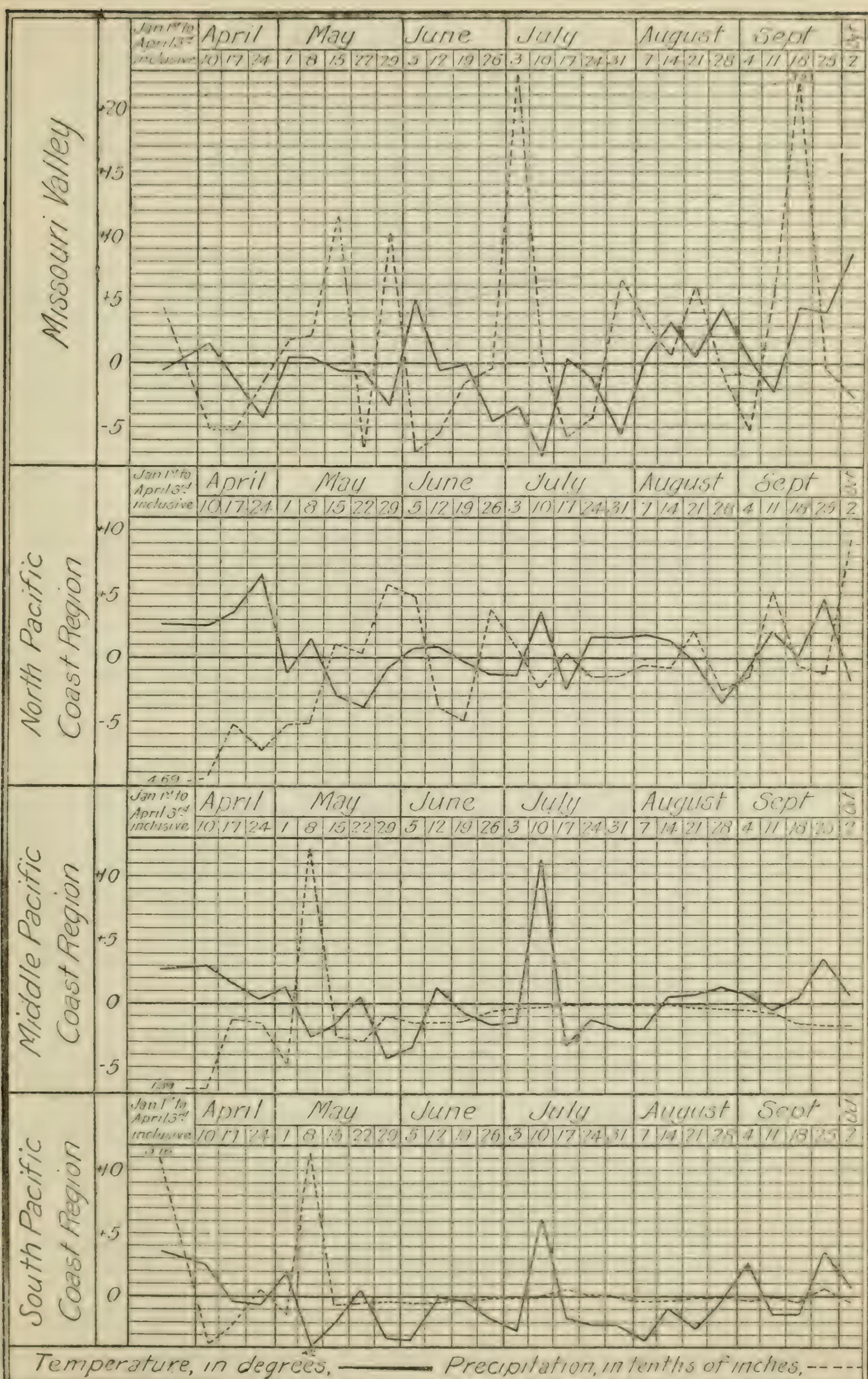


FIG. 128.—Temperature (degrees Fahrenheit) and precipitation (inches) departures for the season of 1905 from the normal of many years for the Missouri Valley and the Pacific coast.

SNOW AND WINTER WHEAT.

The reports indicated that winter wheat was generally well protected westward of the Mississippi River, and also in portions of the Ohio Valley and Middle Atlantic States, but over much of the last-named district there was insufficient snow protection during the severest weather, and in portions of Illinois and Indiana it was feared that the crop had suffered injury, large areas having been covered with ice. On the north Pacific coast the outlook was favorable, except for late sown in Washington. In California the prospect was excellent, except along the Sacramento River, where some damage had been caused by heavy rains.

FEBRUARY.

East of the Rocky Mountains February averaged very cold, with much more than the average precipitation in the South Atlantic and Gulf districts, and decidedly less than the average over the greater part of the central valleys, Middle Atlantic States, New England, and lake region. During the greater part of the month there was ample snow covering over much of the winter-wheat belt, but much snow disappeared after the 20th, leaving the southern and western portions without protection. In California the month was abnormally warm, with plentiful rains in the southern districts. Unusually heavy precipitation occurred in New Mexico, Arizona, and portions of Colorado and Utah.

In Iowa, Nebraska, and Kansas winter wheat was in good condition. In Illinois, Indiana, and Ohio the crop had been generally well protected by snow and was still covered, while ample protection had been the rule in the Middle Atlantic coast districts. The condition of winter wheat on the Pacific coast was favorable except in Washington, where it experienced severe freezing weather.

FRUIT BUDS INJURED BY COLD WEATHER.

The intensely cold weather in the States of the upper Mississippi and lower Missouri valleys caused injury to fruit buds, principally peaches, but in the Atlantic coast districts fruit buds were believed to have escaped material injury.

MARCH.

Nearly the entire country experienced exceptionally favorable conditions for farming operations during the month of March. The temperatures were mild throughout the month, except in the Lake region, Middle Atlantic States, and New England, where it was cold during the first half but mild and favorable during the second half. Portions of the Gulf States suffered from too much rain, and farm work was considerably delayed in the central and western portions. Throughout the central valleys and generally on the Pacific coast farm work was unusually well advanced, and, while slow progress was made in the Middle Atlantic States and New England during the fore part of the month, operations were active during the latter part.

CONDITION OF WHEAT—SPRING FARM WORK.

Practically all reports indicated that winter wheat had come through the winter in unusually fine condition. The outlook on the Pacific coast was promising, except in portions of southeastern Washington, where considerable was winter-killed.

Good progress was made with sowing of spring wheat and oats, the sowing of oats being nearly completed in Illinois and Missouri; in the States farther south the early sown was coming up with good stands. Spring-wheat seeding was unusually well advanced over the southern portion of the spring-wheat region, and was in progress at the close of the month in the extreme northern portion.

Throughout the central valleys the soil was in fine condition for plowing during most of the month and this work was well advanced. Some corn had been planted as far north as Kansas, Missouri, Tennessee, and North Carolina, while farther south a considerable part of the crop had been planted and some was up.

Reports indicated that peach buds had been extensively killed in the central valleys and central Gulf States, but in the Atlantic coast districts peaches had been but little injured. Reports respecting other fruits were generally encouraging.

Some cotton had been planted in Texas, South Carolina, Georgia, and Florida, but practically none elsewhere, and but little land had been prepared for this crop in the central districts.

THE CROP SEASON, APRIL–SEPTEMBER, SUMMARY BY WEEKS.

By weeks, ending with Monday, from April 10 to October 2, the crop conditions may be summarized as follows:

April 10.—The week was very favorable for farming operations in the central valleys and Rocky Mountain and Pacific coast districts, and was generally favorable in the Atlantic coast and east Gulf States, where, however, the latter part of the week was unseasonably cool, with more or less damaging frosts as far south as northern Georgia and Alabama and the western portions of the Carolinas. Rains of the latter part of the previous week interrupted work in the Dakotas and Minnesota, but very good progress with spring work was made in these States. The season's work was well advanced in the States of the lower Missouri and upper Mississippi valleys, but was much behind the average in the central Gulf States and portions of Texas, owing principally to excessive rains in March.

Preparations for planting corn were active under favorable soil conditions in the central valleys and had begun in the southern portion of the Lake region. A large part of the corn area in the Southern States had been planted and much was up with good stands. Planting was general in Kansas and Missouri and had begun in Kentucky and southern Illinois.

All reports indicated that the outlook for winter wheat throughout the country was unusually fine. In California the condition of the crop was excellent and the heaviest crop in years promised.

WEATHER FAVORABLE FOR SEEDING AND GERMINATION.

The sowing of spring wheat was well advanced over the southern part of the spring-wheat region, having been nearly completed in Nebraska and portions of southern Minnesota and South Dakota, and finished in Iowa, and in these States the early sown was coming up well. In the northern portion of the spring-wheat region delay in seeding was caused by the rains of April 1 to 3 and subsequent freezes. In Washington seeding was well advanced and the early sown in both Washington and Oregon was coming up nicely.

Oat seeding was largely finished in the States of the lower Missouri Valley and was well advanced in the upper Mississippi and Ohio valleys, seeding having begun in the upper lake region. Excellent germination was generally indicated, and the situation respecting the crop was very promising.

Very little cotton had been planted in Alabama, Mississippi, and Louisiana, but planting was becoming general over the southern portion of the eastern districts and in Texas, where germination had been satisfactory. Preparations for planting were unusually backward in the lowlands of Louisiana and Arkansas.

Frosts of the 7th and 8th lessened peach prospects in the South Atlantic States and in the southern portions of the Middle Atlantic States.

PLANTING, GERMINATION, AND GROWTH RETARDED BY LOW TEMPERATURE.

April 17.—Over nearly the whole of the country the week ending April 17 was abnormally cold and unfavorable for germination and growth. In western North Dakota the temperature fell nearly to zero on the 16th, and on that and the following date exceptionally low temperatures for the season occurred throughout the country east of the Rocky Mountains, with freezing temperatures as far south as the northern portions of Alabama and Georgia and central South Carolina, and light to heavy frosts in the central portion of the east Gulf States and light frost at Jacksonville. Heavy rains were unfavorable in the South Atlantic and central Gulf States, while the need of rain was beginning to be felt in portions of the lower Missouri Valley and on the extreme north Pacific coast. The temperature conditions on the Pacific coast were favorable.

While corn planting continued in Kansas, Missouri, and southern Illinois, none had been planted farther north nor in the upper Ohio Valley and Middle Atlantic States. Preparations for planting were active in the central valleys, where planting was awaiting favorable temperature conditions. In the South Atlantic and east Gulf States planting was nearly finished and early corn was being cultivated.

Winter wheat continued in promising condition, but was beginning to need rain in portions of Kansas and Michigan.

Very slow progress was made with spring-wheat seeding over the northern portion of the spring-wheat region, as the work could be prosecuted only in the afternoons, on account of low temperature. The early sown spring wheat appeared to

have sustained no injury from recent cold, except in Nebraska, where some fields were slightly damaged.

Oat seeding was delayed in the Dakotas, Minnesota, Lake region, and portions of the Middle Atlantic States. While growth of the early sown was checked and some injury sustained in Nebraska, the general situation respecting this crop continued promising.

Cotton planting was much delayed in Mississippi and Louisiana, and was later than usual in Texas and the Carolinas. Better progress was made in Alabama and Georgia, and in the southern portions of these States planting was nearing completion. Fair to good stands of the early planted were reported from Alabama, Georgia, and Florida. In Texas the early planted was reported as promising.

Tobacco plants were generally plentiful, and transplanting had begun in South Carolina and Florida.

FRUIT PROSPECTS FURTHER IMPAIRED.

Fruit necessarily sustained injury from the severe cold during the latter part of the week in the central and southern districts, but the damage was less serious in the more northerly sections to the eastward of the Mississippi River.

FAIR PROGRESS IN PLANTING.

April 24.—Generally east of the Rocky Mountains the week was unfavorable for germination and growth. Rains interrupted work in Texas, Arkansas, northern Mississippi, Oklahoma, Colorado, and northern Indiana, while drought was becoming serious in central and eastern Missouri. Dry weather over the southern portions of the central Gulf districts afforded needed opportunity for farming operations. Very favorable conditions prevailed on the north Pacific coast, but in California cool cloudy weather retarded growth.

Rather slow progress with corn planting was made during the week, except in Missouri and Kansas, where work advanced satisfactorily. Preparations for planting were actively carried on in Nebraska, Iowa, and Illinois, but no planting had been done, except in southern Illinois; farther east none had been planted north of the Ohio River, except a little in Ohio. Much corn was killed in the South Atlantic and east Gulf States by the frost of the 17th.

Growth of winter wheat was not rapid, owing to cool weather, but the crop continued promising.

Spring-wheat seeding advanced well in the northern portion of the spring-wheat region and was practically finished in the central and southern portions. Germination and growth of the early sown were very slow, and some injury resulted from freezing in South Dakota and Nebraska. In Colorado and Utah and on the north Pacific coast spring wheat was coming up and growing nicely.

Cotton planting was active, under favorable conditions, over most of the cotton belt, but was delayed by rains in Oklahoma and Indian Territories, Arkansas, and northern Texas. The frost of the 17th killed much cotton in portions of Alabama, Georgia, and the Carolinas. Chopping had begun in southern Texas and portions of the eastern districts, and cultivation in southern Georgia.

Fruit prospects were further lessened throughout the Ohio Valley and east Gulf States and on the Atlantic coast south of New England, peaches suffering most. In the States of the upper Missouri Valley and in the Lake region and New England the fruit outlook was more promising.

TEMPERATURES MORE FAVORABLE, BUT GERMINATION AND GROWTH SLOW.

May 1.—While the temperature conditions of the week ended May 1 were much more favorable than in the previous week, complaints of slow germination and growth were very general in the valleys of the Missouri and Red River of the North, middle Rocky Mountain slope, Lake region, and New England. In the Middle and South Atlantic and Gulf States and in the Ohio Valley, very favorable temperatures prevailed, but the central and west Gulf States and portions of the South Atlantic States and the Ohio and central Mississippi valleys suffered from excessive rains, which hindered farming operations materially. New England, North Dakota, Montana, and Florida continued to need rain, but the portions of the lower Missouri and Ohio valleys needing moisture in the previous week received ample rainfall. On the Pacific coast the week was too cool for favorable growth, with frequent frosts in Washington.

In most of the principal corn States corn planting made slow progress, but extensive preparations for this work had been made. Planting was generally finished in

the Southern States and was nearly completed in the southern portions of Kansas and Missouri. In the southern portion of the Middle Atlantic States planting was actively carried on and had begun as far north as Pennsylvania.

Winter wheat continued in unusually promising condition.

Dry weather was unfavorable for the germination and growth of spring wheat in the Dakotas. The early sown in South Dakota, however, and in Minnesota was doing well. The outlook for spring wheat in Iowa, Oregon, and Washington was very promising.

The general outlook for oats continued favorable in the most important oat States. In Kansas and Nebraska the crop was recovering from the effects of previous cold. In the Dakotas and portions of the Lake region germination had not been satisfactory. Seeding was well advanced in the more northerly sections of the central part of the country and had begun in the northern part of the Middle Atlantic States.

Over the eastern portion of the cotton belt the weather conditions were favorable for cotton planting, which was nearing completion in the more southerly districts, good stands being generally indicated. In the central and western districts planting was much delayed, less than half of the area having been planted in Louisiana and in Oklahoma and Indian Territories, only about one-half in northern Mississippi, and very little in Arkansas. In northern, central, and eastern counties of Texas, much of the cotton area remained unplanted; much cotton land in Texas and Louisiana had been badly washed by rains, necessitating extensive replanting. Over the southwestern part of the cotton area in Texas cotton was generally doing well and chopping and cultivation were in progress.

Transplanting tobacco was nearly finished in South Carolina, and had begun in North Carolina. Plants were generally plentiful, but were backward in Ohio and were being damaged somewhat by insects in Kentucky, where preparations for planting were in progress.

LOCALLY EXCESSIVE RAINS—WINTER WHEAT PROMISING.

May 8.—In California, generally throughout the central and southern Rocky Mountain districts, and in the Dakotas and Minnesota, the week ended May 8 was abnormally cool and moist. Freezing temperatures extended southward to the central portions of Arizona and New Mexico, with frost and snow in the central and northern Rocky Mountain regions and the valleys of the upper Missouri and Red River of the North. In the Gulf States, central valleys, most of the Lake region, and the Atlantic coast districts, excepting New England, the temperature was favorable, but excessive rains hindered work over the northern portions of the central and west Gulf States, in the lower Ohio and central Mississippi valleys, in Minnesota and the Dakotas, and in the middle Rocky Mountain region. Drought continued in New England and rain was needed in the Middle Atlantic States, in portions of Kansas, and on the north Pacific coast.

Heavy rains prevented rapid progress with corn planting over a large part of Missouri, Illinois, and Indiana, but elsewhere this work advanced satisfactorily, planting having begun as far north as the southern portions of South Dakota, Minnesota, Wisconsin, and Michigan. In the Southern States the general condition of the crop was reported as promising, but it was suffering for cultivation over a large part of the South Atlantic and east Gulf States and in Texas.

Winter wheat was heading as far north as the southern portions of Kansas and Missouri and in Kentucky. The general condition of this crop continued highly favorable in the States east of the Rocky Mountains, although some reports of injury by rust were received from Texas and from Oklahoma and Indian Territories. On the Pacific coast winter wheat continued promising, although some unfavorable reports respecting lowland wheat were received from Oregon, and recent heavy rains and high winds caused some lodging in California.

The weather was not favorable for the completion of wheat sowing over the northern portions of North Dakota and Minnesota, and early spring wheat over the central portion of the spring-wheat region and in Iowa made only fair progress. In Nebraska and Colorado and on the north Pacific coast the condition of the crop was promising.

Much cotton remained to be planted in Arkansas, northern Mississippi, portions of Louisiana, and northern and central Texas, and planting was unfinished in the Carolinas, northern Georgia, Tennessee, and Oklahoma. In central and northern Texas a large area required replanting, and that which had come up was not in very promising condition and needed cultivation. In southern Texas the crop was in better condition, although damaged by rain. Good stands were reported from the central and eastern districts of the cotton belt, where the crop was making favorable progress, although needing cultivation in Georgia.

The outlook for most fruits, except peaches, was favorable.

A good hay crop was generally promised.

May 15.—In the upper Mississippi and upper Missouri valleys and throughout the Rocky Mountain and north Pacific coast regions the week ended May 15 was too cool for germination and growth, and excessive rains greatly interfered with farming operations in the central and west Gulf States and generally throughout the central valleys and Lake region. In the Atlantic coast and east Gulf districts, with the exception of New England and the northern portion of the Middle Atlantic States, the temperature conditions were favorable, but there was too much rain in the Carolinas and insufficient moisture in portions of the Middle Atlantic States and New England, the fore part of the week being too cool in the two last-named districts. In California the conditions were more favorable than in the preceding week.

CORN PLANTING DELAYED BY HEAVY RAINS.

In consequence of continuous heavy rains, corn planting was impracticable over nearly the whole of the corn belt, this work having now become greatly delayed. Corn planting progressed favorably in the Middle Atlantic States, where it was largely finished.

Reports of damage to winter wheat by rust and insects, while principally confined to the southern portions of the wheat belt, were more numerous than in the previous week, but the crop, as a whole, continued in promising condition.

Over the southern portion of the spring-wheat region spring wheat grew well and was in good condition, but in the Dakotas and Minnesota growth was very slow, much of the early sown in North Dakota having been frozen. On the north Pacific coast spring wheat was in very promising condition.

An improvement in the condition of oats was reported from Iowa, Nebraska, and Kansas, although rain was needed in portions of the last-named State. In the Dakotas and Minnesota growth was slow, and in Texas the crop suffered from rust. Elsewhere the outlook was promising.

GROWTH OF COTTON SATISFACTORY.

In the central and eastern districts of the cotton belt good stands and satisfactory growth of cotton were generally reported. Considerable planting remained to be done in Arkansas and in the northern portions of Louisiana, Mississippi, and Alabama, and planting was unfinished in the Carolinas. Planting was about completed in Georgia, where the stands were excellent and the plants healthy and growing fast. In the Carolinas, Georgia, Alabama, and Arkansas many fields were foul. In central and northern Texas planting was further delayed, and the crop, which was very weedy, had been much damaged by heavy rains and was doing well over limited areas only. In southern Texas the condition of cotton ranged from fair to good, and much had been chopped and cultivated. Boll weevils and other pests were attacking the crop in localities.

The general outlook for hay was promising, except in the upper Missouri Valley, where growth was very slow.

GENERALLY UNFAVORABLE WEATHER—FROSTS IN NORTHERN DISTRICTS.

May 22.—The weather conditions were generally unfavorable, except in portions of the Middle and South Atlantic and Gulf States and the upper Mississippi and Missouri valleys, the southern Rocky Mountain region, and California. Frequent, and in some cases heavy, rains delayed work in eastern districts and on the north Pacific coast, but improved the condition of grains and grasses, while cool nights and cloudy weather retarded germination and growth in nearly all districts. Frosts, more or less damaging, occurred in New England, the northern portion of the Middle Atlantic States, Ohio, the northern Rocky Mountain region, Oregon, and Washington.

Further delay in corn planting was reported from Ohio, Indiana, and Illinois, and much replanting was necessary in the first and last named States, as well as in Iowa and Nebraska. Planting was nearly completed in southern Missouri, and about three-fourths of the area had been planted in Iowa and northern Missouri, was mostly finished in Nebraska and central Illinois, and was being vigorously pushed in Indiana and Kentucky. On dry, warm soils in Iowa germination was fairly good, but corn needed warmth and sunshine to insure satisfactory growth. Cutworms were doing damage in the Ohio Valley and portions of the Middle and South Atlantic States, and the crop was suffering from lack of cultivation in the last-named district and in the States of the lower Mississippi Valley.

Winter wheat generally continued promising, although complaints of rust were received from Kentucky, Tennessee, Missouri, Oklahoma, and Texas, and reports of short straw from portions of the Middle Atlantic States, Illinois, and Missouri. The crop was beginning to head in southern Nebraska. Winter wheat was doing well in California, heading nicely in Oregon, and looking well but making slow progress in Washington, owing to heavy frosts, which cut down some grain in low valleys.

During the latter part of the week spring wheat improved rapidly, and this crop made satisfactory progress, except on lowlands in North Dakota, where it was slightly damaged by flooding. Spring wheat advanced satisfactorily in Oregon, and, though heavy frosts caused some damage in low valleys in Washington, the crop was looking well.

COTTON NEEDING WARMTH AND CULTIVATION.

While good stands of cotton were generally reported from the eastern and central sections of the cotton belt, cool nights checked growth, and the staple was suffering from lack of sunshine and cultivation, complaints of grassy fields being received from nearly every State in these two sections. Planting was finished in South Carolina and Alabama and nearly completed in North Carolina and Mississippi, but about 25 per cent of the area remained to be planted in Louisiana and Arkansas. Chopping was well advanced in the Carolinas, continued in Georgia, Alabama, and Mississippi, and had begun in some places in Arkansas. In northern Texas, though cotton was damaged somewhat by heavy showers and continued poor in places and very weedy, and much planting was unfinished, the prospects were improved; with more favorable conditions for replanting and cultivation, the crop looked better and cultivation and chopping were progressing. Cotton was growing well in southern Texas; chopping and cultivation were general; squares were forming, and some cotton had been laid by. Boll weevils and other insect pests were active in some counties.

All reports indicated a good crop of hay. Haying was in progress in California, with a heavy crop of excellent quality.

LOW TEMPERATURES UNFAVORABLE—CORN PLANTING NEARLY FINISHED.

May 29.—During the week most of the country experienced unfavorable temperatures, frosts occurring in the early part in the Plateau regions, in most of the northern tier of States east of the Rocky Mountains, and as far south as the interior portions of the Middle Atlantic States. Rains interfered with farm work in portions of the South Atlantic and east Gulf States, in Tennessee, over an area extending from central Texas northward to South Dakota, and in portions of the Lake region. At the close of the week rain was much needed in New England and the Middle Atlantic States, and sunshine and warmth in the South Atlantic and east Gulf States and the Missouri Valley. On the Pacific coast the weather was cool and cloudy, with showers in northern California, Oregon, and Washington.

Corn planting was largely finished, except in the Lake region, Ohio Valley, and the northern portion of the Middle Atlantic States. Throughout the principal corn States germination and growth of corn were very slow owing to cool weather. In the central Gulf States part of the crop had been laid by. In this region corn suffered considerably from overflows. In northern Texas, Oklahoma, Arkansas, and Tennessee corn was much in need of cultivation.

Winter wheat suffered slight deterioration in portions of the central and western districts of the winter-wheat belt, but continued promising in the eastern districts, an improvement being reported from Ohio.

Although freezing temperature occurred in the northern portion of the spring-wheat region, spring wheat was reported in good condition in Minnesota; and while frost in North Dakota proved injurious, the crop in that State was not seriously damaged. Over the southern portion of the spring-wheat region the crop made more favorable progress, although growth was slow. On the north Pacific coast spring wheat was much improved in Washington, but in Oregon it advanced slowly.

In the Dakotas, Minnesota, and Nebraska oats made slow growth, and the crop suffered deterioration in Texas and portions of the Middle Atlantic States, but elsewhere and in the principal oat-producing States the outlook continued very promising.

Throughout nearly the whole of the cotton belt cotton was much in need of cultivation, and reports of abandoned fields were received from the Carolinas, Georgia, Alabama, and Louisiana. Good stands were generally reported, but much planting remained to be done in northern Texas, and planting was unfinished in Arkansas. In southern Texas and in portions of the central and eastern districts the situation was improved and the crop was doing well in localities.

The general outlook for a good crop of hay continued promising.

WARMER OVER MOST OF THE COUNTRY, WITH MARKED CROP IMPROVEMENT.

June 5.—The week ended June 5 was the most favorable of the season in the Rocky Mountain region and over the western portions of the central valleys. Generally favorable conditions also prevailed in the Middle Atlantic and Southern States, but in New England low temperatures, with light frosts and lack of rainfall, prevented growth. Portions of the Ohio Valley, upper Lake region, Oklahoma, and southern Texas suffered from excessive moisture.

In the States of the Missouri and central Mississippi valleys corn improved greatly and good progress was made with cultivation. In the upper Ohio Valley much planting remained to be done, and in the Middle Atlantic States cutworms had caused much damage in fields already planted. In the Southern States early corn was being laid by in good condition.

BEGINNING OF WHEAT HARVEST.

Winter wheat advanced favorably, fewer reports of injury from rust being received from the greater part of the area previously affected. In Ohio and Nebraska, however, although in promising condition, damage from rust and insects increased somewhat. Winter-wheat harvest was in progress in the Southern States, and was beginning in Oklahoma and extreme southern Kansas, and wheat was ripening in the lower Ohio and central Mississippi valleys. Harvest had also begun in California, where wheat was maturing rapidly. On the north Pacific coast winter wheat was in promising condition, having experienced decided improvement in Washington.

Under decidedly better temperature conditions spring wheat made good progress and was stooling well. In portions of the Dakotas, however, the crop was thin and weedy in localities. In Washington spring wheat was in fine condition and had made rapid growth; and while the outlook in Oregon was favorable, low temperatures were detrimental.

The general condition of the oat crop was very promising, an improvement being reported from the Middle Atlantic States and the Missouri Valley. Oats were heading as far north as Kansas, Missouri, and central Illinois, and harvesting was in progress in the South Atlantic and east Gulf States.

A general improvement in the condition of cotton was indicated. Except in southern Texas and portions of the east Gulf and South Atlantic States, where heavy rains fell, the weather afforded opportunity for much-needed cultivation, which was actively carried on, although a large part of the crop was still in grass, the supply of labor being insufficient. Cool nights over the northern portion of the central districts checked the advance of cotton, but, as a whole, growth was satisfactory.

In New England and portions of the Middle Atlantic States the grass crop had been materially shortened by drought, but throughout the central valleys and Lake region a good hay crop was promised.

CULTIVATION ADVANCED—PROGRESS OF WHEAT HARVEST.

June 12.—The Lake region and a part of the upper Mississippi Valley suffered from heavy rains, while the Southern States and the southern portion of the central valleys were beginning to experience the effects of drought. As a whole, however, the weather was favorable for the cultivation of crops. There was ample warmth throughout the central and southern portions of the country, but insufficient heat in the extreme northern districts, especially in New England, Minnesota, and the Dakotas. Throughout the Rocky Mountain and Pacific coast districts the week was generally favorable.

In the Lake region and upper Ohio Valley the condition of corn was not promising, owing largely to unfavorable effects of low temperature and excessive moisture, but in the States of the lower Ohio, upper Mississippi, and Missouri valleys the crop made good progress and, as a rule, showed decided improvement.

Winter-wheat harvest had begun as far north as the central portions of Kansas and Missouri and southern Illinois, and was in full progress in the more southerly sections, where the yields were generally disappointing. In the more northerly portions of the principal winter-wheat States the crop had generally done well, although complaints of rust and insects continued in some sections, and heavy rains in Michigan and Wisconsin caused lodging. On the Pacific coast the outlook continued promising, exceptionally so in Washington.

COTTON GRASSY—BOLL WEEVILS IN TEXAS.

The weather conditions throughout nearly the whole of the cotton belt were favorable for the cultivation of cotton, although a considerable part of the crop continued grassy. A general, though not decided, improvement in the condition of cotton in

the central and western districts was indicated, but in the Carolinas and Tennessee cotton made slow progress, and in the first-mentioned States the plants were small and of unhealthy color. In portions of the central and eastern districts of the cotton belt light rains were desired. In the northern and central counties of Texas prospects were improved, though still poor in localities; in southern Texas the crop was in good condition and an improvement in localities was reported. Boll weevils were active over an increased area.

In the Lake region and New England the apple outlook was more or less promising, but in the central valleys was not favorable, except in some sections.

TEMPERATURES GENERALLY FAVORABLE—RAINFALL UNEVENLY DISTRIBUTED.

June 19.—With the exception of the upper Missouri Valley, where low temperatures prevailed, all districts east of the Rocky Mountains received ample heat during the week. The rainfall was very unevenly distributed, being ample in most northern districts, but insufficient in portions of the central valleys and of the Middle Atlantic and Southern States, although good rains fell in some parts of these districts. The week was favorable for the cultivation of crops, and this previously hindered work was in a very satisfactory state. Abnormally low temperatures prevailed over most of the Plateau districts, with frosts in some places. On the Pacific coast the weather conditions were favorable.

CORN GOOD—COTTON IMPROVED.

Except in eastern Missouri and central and southern Illinois, corn made good progress throughout the corn belt. Cultivation was brought up to date, except in portions of Michigan, Wisconsin, and South Dakota.

Winter wheat progressed under favorable conditions, and harvesting was well advanced in Kansas, Missouri, and southern Illinois, and had begun in Indiana and Maryland.

In portions of Wisconsin and Minnesota dry weather was needed for spring wheat, but this crop generally made very satisfactory progress throughout the spring-wheat region, and was beginning to head in the southern portion. Very favorable reports respecting spring wheat also continued from the North Pacific coast.

The oat crop suffered to some extent from excessive moisture in Wisconsin and Minnesota, rust in southern Iowa, rank growth in northern Illinois, and drought in southern Illinois, but in these States and generally elsewhere the condition of the crop was promising. Oat harvest was in progress as far north as Missouri.

Further improvement in the condition of cotton was very generally indicated throughout the cotton belt. The crop was in a good state of cultivation, although some fields continued foul in portions of the central and western districts and in Florida. While, as a rule, good growth was reported, the plant continued small. Lice were still prevalent in North Carolina, but were less numerous in South Carolina, Georgia, and Alabama. Considerable damage by webworms was reported from Oklahoma and Indian Territories, where some fields were being devoted to other crops. Boll weevils were spreading in northeastern Texas, but generally the damage was not great.

EXCESSIVE RAINFALL IN LOCALITIES, INTERRUPTING CULTIVATION AND WHEAT HARVEST.

June 26.—The region from the upper Lakes westward to the north Pacific coast received insufficient heat, lack of sunshine being especially unfavorable in Washington and Oregon, but elsewhere the temperature conditions were favorable. Excessively heavy rains occurred in the central and west Gulf districts and in portions of the central Missouri and Ohio valleys, lower Lake region, and New England, while portions of the South Atlantic States and central and eastern Missouri continued to suffer from drought. Sunshine was generally needed in the central Gulf States, Tennessee, Ohio Valley, and lower Lake region.

Except in the valleys of the upper Missouri and Red River of the North, where, as a result of low temperatures, the growth of corn was slow, this crop made good progress, although suffering somewhat from lack of cultivation in portions of the Ohio Valley and Middle Atlantic States and in central and western Nebraska. In Iowa corn made vigorous growth and was well cultivated, with better stands than previous reports indicated, and the outlook in Illinois, Missouri, and Kansas was very favorable.

Heavy rains interrupted the harvesting of winter wheat in the Ohio Valley, Tennessee, and portions of the Middle Atlantic States, but elsewhere this work progressed favorably, and was nearing completion in Missouri and southern Kansas. Some grain in shock was damaged by rains in Kentucky and Tennessee.

Spring wheat on lowlands in the Dakotas and Minnesota was suffering somewhat from rust, but as a whole this crop made vigorous growth and continued in promising condition throughout the spring-wheat region and also on the north Pacific coast.

While heavy rains hindered the cultivation of cotton over a large part of the central Gulf districts and in central and northern Texas, where many fields were foul, the crop as a whole experienced general improvement throughout the cotton belt. The plants were generally undersized, especially in the central and eastern districts, but good growth was nearly everywhere reported. Complaints of lice continued from South Carolina and Georgia. In Texas less damage from webworms and boll weevils was indicated; in western Louisiana, however, some fields were abandoned on account of weevils, and in Oklahoma and Indian Territories webworms continued damaging. Some picking had been done in extreme southern Texas.

The weather was unfavorable for haying in the Middle Atlantic States and Ohio Valley and on the north Pacific coast, where considerable hay was spoiled. In portions of the central Mississippi Valley meadows deteriorated, but in the Lake region, the Dakotas, Nebraska, and Kansas a good hay crop was promised.

EXCELLENT GROWTH OF CORN—COTTON GENERALLY FRUITING WELL.

July 3.—The northern districts of the country experienced temperatures too low for rapid growth, but in the Southern States the temperatures were highly favorable. Excessively heavy rains from the central and west Gulf districts northward over the western portion of the central valleys, while relieving drought in Missouri, were injurious in places and interfered extensively with cultivation. The conditions on the Atlantic and Pacific coasts were generally favorable. Rain was much needed in the southern Plateau region.

Corn made excellent growth over the greater part of the corn belt and, except in the upper Missouri and lower Ohio valleys, where rains retarded cultivation, the crop was clean and well advanced. Considerable was laid by in Illinois, Missouri, and Kansas. Late corn in the Southern States was suffering from lack of cultivation.

Winter-wheat harvest was well advanced in the northern portion of the winter-wheat belt and was practically finished in Illinois, Missouri, and eastern Kansas. Rain caused injury to grain in shock in Texas, Tennessee, and Kentucky.

Spring wheat advanced rapidly throughout the spring-wheat region and continued in promising condition. Some rust, however, was reported from the southern portion, and on lowlands in Minnesota there was a tendency to lodge. The crop also continued in fine condition on the north Pacific coast, except in the Willamette Valley, where aphides were unusually numerous.

A fine crop of oats was indicated generally in the principal oat-producing States. Harvesting was in progress in the lower Missouri and central Mississippi valleys.

While cotton generally improved and made good growth throughout the cotton belt, the crop was much in need of sunshine and cultivation in the central and western districts, in portions of which too rank growth was reported. Except in the central districts, cotton was generally fruiting well. Boll weevils and other pests were active in Texas and Louisiana.

Tobacco suffered from drought in central North Carolina and from lack of cultivation in Kentucky; elsewhere this crop was doing well.

Reports generally indicated an apple crop much below average in all sections.

Considerable hay was damaged by rains in Iowa, Nebraska, and Tennessee. In the upper Ohio Valley and northern portion of the Middle Atlantic States and New England an average crop of hay was being secured under favorable conditions.

LOCAL DAMAGE BY HEAVY RAINS—SOME RUST IN SPRING WHEAT.

July 10.—In the districts east of the Rocky Mountains temperature conditions were generally favorable, though rather cool in the Missouri Valley. Over much the greater part of the country from the South Atlantic and Gulf coasts northward to the Lake region, Minnesota, and the Dakotas excessive rainfall greatly hindered the cultivation of crops, caused rapid growth of weeds, and in places injured hay and harvested grain. There was practically no rain in New England, only light showers on the immediate Middle Atlantic coast, and none in the Rocky Mountain and Pacific coast regions. In central and northern California and portions of Oregon and Washington intense heat prevailed during the latter part of the week.

The corn crop experienced a week of very favorable conditions for growth, except in the upper Missouri Valley, where its progress was rather slow on account of insufficient heat and lack of sunshine. While rains interfered with cultivation to some

extent, the crop as a whole was in a fairly good state of cultivation and was largely laid by, except in the more northerly districts.

Winter-wheat harvest continued in the more northerly districts and was largely finished elsewhere. Rainy weather extensively interfered with thrashing and caused damage to grain in shock in portions of the Middle Atlantic States and central valleys. The abnormal heat on the north Pacific coast during the latter part of the week caused but slight damage to the wheat crop in Washington.

In portions of South Dakota and Minnesota spring wheat on low lands suffered from overflows, but elsewhere in the spring-wheat region the crop was in promising condition. Rust continued in South Dakota and Minnesota, though not materially increasing, and was beginning to appear in North Dakota. Spring wheat continued promising on the north Pacific coast, though exposed to trying heat conditions during the latter part of the week.

Both standing and harvested oats suffered considerably from wet weather.

In the Carolinas, Georgia, and Florida, over the greater part of Alabama, and in southern Mississippi cotton generally did well. Good growth was reported from the central and western districts, but much of the crop suffered deterioration, largely from lack of cultivation due to continuous heavy rains. In Tennessee, northern Mississippi, and Louisiana, fields were abandoned to grass. Too rank growth was more or less reported in all districts, except the Carolinas and Florida.

In New England and portions of the Middle Atlantic States much hay was secured in good condition, but in the central valleys haying progressed under disadvantages, and considerable hay was damaged.

CORN OUTLOOK VERY PROMISING—LIGHT FRUITING AND TOO RAPID GROWTH IN COTTON.

July 17.—Favorable temperatures prevailed during the week ending July 17 throughout the country. The intense heat on the Pacific coast during the latter part of the previous week was followed by decidedly lower temperature. Heavy rains interfered with work in the Ohio Valley and over a large part of the South Atlantic and east Gulf States, but a very general absence of rain in the west Gulf districts, with only light showers over much of the Missouri and upper Mississippi valleys, afforded favorable opportunity for much-needed cultivation.

Corn made splendid progress throughout nearly the whole of the corn belt, and improved decidedly in the States of the Missouri Valley, where its previous progress had been retarded by cool weather. While the general outlook for this crop was very promising, it sustained some injury on low land in Missouri and in portions of the South Atlantic and east Gulf States, and was not in a good state of cultivation in portions of the Ohio Valley.

Further reports of injury to harvested winter wheat were received from the central Mississippi and Ohio valleys, the Middle Atlantic States, Texas, and Oklahoma and Indian Territories. Harvesting, where not finished in the more northerly districts, was well advanced.

Spring wheat experienced a week of favorable weather and continued in promising condition.

In the central Mississippi and Ohio valleys and in portions of the Middle Atlantic States, oat harvest was interrupted, and considerable damage to harvested and standing oats resulted from wet weather. Harvesting was largely finished, except in the more northerly districts.

While too rapid growth of cotton and light fruiting were very generally reported throughout the cotton belt, an improvement was indicated in many districts. The crop continued to suffer from lack of cultivation, especially in the central and western portions of the belt, where, however, the weather of the week was favorable for cleaning the fields, a work that was pushed vigorously.

Much hay was damaged in the central Mississippi and Ohio valleys and Middle Atlantic States, but in New England and the Missouri and upper Mississippi valleys haying progressed under favorable conditions.

Nearly all reports indicated an inferior apple crop.

WEATHER FAVORABLE FOR GROWTH—SOME HARVESTED CROPS DAMAGED BY SHOWERS.

July 24.—Although excessively hot and dry in portions of the Middle Atlantic States and Kentucky and Tennessee during the forepart of the week, with similar conditions also prevailing in the northern plateau region and on the north Pacific coast, as a rule temperatures were favorable. Showers delayed work and caused some damage to crops in Virginia, West Virginia, portions of the lower Ohio and

central and lower Mississippi valleys, Oklahoma, and Texas, while rain was needed in New England, Tennessee, Georgia, Alabama, Kansas, and generally throughout the plateau districts.

Favorable weather caused rapid growth of corn and, with very few exceptions, the crop was in excellent condition.

Winter wheat harvest was nearly completed in the principal winter-wheat States, and thrashing was well advanced. Rains caused further damage to grain in shock or stack in Virginia, Kentucky, Missouri, Oklahoma, and Texas.

In the principal oat-producing States harvesting of this crop was well advanced, while in the more northerly districts oats were heading and the early sown were maturing rapidly. The crop generally was in promising condition, though badly lodged in Ohio, and some complaints of lodging were received from Wisconsin.

Although improvement was indicated in parts of nearly all of the cotton States, it was neither general nor marked. While the staple grew rapidly, and was generally fruiting well in portions of Georgia, Alabama, Texas, and Missouri, complaints of unsatisfactory fruiting were received from the Carolinas, Mississippi, Alabama, Tennessee, and Oklahoma, and of rust or shedding from all sections. Insects were causing considerable damage to cotton in localities in Texas, but generally no great injury was reported. The crop was opening in the southern portion of the belt, and picking was under way in southern Texas.

Tobacco made rapid growth and was generally in satisfactory condition. The crop was weedy and some was drowned out in Kentucky, damaged locally by rains in Virginia, and was poor on light soil in Maryland. Topping was in progress in New England and Ohio, and curing was becoming general, with good results, in North Carolina.

Haying was delayed by rains in Virginia and portions of the Ohio Valley, and considerable damage to hay was reported from Oklahoma, Missouri, and southern Illinois. Elsewhere a good crop was being secured under favorable conditions.

CONDITION OF COTTON—GOOD HAY YIELDS GENERALLY SECURED.

July 31.—During the week the Ohio Valley and northern portions of the Middle Atlantic States and New England experienced temperatures too low for best results, but elsewhere the temperature conditions were favorable. Rains interfered with farm work in the Missouri Valley, northeastern Texas, and portions of the lower Ohio Valley and east Gulf coast districts, while rain was needed in Georgia, portions of Florida, northern Mississippi, northern Illinois, Ohio, and northern New Jersey.

In the Ohio Valley the growth of corn was somewhat checked by cool weather, but elsewhere in the principal corn States this crop made excellent progress. Throughout the Atlantic coast districts a fine crop was indicated. In Tennessee, Arkansas, Indian territory, and northern Texas the condition of corn was not so promising.

Winter-wheat harvest was finished, except a small part of the crop in Michigan and New York.

Spring wheat made favorable progress, no rust damage having been reported except from scattered fields in South Dakota, where smut and blight were also prevalent to some extent. Late spring wheat was materially damaged in Washington by hot winds of the preceding week, but the early crop escaped injury. Harvest was general in Oregon, with about the average yield and quality.

Some improvement in the condition of cotton over most of Texas was indicated, and, while too rank growth and unsatisfactory fruiting were reported from Oklahoma, Arkansas, Louisiana, and Mississippi, a general, but slight, improvement was also shown in these States. In Alabama the crop generally deteriorated; in Georgia it was fruiting rapidly where sufficient rains had occurred, but in other localities of that State rain was badly needed, and shedding, rust, and black root were prevalent. Too rank growth and shedding were also reported from Tennessee, the Carolinas, and Florida, in which States no improvement was indicated except on clay lands in South Carolina, while on sandy lands in that State the crop deteriorated.

Haying was retarded in portions of Iowa, North Dakota, and Virginia, but reports generally indicated that a good crop of hay had been secured.

SLIGHT INJURY TO SPRING WHEAT BY RUST—CORN GOOD—COTTON IRREGULAR.

August 7.—Texas and Oklahoma experienced very warm weather, while it was too cool over the northern portion of the Lake region and on the California coast; otherwise temperature conditions during the week were generally favorable. Too much rain proved detrimental in portions of Nebraska, Kansas, and Missouri, and also in Florida and portions of Mississippi, but in northern Alabama, Georgia, and the

Carolinas, and over a considerable part of the Middle Atlantic States, Ohio Valley, and Tennessee rain was much needed, the effects of drought having become serious over the greater part of Georgia. Rain was also needed on the north Pacific coast.

Over the central and western portions of the corn belt and the greater part of the Middle Atlantic States corn continued in excellent condition, and, while needing rain in the Ohio Valley, the condition of the crop in that district was generally promising.

While rust in spring wheat was more or less prevalent in the Dakotas, and to a slight extent in Nebraska, Iowa, and Minnesota, the reports generally indicated that the crop had not sustained serious injury. Harvest was nearly finished in Iowa and was in progress in Nebraska and the southern portions of South Dakota and Minnesota, but had not begun in North Dakota, where the crop was generally in excellent condition, with long heads, which were filling well. In Oregon harvesting was active; in Washington spring wheat was ripening rapidly and was beyond further injury from hot winds.

Harvesting of oats was finished, except in extreme northerly districts, where it was well advanced.

Cotton showed some improvement in Tennessee, western North Carolina, northern Alabama, Mississippi, Arkansas, Oklahoma and Indian Territories, northeastern Texas, and portions of Louisiana, but elsewhere over the cotton belt the crop had deteriorated. The prevalence of rust was very generally reported from the eastern districts, and also from portions of the central and western districts. Boll weevils and bollworms were doing considerable damage in Texas and western Louisiana, but in the first-named State they were less numerous. Picking was general in southern Texas and in some central counties of that State, and had commenced over the southern portion of the eastern districts.

SPRING WHEAT HARVEST WELL ADVANCED—HEAVY RAINS IN CENTRAL AND EASTERN COTTON BELT.

August 14.—Very favorable temperatures prevailed in all districts east of the Rocky Mountains, the week averaging slightly cooler than usual in the Gulf States and warmer than usual throughout the central and northern portions of the country. The drought prevailing in the previous week in the Middle and South Atlantic and east Gulf States was relieved by abundant rains, which proved damaging in portions of the Carolinas and Florida. Needed rains also occurred in portions of the upper Mississippi and lower Missouri valleys, but parts of Nebraska, Iowa, Arkansas, and Texas were in need of moisture. Farm work was interrupted by heavy rains in the central Gulf district and in the lower Ohio Valley. Rain was badly needed on the north Pacific coast.

The reports continued to indicate an excellent outlook for corn throughout the central valleys, Lake region, and Middle Atlantic States. Rain afforded relief in the Ohio Valley; portions of Illinois, Missouri, and Nebraska were in need of rain until the close of the week, when good rains occurred where needed in the two first-mentioned States. Early corn was practically made in the southern portions of Kansas and Missouri.

Spring wheat did well, only slight injury from rust being reported. Under high temperatures the crop ripened rapidly, some of the early sown having been harvested in North Dakota. Cutting was well advanced in central Minnesota and northern South Dakota, and was practically finished in the southern portions of these States, and in Iowa and Nebraska. In Oregon spring wheat was badly shriveled in the Willamette Valley, where the yields were disappointing.

Only a small part of the oat crop in the extreme northern districts remained unharvested.

As in the previous week, the least favorable reports respecting cotton were received from the eastern districts, where the prevalence of rust and shedding continued. During the week a large part of the central and eastern portions of the cotton belt received from 2 to 6 inches of rain, which proved injurious. In northern Alabama and in portions of Mississippi, Louisiana, and Texas cotton improved, but in other portions of these States the crop deteriorated. In Oklahoma and Indian Territories, Arkansas, and Missouri cotton generally improved.

The apple outlook continued unchanged, a poor crop being indicated in nearly all the principal apple-producing States.

The soil was in excellent condition for fall plowing throughout the central valleys, Lake region, and Atlantic coast districts, and this work made good progress.

CORN DAMAGED BY HIGH WINDS—EXTENSIVE RUST AND SHEDDING IN COTTON.

August 21.—During the week central and western Texas experienced unusual heat, while unseasonably cool weather prevailed in New England and the northern portion of the Middle Atlantic States; elsewhere the temperature was favorable. The rainfall was excessive and injurious in the Dakotas and Minnesota, and also in parts of the Lake region, South Atlantic and central Gulf States, and in Florida. Rain was badly needed over the greater part of Texas, in portions of Kansas, generally throughout the central and southern Rocky Mountain districts, and in Oregon. Frosts, causing slight damage, occurred on the 16th in Montana and Idaho.

The previously reported excellent condition of corn continued generally throughout the principal corn-producing States, and also in the Atlantic coast and eastern Gulf districts. Windstorms blew down considerable corn in Nebraska, Missouri, Arkansas, and Ohio. In some counties in Kansas and generally throughout Texas the crop was in need of rain.

The harvesting, stacking, and thrashing of spring wheat on low lands in the northern part of the spring wheat region, where grain was fully ripe, were interrupted during the forepart of the week, the fields being too wet for the reapers. Local storms in North Dakota and northeastern South Dakota caused the lodging of considerable grain. Complaints of shrunken grain were general from Washington and western Oregon.

While cotton improved in portions of the central and western districts, the crop as a whole suffered deterioration, which was most marked in the eastern districts. Rust and shedding were extensive throughout the belt, and dry, hot weather proved injurious over much of Texas, where premature opening was reported, but boll weevils in that State, as a rule, were diminishing. The crop improved in Arkansas, some northeastern counties in Texas, in portions of Louisiana, northern Alabama, and in a few places in South Carolina.

Wet weather proved injurious to tobacco in Ohio and Indiana, but most reports respecting this crop were favorable, an improvement in Kentucky, the Middle Atlantic States, and New England being indicated.

Much complaint of blight and rot in potatoes was received from the Lake region and the northern part of the Middle Atlantic States, but the reports from the Missouri and central Mississippi valleys were more favorable.

WEATHER FAVORABLE FOR CORN, CUTTING BEGUN—INCREASE OF SHEDDING AND RUST IN COTTON.

August 28.—During the week the temperatures were highly favorable in the central valleys and in the Gulf and Atlantic coast districts, with the exception of the northern portion of the Middle Atlantic States and New England, where it was rather cool. Wet weather interfered with farm work and injured crops in portions of Virginia, the Carolinas, Alabama, Kentucky, Tennessee, Wisconsin, Iowa, and the Dakotas. Rain was much needed over the southeastern Rocky Mountain slope, the greater part of Texas, and on the north Pacific coast.

The principal corn States of the central valleys experienced a week of exceptionally favorable weather conditions for the development and maturity of corn. There was everywhere ample moisture to insure satisfactory development of the crop, except in Texas and portions of Kansas, but in the last-named State only the late planted was suffering for rain. Cutting was in progress in Oklahoma and Indian Territories, southern Missouri, and over a large part of Kansas. The reports indicated that the bulk of the early corn would be safe from injury from frost by September 15, and most of the late corn by October 1. Some damage from local storms was reported from portions of Illinois and South Dakota.

Spring-wheat harvest was finished, except in the northern portions of Minnesota and South Dakota and in North Dakota where, although well advanced, it was delayed by rains.

In some northeastern counties of Texas, in Arkansas, and in portions of Mississippi, Alabama, and Georgia improvement in the condition of cotton was indicated, and in Oklahoma and Indian Territories and Missouri the crop was in fair to good condition; elsewhere cotton did not make favorable progress. Complaints of shedding were received from every State, of rust from the eastern districts, of premature opening from Texas, Arkansas, and North Carolina, and of rotting of bolls from South Carolina, Georgia, Alabama, and Mississippi. The bolls were opening rapidly generally throughout the belt and picking was in progress in all but the northerly districts.

Tobacco suffered from wet weather in portions of Kentucky, and in Virginia and Maryland, but in the first-mentioned State generally made good progress. A good

crop was promised in Pennsylvania, New York, and New England. Cutting was general.

More favorable reports respecting apples were received from Maryland and Virginia, but elsewhere the outlook for this crop continued very poor.

Plowing for fall seeding was active nearly everywhere, except in Texas, where the soil was too dry. This work was much further advanced than usual and some seeding was done.

COTTON OPENING RAPIDLY—MUCH TOBACCO HOUSED.

September 4.—Temperatures favorable for the maturing of crops prevailed in all districts east of the Rocky Mountains during the week, except in the northern portions of the upper Missouri and upper Mississippi valleys and in northern New England, where it was somewhat too cool. Scattered light frosts, causing slight damage, occurred in the central and northern Rocky Mountain districts and in the upper Missouri Valley during the latter part of the week. The greater part of Texas, portions of Kansas and Missouri, and the north Pacific coast continued to need rain.

Under favorable temperatures corn advanced rapidly and the condition of the crop continued excellent generally throughout the corn belt.

Considerable over-ripe spring wheat remained uncut on flooded lowlands in northern Minnesota and eastern North Dakota and moisture injured grain in shock in portions of South Dakota and Iowa. On the north Pacific coast high winds caused injury to standing grain in Washington, but otherwise the weather was favorable for harvesting and thrashing.

While there was a slight improvement in the condition of cotton in northeast Texas and in portions of the central cotton States, the reports, as a whole, indicated deterioration in the average condition of the crop as compared with the previous week. Rust and shedding continued quite general, but injury from boll weevils in Texas was somewhat diminished. Cotton opened rapidly throughout the belt, and the weather was favorable for picking, which was generally active, having been completed in portions of Alabama and Georgia.

Much tobacco in the Ohio Valley and Middle Atlantic States was housed and the remainder was maturing rapidly. A good crop was generally reported, especially in the northern part of the Middle Atlantic States and in New England.

In Texas and portions of Kansas and Nebraska the soil was too dry for plowing, but elsewhere this work made excellent progress.

PROGRESS IN CORN CUTTING AND COTTON PICKING—BLIGHT AND DECAY IN POTATOES.

September 11.—In the lower Missouri, central Mississippi, and Ohio valleys the week was cool and wet, and farm work was more or less interrupted in these districts, more particularly in the western portions. The temperature conditions in the Atlantic coast and Gulf districts and on the Pacific coast were generally favorable.

Notwithstanding the excessive moisture and cool weather over the greater part of the corn belt, corn generally made good progress toward maturity, having advanced rapidly in the northern and western portions. Much of the crop was safe, and cutting was general over the southern portion of the belt.

The harvesting of spring wheat was practically finished in North Dakota and Minnesota. Large areas, however, on flooded lowlands in the last-named State were abandoned. In North Dakota the little thrashing done indicated disappointing yields, considerable being smutty. In South Dakota the yield of spring wheat was good, but the quality was variable. Thrashing was completed in Oregon and harvesting was progressing under favorable conditions in Washington, except in the northwestern counties, where it was interrupted by showers.

In the Carolinas the cotton situation was not materially changed as compared with that of the previous week. In South Carolina a slight improvement was indicated in localities and deterioration in others, the plant having stopped growing on sandy lands, but continuing green and fruiting on clay soils. Slight improvement was reported from Alabama and portions of Louisiana and Texas, but in Florida, Georgia, Tennessee, Missouri, Arkansas, Oklahoma, and Indian Territories, and the greater part of Texas there was more or less deterioration, with slight improvement over scattered local areas. Boll weevils and other pests were increasing in portions of Texas. Generally the weather conditions throughout the belt were highly favorable for picking, which work was actively carried on.

The general outlook for potatoes continued unpromising, blight and decay being extensively reported, except in New England and portions of the Missouri Valley,

where the prospects were more favorable. In New England a good crop was indicated and in Iowa the early potatoes were good, but the late were damaged by blight.

Plowing and seeding made excellent progress throughout the central valleys, Lake region, and Middle Atlantic coast districts.

CORN DAMAGED BY RAINS AND HIGH WINDS IN LOWER MISSOURI VALLEY.

September 18.—Except in New England and the northern part of the Middle Atlantic States, where the week averaged considerably cooler than usual, the temperature was above the normal and generally favorable, the week being decidedly warm over the greater part of the central valleys, Gulf States, and eastern Rocky Mountain slope. Light to heavy frosts occurred in the Rocky Mountain regions and also in North Dakota, the Lake region, New England, and the northern portion of the Middle Atlantic States, but they resulted in no serious injury. A marked feature of the week was the excessive precipitation, accompanied in places by high winds, in the lower Missouri Valley, where much damage was done, especially in central and western Missouri and eastern Kansas. Wet weather also proved detrimental over a large part of the Middle Atlantic States and in portions of the South Atlantic and east Gulf districts, while drought continued over portions of Texas. Generally favorable weather prevailed in the central Gulf States, Tennessee, and most of the Ohio Valley and Middle Atlantic States. Favorable weather also prevailed in California, and showers relieved drought conditions to a greater or less extent in Washington and Oregon.

While corn experienced favorable conditions over a large part of the corn belt, late corn in the upper Ohio and Missouri valleys was maturing slowly and the crop in the lower Missouri Valley suffered seriously from excessive rains and high winds, especially in Missouri and Kansas. In the first-mentioned State a large part of the crop was blown down or badly lodged, much was under water, and that in shock was beginning to mold. Over the northern part of the corn belt from two-thirds to three-fourths of the crop was safe from frost.

While a slight improvement in the condition of cotton was reported from Oklahoma and Indian Territories and portions of Louisiana and northern Texas, the crop as a whole over most of the belt experienced little or no change, with a tendency toward deterioration. Premature opening was extensively reported in the eastern and western districts, but only a few complaints of this character were received from the central portion. Boll weevils were increasing in Texas and were causing injury in western Louisiana. A poor top crop was promised. Picking was advancing rapidly and was nearing completion in most fields in southern Georgia.

Except in Kentucky, where about one-third of the crop remained to be secured, tobacco was nearly all cut and housed. Moist atmosphere was not favorable for curing in Kentucky and New England, but in Virginia, North Carolina, and Tennessee the crop was curing nicely.

Blight and rot in potatoes continued to be extensively reported in the principal potato-producing States, although fair yields were indicated in some sections.

Plowing for fall seeding was interrupted by rains in the lower Missouri and Ohio valleys, and was prevented by drought in portions of the Southern States; elsewhere this work was well advanced.

CONDITION OF COTTON GENERALLY UNSATISFACTORY, BUT PICKING ACTIVE.

September 25.—The temperature during the week was favorable throughout the country, being nearly everywhere above the normal. Rains caused some damage in portions of the Missouri and upper Mississippi valleys, while a considerable part of the South Atlantic and Gulf States was in need of rain. Damaging frosts occurred in the middle Rocky Mountain regions and light frosts, with little or no injury, in portions of the lower Lake region and interior of the Middle Atlantic States.

Except in limited portions of the Missouri Valley, corn experienced a week of conditions highly favorable for maturing the crop, from 75 to 90 per cent being safe from frost. In Nebraska considerable corn was blown down by high winds, making harvesting more difficult, but not reducing the yield. Some corn in shock in Missouri and Kansas was damaged by moisture, due largely to rains of the previous week.

The thrashing of spring wheat in the Dakotas and Minnesota was interrupted by rains during the first half of the week, but shock thrashing and stacking were nearly finished.

The reports indicated but little change in the condition of cotton in South Carolina, Georgia, Alabama, and Oklahoma and Indian Territories, a slight improvement in North Carolina, Missouri, Arkansas, and northeastern Texas, and more or less

deterioration in other portions of the cotton belt, although there was decidedly less complaint of rust and shedding in the central and in portions of the eastern districts. Picking in Texas was interrupted to some extent by rain, but this work was active under generally favorable conditions in all districts, except in the north-central portion of the belt, where it was not yet general. Picking was nearing completion in portions of Georgia, Louisiana, and extreme southern Texas.

Some injury to housed tobacco by moist weather was reported from portions of the Middle Atlantic States and New England, but elsewhere the reports respecting this crop were favorable.

FAVORABLE WEATHER—FINE CORN YIELD ASSURED—LIGHT APPLE CROP.

October 2.—The weather conditions of the week, as a whole, were exceptionally favorable to agricultural interests. Under the influence of warm and generally dry weather throughout the central valleys, Lake region, and Atlantic coast districts, late crops matured rapidly. Florida and portions of the central Gulf districts suffered injury from excessive rains, while much-needed rains fell in the Rocky Mountain and North Pacific coast regions. The Middle and South Atlantic States and southern Texas were in need of rain. Frosts occurred in the middle Rocky Mountain districts and in the upper Ohio Valley, lower Lake region, and northern portion of the Middle Atlantic States, but caused no serious injury.

Highly favorable weather prevailed throughout the principal corn States. An exceptionally large and fine yield of corn was assured over much the greater part of the corn belt, and only a very small part of the crop in the north-central portion, estimated at from 2 to 5 per cent of the total, remained exposed to injury from frost, and this was maturing rapidly. The crop in Missouri was extensively blown down or lodged, but, notwithstanding this and the damage by September floods, a heavy yield was assured in that State.

As a whole, the reports indicated no decided change in the condition of cotton, as compared with the previous week, a slight improvement being shown in northern Alabama and in portions of Texas, while in other sections of the latter State there was a slight deterioration. The crop suffered from the ravages of insects in Louisiana, Arkansas, and Texas, boll weevils being numerous in the last-named State. Rains caused slight damage in Georgia, Alabama, southwestern Mississippi, and Louisiana, and seriously injured the crop in Florida. With the exception of heavy rains in Louisiana, southern Mississippi, and Florida, and showers in portions of Alabama and Georgia, the weather conditions were favorable for picking.

A light apple crop was reported nearly everywhere. Only in a few unimportant apple-producing States were satisfactory yields indicated.

Owing to the extensive prevalence of blight and rot in the principal potato-producing States, a light crop of potatoes of inferior quality was generally promised.

The fall season thus far had been exceptionally favorable for plowing and seeding in the central valleys, Lake region, and Middle Atlantic States. In portions of the Southern States and on the North Pacific coast dry soil conditions were not favorable for this work.

OCTOBER.

The month of October was somewhat milder than usual in the districts east of the Mississippi River, and much colder than usual from the Missouri Valley northwestward to the Pacific coast. The lower Ohio, central Mississippi, and lower Missouri valleys and portions of the central and west Gulf States suffered from heavy rains, while droughty conditions prevailed on the South Atlantic and west Gulf coasts, in central and western Kansas, the middle and southern plateau region, and California.

Over the south-central and southwestern portions of the corn belt wet weather proved unfavorable for cutting and husking corn, and caused considerable mold and decay. Good progress was made, however, with gathering corn in other portions of the corn belt, the crop having fully matured before the occurrence of injurious frost. Favorable weather for gathering and husking corn prevailed throughout the Atlantic coast districts.

Heavy rains in portions of the Ohio, central Mississippi, and lower Missouri valleys hindered plowing and fall seeding to a considerable extent, but, as a whole, this work was prosecuted under favorable conditions and at the close of the month was largely completed, and good stands of fall-sown wheat were generally indicated throughout the central valleys, Lake region, and Middle Atlantic States.

At the close of the month cotton picking was from one-half to two-thirds completed in Oklahoma and Indian Territories, Arkansas, and northwestern Mississippi, and a much larger proportion of the crop had been gathered in other sections, picking being practically completed in the more southerly districts.

November.

While the Atlantic coast districts experienced droughty conditions, and heavy rains proved detrimental in the west Gulf States, the weather conditions during November, 1905, generally were favorable for farming operations in nearly all districts, being exceptionally so in the central valleys. The long-continued drought in California was relieved by generous rains near the close of the month, when a heavy fall of snow occurred throughout the northern Rocky Mountain region and thence eastward to the upper lakes.

The reports indicated that in the principal winter-wheat States wheat was entering the winter in excellent condition. In the Middle Atlantic States, however, the germination of late-sown wheat was not wholly satisfactory, but that sown early was in promising condition. The Hessian fly was reported from scattered localities in Missouri and Pennsylvania, and also in Michigan, being confined principally to the early sown in the last-mentioned State. On the North Pacific coast the conditions had been favorable for seeding, but germination was not satisfactory.

Except in a small part of western Mississippi and scattered localities in Alabama, practically all of the cotton crop in the districts east of the Mississippi had been gathered by the close of the month, the same being true of Louisiana, but in Missouri, Arkansas, Texas, and Oklahoma and Indian Territories a small part of the crop was still in the fields.

Average daily temperature departures (degrees Fahrenheit) for season of 1905 from normal based upon observations for many years, by sections.

Section.	From Jan. 1 to Apr. 3, inclusive.	For weeks ended—							
		April—			May—				
		10.	17.	24.	1.	8.	15.	22.	29.
New England	−2.5	+1.8	+ 1.0	−3.2	+1.8	+1.4	+0.5	−4.2	+1.0
Middle Atlantic States	−2.8	+0.2	+ 1.1	−2.4	+4.2	+3.8	+3.9	−0.8	−0.5
South Atlantic States	−2.6	+0.2	+ 0.1	−2.4	+3.3	+4.4	+7.3	+1.1	−0.6
Florida Peninsula	−1.2	−1.3	− 1.0	−2.3	+2.7	+4.0	+4.0	+2.3	+1.3
Eastern Gulf States	−3.2	−1.1	− 3.0	−3.1	+2.0	+4.9	+6.0	+1.0	+0.9
Western Gulf States	−2.9	−0.6	− 4.7	−3.1	+0.7	+3.9	+4.0	+0.9	+1.7
Ohio Valley and Tennessee	−2.8	−1.1	− 3.8	−4.6	+2.6	+6.8	+5.8	−4.2	−0.4
Lower Lake region	−2.6	+1.8	− 4.6	−6.1	+2.9	+4.8	+1.4	−3.1	−2.4
Upper Lake region	−1.5	+1.3	− 4.5	−1.8	+2.8	+1.2	+0.4	−1.9	−2.6
North Dakota	+4.0	+3.3	− 1.4	−3.0	+1.3	−7.3	+7.3	+2.3	−5.0
Upper Mississippi Valley	−1.9	+0.3	− 7.4	−3.5	+1.2	+3.2	−0.3	−3.0	−3.2
Missouri Valley	−0.5	+1.5	− 1.1	−4.2	+0.5	+0.3	−0.6	−0.6	−3.3
Northern slope	+1.5	+2.7	−10.3	−1.3	+2.3	−3.9	−5.6	−0.3	−4.9
Middle slope	−1.6	+1.5	− 9.3	−5.0	−0.7	−1.2	+0.8	−0.5	−1.0
Southern slope	−2.8	+1.0	− 9.5	−6.5	+0.5	+1.0	+2.0	−0.5	−2.0
Southern plateau	+1.2	+1.5	− 4.0	−3.0	−0.8	−7.5	−7.3	+1.7	−5.0
Middle plateau	+2.3	+4.4	− 2.4	0.0	+4.6	−5.6	−9.2	+1.6	−3.4
Northern plateau	+4.1	+3.8	+ 2.0	+2.4	−1.0	−1.0	−6.4	−4.2	−3.8
North Pacific coast region	+2.7	+2.6	+ 3.4	+6.3	−1.1	+1.4	−3.0	−4.0	−0.9
Middle Pacific coast region	+2.9	+3.0	+ 1.8	+0.2	+1.2	−2.8	−1.8	+0.5	−4.2
South Pacific coast region	+3.6	+2.5	− 0.2	−0.8	+2.0	−4.2	−2.0	+0.5	−3.2

Section.	For weeks ended—								
	June—				July—				
	5.	12.	19.	26.	3.	10.	17.	24.	31.
New England	−2.9	−3.9	+2.8	−3.1	−3.8	+ 1.9	+3.9	+1.5	−2.8
Middle Atlantic States	−2.2	−1.6	+3.2	+0.5	−2.8	+ 1.5	+1.3	+2.6	−2.2
South Atlantic States	0.0	0.0	+1.2	+2.5	−0.6	+ 1.1	−1.2	+2.9	−0.8
Florida Peninsula	+1.7	−0.3	+0.3	+0.3	+1.3	+ 1.0	−1.7	+0.3	+0.3
Eastern Gulf States	+1.5	+2.5	+0.8	+1.1	+0.6	− 1.8	−1.4	−0.5	−0.5
Western Gulf States	+2.4	+4.1	+1.7	−2.4	−0.6	− 4.3	−2.9	−1.4	−1.0
Ohio Valley and Tennessee	−0.2	−1.6	+2.7	+1.3	−2.5	− 0.6	+0.2	+1.6	−4.4
Lower Lake region	−4.1	−2.0	+3.9	0.0	−4.4	+ 3.5	+0.2	+2.1	−4.1
Upper Lake region	−0.2	−2.8	+2.1	−3.2	−3.9	− 1.2	−0.8	+0.4	−3.2
North Dakota	+8.0	−3.7	−6.7	−8.7	−3.3	− 4.7	+2.7	−3.3	−5.7
Upper Mississippi Valley	+2.6	+1.1	+3.3	−2.3	−4.3	− 5.8	−1.0	0.0	−5.6
Missouri Valley	+5.0	−0.5	0.0	−4.7	−3.3	− 7.2	+0.1	−1.2	−5.5
Northern slope	+6.1	−0.4	−5.3	−8.4	−3.1	− 4.0	+2.7	−0.7	−2.3
Middle slope	+4.3	+3.0	+2.2	−2.7	+0.2	− 7.3	−0.3	−0.8	−2.3
Southern slope	+1.0	+2.0	+1.5	−2.5	+1.0	− 6.0	−2.5	−3.5	0.0
Southern plateau	−1.4	−0.8	−1.5	−1.2	−1.3	+ 2.0	−2.4	−4.0	−2.3
Middle plateau	−0.2	−0.6	−0.4	0.0	−3.6	+ 1.0	0.0	+1.6	+1.6
Northern plateau	−0.2	+2.6	−1.8	−1.4	−4.4	+ 4.4	−2.2	+5.4	+3.6
North Pacific coast region	+0.6	+0.9	−0.3	−1.3	−1.4	+ 3.7	−2.4	+1.7	+1.6
Middle Pacific coast region	−3.5	+1.2	−0.8	−1.7	−1.5	+11.2	−3.2	−1.2	−2.0
South Pacific coast region	−3.5	0.0	−0.2	−1.8	−2.8	+ 6.2	−1.8	−2.2	−2.2

Average daily temperature departures (degrees Fahrenheit) for season of 1905 from normal based upon observations for many years, by sections—Continued.

Section.	For weeks ended—								
	August—				September—				October—
	7.	14.	21.	28.	4.	11.	18.	25.	2.
New England	−2.0	+3.8	−6.8	−0.4	−0.9	+0.2	−3.2	+3.0	− 1.8
Middle Atlantic States	−1.3	+2.4	−4.8	+0.3	+1.7	−1.2	−1.1	+4.9	+ 3.2
South Atlantic States	−1.2	+1.0	−1.4	−0.2	+1.4	−0.2	+0.4	+5.6	+ 4.5
Florida Peninsula	−0.3	+0.7	0.0	+0.3	+1.0	+1.3	+0.7	+2.0	+ 0.7
Eastern Gulf States	+0.9	−0.6	+0.5	+1.4	+1.2	+1.0	+2.5	+3.1	+ 4.6
Western Gulf States	+1.9	+0.7	+2.0	+3.6	+0.7	+1.4	+4.3	+1.9	+ 5.6
Ohio Valley and Tennessee	−0.2	+1.3	−1.1	+1.0	+1.2	−3.0	+2.8	+3.2	+ 6.0
Lower Lake region	−2.4	+3.8	−2.1	+0.9	+0.8	−1.4	+1.1	+3.8	+ 6.0
Upper Lake region	−1.7	+4.1	+0.7	+2.2	+0.9	+1.2	+2.7	+4.0	+ 9.6
North Dakota	+0.3	+4.0	−0.7	+6.0	−2.3	+5.0	+2.0	+5.7	+10.7
Upper Mississippi Valley	+1.2	+3.6	−0.2	+1.2	+0.5	−2.4	+4.2	+3.6	+ 8.2
Missouri Valley	+0.5	+3.3	+0.4	+4.4	+0.2	−2.1	+4.3	+4.0	+ 8.8
Northern slope	−0.3	+2.1	+0.7	+6.7	+0.4	+3.3	+2.3	+7.9	+ 3.1
Middle slope	−0.7	−1.0	+2.0	+8.0	+2.8	−1.5	+6.3	+2.7	+ 5.5
Southern slope	0.0	0.0	+7.5	+9.5	+4.0	+1.0	+6.5	0.0	+ 4.5
Southern plateau	−0.8	−0.7	+1.5	+2.7	+4.0	−1.3	+2.7	+2.7	− 2.0
Middle plateau	−0.8	+0.6	+0.2	+3.2	+4.4	+0.6	+0.8	+2.8	− 2.4
Northern plateau	+4.0	+4.5	−3.5	+4.2	0.0	+5.6	−0.2	+8.4	− 3.2
North Pacific coast region	+1.9	+1.3	−0.1	−3.6	−0.9	+2.0	0.0	+4.7	− 1.9
Middle Pacific coast region	−2.0	+0.5	+0.8	+1.2	+0.8	−0.5	+0.2	+3.5	+ 0.8
South Pacific coast region	−3.5	−1.0	−2.8	−0.5	+2.8	−1.5	−1.5	+3.5	+ 0.8

Precipitation departures (inches and hundredths) for the season of 1905 from normal based upon observations for many years, by sections.

Section.	From Jan. 1 to Apr. 3, inclusive.	For weeks ended—							
		April—			May—				
		10.	17.	24.	1.	8.	15.	22.	29.
New England	−3.19	+0.16	−0.32	−0.35	−0.62	−0.47	−0.03	−0.06	−0.66
Middle Atlantic States	−1.82	+0.37	+0.29	−0.60	−0.38	−0.52	+0.40	−0.08	−0.62
South Atlantic States	−2.38	+0.09	+0.88	−0.63	+0.10	+0.56	−0.05	+0.14	+0.58
Florida Peninsula	−1.56	−0.11	+0.29	+1.23	−0.50	−0.37	−0.74	−0.65	+0.19
Eastern Gulf States	+0.73	−0.09	−0.04	−0.84	+1.15	−0.11	−0.32	+1.02	+0.59
Western Gulf States	+0.09	−0.49	+0.23	+0.22	+1.67	+0.83	+0.92	−0.23	−0.29
Ohio Valley and Tennessee	−3.84	−0.52	−0.33	−0.17	+0.09	+0.03	+1.76	−0.23	−0.11
Lower Lake region	−2.37	−0.29	+0.02	+0.90	−0.27	+0.20	+0.60	−0.37	−0.10
Upper Lake region	−0.63	−0.07	−0.39	−0.08	0.00	+0.30	+1.05	−0.35	−0.37
North Dakota	−0.63	−0.40	−0.45	−0.49	−0.42	+0.19	+1.33	+0.25	−0.26
Upper Mississippi Valley	−1.49	−0.33	−0.47	+0.02	+0.17	0.00	+1.17	−0.55	−0.14
Missouri Valley	+0.44	−0.51	−0.51	−0.14	+0.19	+0.21	+1.15	−0.64	+1.01
Northern slope	+0.17	−0.15	+0.03	+0.50	−0.14	+0.68	+0.41	−0.28	+0.25
Middle slope	+2.20	−0.22	−0.16	+0.82	−0.26	−0.03	−0.26	+0.20	+0.76
Southern slope	+3.16	−0.12	−0.30	+1.37	+0.12	+0.12	−0.43	+0.54	+2.81
Southern plateau	+4.56	+0.01	+0.62	+0.40	−0.11	+0.17	−0.09	−0.09	−0.08
Middle plateau	−0.02	−0.15	+0.24	−0.02	−0.06	+0.51	+0.16	−0.18	−0.02
Northern plateau	−2.20	−0.16	−0.05	+0.05	−0.08	+0.19	+0.18	−0.11	−0.01
North Pacific coast region	−4.69	−0.92	−0.51	−0.73	−0.53	−0.51	+0.10	+0.02	+0.57
Middle Pacific coast region	−1.39	−0.68	−0.12	−0.16	−0.49	+1.20	−0.25	−0.30	−0.10
South Pacific coast region	+3.16	−0.39	−0.23	+0.05	−0.16	+1.13	−0.08	−0.06	−0.04

Precipitation departures (inches and hundredths) for the season of 1905 from normal based upon observations for many years, by sections—Continued.

Section.	For weeks ended—								
	June—				July—				
	5.	12.	19.	26.	3.	10.	17.	24.	31.
New England	−0.43	+0.49	+0.67	+0.41	+0.46	−0.79	−0.38	−0.49	+0.44
Middle Atlantic States	−0.11	−0.18	−0.10	+0.48	−0.08	−0.57	+0.61	+0.14	−0.08
South Atlantic States	−0.29	−0.90	−0.48	0.75	−0.34	+0.03	+0.39	−0.41	+0.26
Florida Peninsula	+0.14	−1.29	−1.29	+0.67	0.25	−0.28	+2.01	−1.08	−0.13
Eastern Gulf States	−0.25	−1.13	0.08	0.15	+0.09	+0.03	−0.06	−0.22	−0.08
Western Gulf States	−0.48	−0.94	−0.53	+2.54	+0.49	+1.79	−0.56	+1.42	−0.24
Ohio Valley and Tennessee	−0.14	+0.07	−0.22	−0.72	+0.13	+0.06	−0.31	−0.01	−0.59
Lower Lake region	−0.29	+1.11	+0.29	−0.28	0.39	−0.01	+0.41	−0.57	+0.16
Upper Lake region	+0.04	+0.79	−0.02	+0.08	−0.51	+0.88	−0.03	−0.01	+0.23
North Dakota	+0.84	−0.14	+0.40	+0.09	+0.05	+0.06	+0.11	−0.35	+0.45
Upper Mississippi Valley	−0.69	+0.41	−0.15	−0.56	+1.25	+0.04	−0.37	−0.34	−0.50
Missouri Valley	−0.70	−0.56	0.15	0.04	+2.27	+0.08	−0.58	−0.42	+0.65
Northern slope	−0.27	0.09	+0.27	+0.13	+0.71	−0.11	−0.18	+0.18	+0.72
Middle slope	−0.10	0.19	−0.10	+0.15	+0.80	+0.10	−0.50	−0.11	+1.10
Southern slope	−0.76	−0.10	+0.36	−0.02	−0.60	+1.71	−0.54	+1.48	−0.40
Southern plateau	−0.02	+0.48	−0.03	−0.08	−0.14	−0.22	−0.25	+0.04	+0.37
Middle plateau	−0.14	−0.12	−0.08	−0.08	−0.07	−0.09	+0.16	−0.07	−0.02
Northern plateau	+0.43	+0.04	−0.16	+0.69	0.05	−0.14	0.10	−0.06	+0.11
North Pacific coast region	+0.48	−0.40	−0.50	+0.38	+0.08	−0.24	+0.02	−0.16	−0.15
Middle Pacific coast region	−0.14	−0.14	−0.13	−0.08	−0.04	−0.02	0.00	0.00	0.00
South Pacific coast region	−0.05	−0.04	−0.01	0.00	0.00	0.00	+0.05	0.00	0.00

Section.	For weeks ended—								
	August—				September—				October—
	7.	14.	21.	28.	4.	11.	18.	25.	2.
New England	−0.42	+0.18	+0.67	−0.26	+1.77	+0.26	+0.44	0.00	−0.77
Middle Atlantic States	−0.31	+1.45	−0.18	+1.07	+0.75	−0 57	+0.05	−0.56	−0.81
South Atlantic States	−0.69	+1.51	−0.66	−0.49	−0.81	−0.85	+0.31	−0.87	−0.92
Florida Peninsula	+1.88	+0.17	+1.37	+0.14	−0.94	−0.74	−1.13	−0.78	+2.85
Eastern Gulf States	+0.03	+0.55	−0.01	−0.11	−0.52	−0.43	−0.16	−0.51	+2.04
Western Gulf States	−0.59	−0.36	−0.20	−0.72	−0.30	−0.21	−0.91	−0.26	−0.42
Ohio Valley and Tennessee	−0.14	+0.52	+0.54	+0.21	+0.05	+0.23	−0.24	−0.53	+0.03
Lower Lake region	+0.01	+0.10	+1.09	−0.51	+0.05	−0.09	−0.44	−0.49	−0.63
Upper Lake region	+0.30	−0.22	+1.12	−0.35	+1.21	−0.72	+0.14	−0.56	−0.48
North Dakota	−0.37	+0.54	+0.67	−0.22	+0.31	−0.28	+0.10	−0.30	+0.51
Upper Mississippi Valley	+0.41	+0.50	−0.03	+0.54	+0.04	−0.15	+0.21	−0.13	−0.44
Missouri Valley	+0.30	+0.07	+0.60	−0.09	−0.53	+0.53	+3.03	−0.02	−0.28
Northern slope	+0.06	+0.07	−0.27	−0.22	−0.03	−0.15	−0.09	−0.11	+0.36
Middle slope	−0.23	+0.06	+0.11	−0.42	−0.36	+0.88	+0.10	−0.29	−0.28
Southern slope	−0.36	−0.36	−0.54	−0.56	−0.54	+2.11	−0.45	−0.38	+0.36
Southern plateau	−0.21	−0.17	−0.36	+0.09	−0.14	+0.32	−0.21	+0.08	+0.72
Middle plateau	−0.12	+0.21	−0.15	+0.03	−0.04	−0.09	−0.12	0.00	+0.49
Northern plateau	+0.03	−0.04	−0.05	−0.04	−0.12	−0.15	−0.03	−0.18	+0.57
North Pacific coast region	−0.08	−0.09	+0.20	−0.26	−0.14	+0.52	−0.04	−0.12	+0.93
Middle Pacific coast region	0.00	0.00	−0.01	−0.02	−0.05	−0.09	−0.15	−0.18	−0.18
South Pacific coast region	−0.02	−0.01	0.00	0.00	−0.01	0.00	−0.02	+0.04	−0.03

PLANT DISEASES IN 1905.

By W. A. Orton, *Plant Pathologist, Bureau of Plant Industry.*

This résumé of plant diseases in 1905 is compiled from reports of field observations by agents of this Department and officers of the several State experiment stations, whose cooperation is gratefully acknowledged. Especial assistance has been given by the following collaborators of this Department in their respective experiment stations: F. H. Blodgett, Maryland; A. D. Selby, Ohio; J. L. Sheldon, West Virginia; F. L. Stevens, North Carolina; L. H. Pammel, Iowa; F. D. Heald, Nebraska; H. L. Bolley, North Dakota, and W. Paddock, Colorado. It indicates briefly the prevalence of plant diseases in the United States in 1905 as compared with conditions in previous years, which are recorded in the seven preceding Yearbooks. The information at hand is comparatively incomplete, as in no case are there reports from every State regarding the occurrence or prevalence of any given disease. The prevalence of plant diseases in States not mentioned is therefore left in doubt.

POME FRUITS.

Apple.—Black-heart (*Bacterium mali* Brz.) was reported from Lancaster, Saline, and Platte counties, Nebr.

Black-rot and canker (*Sphaeropsis malorum* Pk.) were reported as occurring to a slight extent in Nebraska, Michigan, Missouri, Ohio, West Virginia, and Wisconsin.

Bitter-rot (*Glomerella rufomaculans* (Berk.) Sp. and von Schr.) was unusually severe in Maryland, Virginia, and West Virginia, especially on the Yellow Newtown in Virginia. Mr. W. M. Scott, of this Department, demonstrated that five thorough sprayings with Bordeaux mixture in midsummer, when infection takes place, will control this dreaded disease. (See Bulletin No. 93, Bureau of Plant Industry.) Bitter-rot was less prevalent in Ohio, Arkansas, Missouri, and other central States on account of cool weather.

Illinois canker (*Nummularia discreta* (Schw.) Tul.) was occasionally observed in Missouri, West Virginia, and adjacent States.

Blight (*Bacillus amylovorus* (Burr.) De Toni) was unusually severe from Alabama and Tennessee to Virginia and Pennsylvania and locally in New York; also in Ohio, Arkansas, Missouri, Iowa, Nebraska, and Minnesota. It did much damage in Colorado and Utah.

Brown-rot (*Sclerotinia fructigena* (Pers.) Schrt.) was observed on apples in Missouri and Nebraska, where it prevailed to a slight extent as during several previous seasons.

Crown-gall continues to injure nursery stock throughout the country, especially from the Middle States south and westward. Mr. G. G. Hedgcock, of this Department, has shown (Bulletin 90, Part II, Bureau of Plant Industry) that apple crown-gall is not of a contagious nature, and that it is distinct from the disease "hairy-root," previously confused with it. His experiments have also shown that much of this form of crown-gall can be avoided by wrapping the grafts. (See Bulletin 100, Part II, Bureau of Plant Industry.)

Flyspeck (*Leptothyrium pomi* (Mont. and Fr.) Sacc.) and sooty-blotch (*Phyllachora pomigena* (Schw.) Sacc.) disfigured unsprayed fruit as usual in the Eastern and Middle States.

Leaf-spot (*Phyllosticta* spp.) was reported to be generally prevalent in Maryland, Ohio, Missouri, Nebraska, West Virginia, Virginia, and North Carolina. It is especially injurious in neglected and unsprayed orchards, where it causes premature defoliation.

Root-rot (*Clitocybe parasitica* Wilcox, in part) was reported from Arkansas and West Virginia. It causes some loss in these and other south central States.

Texas root-rot (*Ozonium* sp.) has done considerable damage to apples in Texas and New Mexico.

Rot (*Penicillium glaucum* Lk.) is the principal cause of decay of fruit in Missouri and Nebraska.

Pink-mold (*Cephalothecium roseum* Cda.) was reported this year only from Maine. An apple rot due to *Alternaria* sp. was described by B. O. Longyear in Colorado Station Bulletin No. 105. It does comparatively slight damage there. Powdery mildew (*Podosphaera leucotricha* (E. and E.) Salm.) was reported this year only from Nebraska.

Rust (*Gymnosporangium macropus* Lk., etc.) appears to be most common in West Virginia, Tennessee, South Carolina, Georgia, and in eastern Nebraska and other Central Western States. It defoliates small orchards where cedars are allowed to remain. Large growers combat it by removing the red cedars.

Scab (*Venturia inaequalis* (Cke.) Aderh.) was, owing to the wet and cool season, far more destructive than usual over most of the country. Great losses were reported from Arkansas, Indiana, Iowa, Michigan, Nebraska, and Ohio. In Ohio the loss is estimated at one and a half million dollars. Scab increased in Maryland, Pennsylvania, and New England, but not to such a serious extent. In New York scab was not troublesome, but there was unusual complaint of injury from spraying—russeting of the fruit and spotting and dropping of the leaves. Scab has continued to spread in California, northern Idaho, and elsewhere.

Pear.—Blight (*Bacillus amylovorus* (Burr.) De Toni) caused much loss throughout the country, as usual. Noteworthy demonstrations have been undertaken by this Department in cooperation with the local authorities in Georgia, and especially in California, to show how this disease may be controlled.

Leaf-blight (*Entomosporium maculatum* Lév.) and leaf-spot (*Septoria piricola* Desm.) caused considerable loss, especially in New York, Ohio, Michigan, and West Virginia. The former appears to have been less abundant in the South and West.

Rust (*Gymnosporangium* sp.). One outbreak was reported from Long Island on Kieffer pears.

Scab (*Venturia pirina* Aderh.) was bad in California owing to weather conditions. Unusual loss, estimated at $50,000, was reported in Ohio. The disease was not as bad as expected in New York.

Texas root-rot (*Ozonium* sp.) has been injurious to pears in Texas and New Mexico.

Quince.—Black-rot (*Sphaeropsis malorum* Pk.) was destructive to this fruit in Maryland, Ohio, and West Virginia.

Leaf-spot (*Entomosporium maculatum* Lév.) was reported from Delaware, Ohio, and West Virginia. This and black-rot are easily controlled by spraying.

Blight (*Bacillus amylovorus* (Burr.) De Toni) prevailed as usual.

STONE FRUITS.

Almond.—Shot-hole (*Cercospora circumscissa* Sacc.) prevailed to about the usual extent in the coast regions of California. It is easily prevented by sprays.

Apricot.—Shot-hole (*Phyllosticta circumscissa* Cke.) is causing a gradually increasing loss throughout California, and treatment is rare and rather difficult. Troubles possibly similar have done much injury to twigs of apricot and peach.

Blight (*Bacillus amylovorus* (Burr.) De Toni) was reported on Russian apricot from Nebraska.

Cherry.—Black-knot (*Plowrightia morbosa* (Schw.) Sacc.) was reported from Nebraska, Ohio, West Virginia, and Wisconsin. This is a common disease elsewhere, especially on wild trees and in neglected orchards. It is easily controlled by spraying and cutting out the knots.

Brown-rot (*Sclerotinia fructigena* (Pers.) Schrt.) was more destructive this year in New York, New Jersey, Maryland, Ohio, Michigan, and West Virginia than usual. Less trouble was experienced in Rhode Island, Nebraska, and Missouri.

Leaf-spot (*Cylindrosporium padi* Karst.) was serious in Nebraska, New York, Ohio, West Virginia, and in Florida on *Prunus serotina* Ehrh. The loss in Ohio is estimated at $25,000. Iowa, Maryland, and Missouri reported less injury. It is readily controlled by spraying.

Powdery mildew (*Podosphaera oxyacanthae* (DC.) De By.) was reported to be very common in Arkansas, doing considerable damage there late in spring. The occurrence of this disease, with slight loss, was reported from Iowa, Ohio, and West Virginia.

Root-rot, due to an undetermined fungus, has done much harm in Nebraska, especially on trees weakened by leaf-spot.

Rust (*Puccinia pruni* Pers.) was reported from Nebraska.

Trunk-rot (*Schizophyllum commune* Fr.). A case has been reported from Lincoln, Nebr., where this fungus occurred as an undoubted parasite, destroying the orchard.

Peach.—Brown-rot (*Sclerotinia fructigena* (Pers.) Schrt.) was on the whole more destructive than usual. In Georgia the loss was greater in the southern than in the middle and northern peach sections of that State, and amounted to one-third of the crop, or 800 carloads. Maryland, New Jersey, and Connecticut suffered severely. In one instance in Pennsylvania 20 carloads were lost. The estimated damage in Ohio was $250,000. There was serious injury to the crop in West Virginia. In Missouri and Nebraska the peach crop had previously been greatly reduced by cold.

Crown-gall was reported as being common on nursery stock from all sections.

Little-peach was worse than last year in Michigan, and continues spreading at about the usual rate.

Leaf-curl (*Exoascus deformans* (Berk.) Fckl.), although generally prevalent, has done less injury in the great fruit-growing districts of New York, Ohio, Georgia, and the Pacific coast on account of the general use of preventive winter sprays. Where peach growing is less important spraying is neglected and much loss results. Loss was reported from Indiana, part of Ohio, South Carolina, Nebraska, Maryland, and Michigan.

Root-knot (*Heterodera radicicola* (Greef.) Müll.) has done much injury to young orchards in the Gulf States, as in previous years.

Root-rot, due to somewhat obscure causes, was reported from Georgia, Ohio, and Nebraska.

Rosette occurred in isolated instances in Georgia and Missouri.

Rust (*Puccinia pruni* Pers.) occurred to a slight extent. Reports came from Florida, Missouri, and Ohio only.

Scab (*Cladosporium carpophilum* Thüm.) was reported as causing serious injury in Florida, Missouri, Ohio, and West Virginia, though not as great as in some years.

Texas root-rot (*Ozonium* sp.) has greatly injured peaches in Texas and New Mexico.

Yellows has prevailed to about the normal extent or somewhat more in Indiana, Maryland, Ohio. and West Virginia. The relative loss is greatest where peach grow-

ing is a new or secondary industry, and preventive measures are therefore not practiced.

Plum.—Black-knot (*Plowrightia morbosa* (Schw.) Sacc.) was reported from Delaware, Maryland, Indiana, and Nebraska to occur as usual, and from Ohio and West Virginia as more prevalent. It does not appear to be a very dangerous disease to the watchful grower. It was most serious on the damson near wild trees.

Black-spot (*Pseudomonas pruni* Erw. Sm.). This bacterial rot of the fruit occurred to a limited extent in Connecticut and Rhode Island.

Blight (*Bacillus amylovorus* (Burr.) De Toni) was reported from Furnas County, Nebr.

Brown-rot (*Sclerotinia fructigena* (Pers.) Schrt.) has done more than usual harm from Florida to Maryland and in New Jersey, Connecticut, Vermont, Iowa, Ohio, West Virginia, Michigan, Indiana, Missouri, and Nebraska. The estimated loss in Ohio was $25,000. Thorough spraying and destruction of the mummied fruit has controlled the disease when practiced.

Leaf-curl (*Exoascus* spp.) was reported on Chickasaw plums in Iowa, but was less prevalent than usual. It was also reported from South Dakota, especially on Miner and sand cherry.

Leaf-spot (*Cylindrosporium padi* Karst.) has been most serious in New York, Michigan, and Ohio. The estimated loss in Ohio was $20,000. It occurred to a considerable extent in Florida, Arkansas, Missouri, and West Virginia, but was not troublesome in Wisconsin and Nebraska. This disease is easily controlled by spraying.

Plum-pockets (*Exoascus pruni* Fckl.) appears to be most common and injurious in Wisconsin, Minnesota, and North Dakota. It was reported as of minor importance in Arkansas, Missouri, and Nebraska, and was observed in Colorado for the first time this year.

Rust (*Puccinia pruni* Pers.) was reported on prune from California. The trouble was not serious in any particular locality, but collectively was of some importance.

Scab (*Cladosporium carpophilum* Thüm.) was reported to occur to a slight extent in Iowa and abundantly on susceptible varieties in Missouri and South Dakota.

SMALL FRUITS.

Blackberry.—Anthracnose (*Gloeosporium venetum* Speg.) was less prevalent in Ohio and Iowa.

Crown-gall was reported from Arkansas, Nebraska, Colorado, Ohio, and Indiana.

Leaf-spot (*Septoria rubi* Westd.) was abundant in Florida, Missouri, Nebraska, Ohio, West Virginia, and Wisconsin. The extent of the injury was generally small or uncertain, but was estimated at 20 per cent in Florida and Ohio.

Rust (*Gymnoconia interstitialis* (Schl.) Lagh.) was mentioned as occurring in Alabama, Arkansas, Florida, Iowa, Maryland, Missouri, Ohio, and West Virginia.

Cranberry.—Anthracnose, rot, scald, and blast, diseases described by C. L. Shear in Farmers' Bulletin No. 221, were the cause of losses ranging from 15 to 20 per cent in New Jersey, and much less in Massachusetts and Wisconsin. The relative prevalence was about the same as last year. Spraying experiments made by this Department showed that these diseases can be fully controlled with Bordeaux mixture (see Bulletin 100, Part I, Bureau of Plant Industry).

Currant.—Leaf-spot (*Septoria ribis* Desm., etc.) defoliated plants in Iowa, Nebraska, Ohio, and West Virginia.

Powdery mildew (*Sphaerotheca mors-uvae* (Schw.) B. & C.) was reported only from Ohio and Nebraska.

Gooseberry.—Leaf-spot (*Septoria ribis* Desm., etc.) was reported of slight occurrence in Nebraska, Missouri, and West Virginia, but injuring 25 per cent of the crop in Ohio, where spraying is a necessity.

Powdery mildew (*Sphaerotheca mors-uvae* (Schw.) B. & C.) was mentioned from Arkansas, Iowa, Missouri, Ohio, and West Virginia, but the disease was not serious as a rule, since the crop is unimportant.

Grape.—Black-rot (*Guignardia bidwellii* (Ell.) V. & R.) has been very destructive this year in the Lake Erie grape region of New York, Pennsylvania, and Ohio on account of rainy weather and failures in spraying, due to lack of thoroughness. The loss in Ohio is estimated at 30 per cent of the crop, worth $95,000. In the remainder of the Eastern and Middle States the loss appears to have been slight.

The California vine disease is slowly destroying vineyards in the Sacramento Valley, Santa Clara Valley, and southern California. The total losses to date for several years is estimated at $40,000,000. Mr. N. B. Pierce, of this Department, has demonstrated the resistance of the variety Lenoir, which is replacing the others in these sections.

Downy mildew (*Plasmopara viticola* (B. & C.) Berl. & De Toni) was more destructive in Arkansas and New York, but in other States (Connecticut, Maryland, Ohio, Iowa, Minnesota, Missouri, Wisconsin, and West Virginia) it seems to have been less serious.

Powdery mildew (*Uncinula necator* (Schw.) Burr.) has occurred to only a slight extent in California, Michigan, Missouri, and West Virginia.

Raspberry.—Anthracnose (*Glœosporium venetum* Speg.) was widely reported, but was nowhere unusually serious. Spraying was generally successful.

Crown-gall was reported common in Arkansas, Colorado, Ohio, and Nebraska.

Leaf-spot (*Septoria rubi* Westd.) was reported as unimportant in Missouri, Ohio, and West Virginia.

Rust (*Gymnoconia interstitialis* (Schl.) Lagh.) aroused complaint in West Virginia, but was reported as unimportant in Ohio and Iowa.

Strawberry.—A bud nematode was found to be injurious in one instance in South Carolina.

Leaf-spot (*Sphaerella fragariæ* (Tul.) Sacc.) was reported more abundant in Missouri, West Virginia, and Florida. This disease was common throughout the country, but unimportant, as short rotations or spraying with Bordeaux mixture readily controlled it.

TROPICAL FRUITS.

Banana.—Ripe-rot (*Glœosporium musarum* Cke. & Mass.) injured 50 per cent of the banana crop in Hawaii, especially in fruit not properly packed; estimated loss $30,000.

Scab, due to an undetermined fungus, affected about 10 per cent of the Hawaiian crop.

Mango.—Blight (*Colletotrichum* sp.) was less prevalent in Hawaii, owing to dry weather. It yields to treatment with Bordeaux mixture.

Orange.—Wither-tip (*Colletotrichum glœosporioides* Penz.). This and similar troubles of citrus fruits have been more prevalent in Florida the present winter on account of heavy rainfall.

Pineapple.—Wilt is said to have been more abundant in Florida.

VEGETABLES AND FIELD CROPS.

Asparagus.—Rust (*Puccinia asparagi* DC.) appears to be again increasing in the Eastern States, having been more prevalent this year from Maryland to Massachusetts. Reports from South Carolina, Ohio, Iowa, Nebraska, and North Dakota show that the rust is widely scattered, but less injurious than a few years ago. On the Pacific slope it seems to retain its virulence. Treatment with sulphur, combined with cultural and sanitary measures, has been shown by R. E. Smith, in bulletins 165 and 172 of the California Station, to afford a practicable means of control and has been generally adopted by the growers.

Bean.—Anthracnose (*Colletotrichum lindemuthianum* (Sacc. & Magn.) Bri. & Cav.) prevailed to an unusual extent along the Atlantic coast, causing heavy losses to truckers, particularly in Florida, North Carolina, South Carolina, and Virginia. It is also reported as worse in Maryland, Ohio, West Virginia, Iowa, Nebraska, and Wisconsin, but less serious on the whole in New York, where treatment with Bordeaux mixture was successful.

Bacteriosis (*Bacillus phaseoli* Erw. Sm.) was more prevalent in New York, and was observed to be generally prevalent in the South; reported also from West Virginia and Nebraska.

Damping-off (*Rhizoctonia* sp.) was locally injurious in South Carolina.

Downy mildew (*Phytophthora phaseoli* Thax.) was much worse in Connecticut, where Dr. G. P. Clinton, of the Connecticut Station, discovered the oospore stage. The disease was also reported from Delaware and doubtfully from Maryland.

Powdery mildew (*Erysiphe polygoni* DC.) occurred on 33 per cent of the crop in Ohio.

Rust (*Uromyces appendiculatus* (P.) Lév.) was reported more prevalent in Connecticut, Ohio, West Virginia, Iowa, and New Mexico. Its occurrence was reported in Maryland, North Carolina, and Nebraska.

Beet.—Curly-top of sugar beets was destructive in limited areas in the Western States, but less so on the whole than in previous years.

Leaf-blight (*Cercospora beticola* Sacc.) occurred about as usual in New York, Ohio, Michigan, West Virginia, and other Eastern States.

Soft-rot (*Bacterium teutlium* Metcalf) was reported from Nebraska.

Cabbage.—Black-rot (*Pseudomonas campestris* (Pam.) Erw. Sm.) prevailed throughout the southern trucking belt, leading to unusual loss on account of the weather conditions, which favored the invasion of soft-rot bacteria and made the crop very perishable. Black-rot was also bad in Ohio and Indiana, but less so in Iowa.

Club-root (*Plasmodiophora brassicae* Wor.) was reported from Maryland, New Jersey, Ohio, West Virginia, and South Carolina.

Wilt (*Fusarium*) occurred to some extent in Maryland and North Carolina.

Cauliflower.—Black-rot (*Pseudomonas campestris* (Pam.) Erw. Sm.) was reported from Iowa, Maryland, and Ohio.

Cantaloupe.—Anthracnose (*Colletotrichum lagenarium* (Pass.) Ell. & Hals.) was common. The greatest injury reported was from Nebraska, amounting in some cases to from 50 per cent to 100 per cent of the crop.

Leaf-blight (*Alternaria brassicae* var. *nigrescens* Pegl.) was much more injurious this year. It prevailed along the Atlantic coast, often associated with downy mildew (see Cucumber). In Florida nearly the whole commercial crop was destroyed just before ripening. South Carolina, North Carolina, Maryland, New Jersey, and Connecticut also suffered much loss. The loss in Ohio was estimated at 20 per cent. In the Central and Middle Western States it seems to have been less prevalent, but in Colorado did much damage. The Colorado Station is breeding a resistant strain.

Wilt (*Bacillus tracheiphilus* Erw. Sm.) occurred from Ohio to Nebraska, in Indiana injuring 15 to 25 per cent of the crop.

Celery.—Leaf-blight (*Cercospora apii* Fres.) appears to have been injurious in Florida, Georgia, North Carolina, Delaware, and Ohio.

Leaf-spot (*Septoria petroselini* Desm. var. *apii* Br. & Cav.) was reported only from New York, and *Phyllosticta apii* Hals. only from Delaware.

Root-rot and damping-off, due to *Sclerotinia libertiana* Fckl., *Rhizoctonia*, and *Fusarium*, caused heavy losses in Florida.

Root-knot (*Heterodera radicicola* (Greef.) Müll.) aroused complaint in Arkansas.

Cucumber.—Anthracnose (*Colletotrichum lagenarium* (Pass.) Ell. & Hals.) was reported as causing loss in North Carolina, West Virginia, Ohio, and Massachusetts; also in Nebraska, where in connection with wilt it caused a loss of over $10,000 in one county. It appears to have been more prevalent than last year.

Downy mildew (*Pseudoperonospora cubensis* (B. & C.) Rost.) was again very prevalent along the Atlantic coast from Florida to Massachusetts, and also in Ohio and West Virginia. Successful spraying experiments were reported and methods advised in South Carolina Experiment Station Bulletin 116 and in Farmers' Bulletin 231. This disease was also destructive to cucurbits in Porto Rico.

Wilt (*Bacillus tracheiphilus* Erw. Sm.) was reported more prevalent in western New York, where it caused an epidemic in greenhouses also.

Eggplant.—Fruit-rot (*Phyllosticta hortorum* Speg.) occurred at Lincoln, Nebr.

Wilt (*Bacillus solanacearum* Erw. Sm.) was reported for the first time from Colorado.

Ginseng.—Leaf-blight (*Alternaria* sp.) was more prevalent in New York than before.

Three new diseases, stem anthracnose (*Vermicularia dematium* (Pers.) Fr.), leaf anthracnose (*Pestalozzia funerea* Desm.), and wilt (*Neocosmospora vasinfecta* var. *nivea* Erw. Sm.), are reported by H. S. Reed in Bulletin No. 69 of the Missouri Station as the cause of considerable injury to cultivated ginseng in Missouri.

Lettuce.—Anthracnose (*Marsonia perforans* Ell. & Ev.) has been very destructive in greenhouses in Michigan.

Downy mildew (*Bremia lactucae* Regel.) was reported in one severe case from New York.

Drop (*Sclerotinia libertiana* Fckl.) occurred in Florida to a very serious extent.

Melon.—See Cantaloupe and Watermelon.

Onion.—Downy mildew (*Peronospora schleideniana* De By.) occurred generally in New York, especially late in the season, and was reported from Vermont.

Smut (*Urocystis cepulae* Frost) was reported from one locality in Iowa.

Pea.—Leaf-spot (*Ascochyta pisi* Lib.) was more prevalent in Ohio, injuring 30 per cent of the crop. Spraying and rotation of crops gave good results.

Powdery mildew (*Erysiphe polygoni* DC.) occurred in Ohio and West Virginia. In Ohio 20 per cent of the crop was injured. Bordeaux mixture controlled the disease effectually.

Potato.—Brown-rot (*Bacillus solanacearum* Erw. Sm.) occurred locally from Virginia to Florida and in Ohio and Iowa.

Dry-rot (*Fusarium oxysporum* Schlecht.) was reported from Florida, Iowa, Ohio, and West Virginia, the losses varying from 10 to 50 per cent of the crop.

Early-blight (*Alternaria solani* (E. & M.) J. & G.) was on the whole less prevalent, but did considerable harm nevertheless. It was reported from Florida, New

Jersey, Connecticut, Massachusetts, Vermont, New York, Ohio, Michigan, Iowa, Wisconsin, and Nebraska.

Late-blight (*Phytophthora infestans* De By.) was again extremely destructive throughout the Northern States from Maine to Minnesota, particularly in Vermont, New York, Ohio, Michigan, Wisconsin, and Minnesota. The loss in New York was estimated at 50 bushels per acre, and the yield per acre was in many cases increased more than that by spraying. The loss in Ohio is placed at $2,000,000 and in Wisconsin at $5,000,000. The resultant rotting of the tubers was very serious this year. The disease occurred in Florida in May and did some slight injury there.

Scab (*Oospora scabies* Thax.) was reported as usual from all States, with mention of serious loss where soil had been limed. In Colorado, Wyoming, and Idaho the injury appears to have been especially great, and perhaps complicated by stem-blight. Prof. L. R. Jones, of the Vermont Station, has found formaldehyde gas generated by the permanganate method an efficient means of disinfecting large quantities of potatoes in bulk without soaking them. (Report of Vermont Station for 1905.)

Stem-blight (*Corticium vagum* B. & C. var. *solani* Burt.) appeared most injurious in the Rocky Mountain section, but was reported from Florida, South Carolina, Virginia, Ohio, and Iowa.

Sugar cane.—Dr. N. A. Cobb reported that the crop in Hawaii was injured up to 10 per cent by the "rind disease" and by the "root disease" (*Marasmius?*), and to a lesser extent by leaf-spot (*Cercospora* sp.?), "pineapple disease," and "top-rot."

Sweet potato.—Black-rot (*Ceratocystis fimbriata* Ell. & Hals.) was reported from North Carolina and Maryland.

Tobacco.—Bed-rot (*Rhizoctonia*) caused some loss in Ohio.

Mosaic disease was more prevalent in Connecticut and Ohio, where the loss due to the depreciation in the quality is estimated at $50,000.

Tomato.—Anthracnose (*Colletotrichum phomoides* (Sacc.) Chest.) was reported from Massachusetts, New Jersey, and Ohio. The disease was of minor importance.

Blight (*Bacillus solanacearum* Erw. Sm.) is on the increase in Colorado and locally worse in Maryland. It was reported also from North Carolina and Ohio.

Damping-off due to various fungi injured seedlings in California.

Downy mildew (*Phytophthora infestans* De By.) was quite common in Massachusetts this season, owing to unusual weather conditions, and was reported also from southern California, where it caused large losses to the winter crop.

Fruit-rot (cause unreported) was less injurious in Indiana, Iowa, and Maryland, but worse in Massachusetts, North Carolina, and West Virginia.

Leaf-spot (*Septoria lycopersici* Speg.), the most injurious disease of tomato, caused losses ranging from 5 to 50 per cent in Delaware, Maryland, North Carolina, Ohio, and West Virginia.

Point-rot aroused complaint in Connecticut, North Carolina, Ohio, and South Carolina.

Western blight caused heavy losses in the Rocky Mountain States, estimated at $40,000 in Utah. The cause remains unknown.

Wilt or summer blight (*Fusarium* sp.) was reported by R. E. Smith in Bulletin 175 of the California Station to have been unusually prevalent, especially in southern California, where many fields were completely ruined. The loss in other parts of the State was from 1 to 50 per cent.

Turnip.—Black-rot (*Pseudomonas campestris* (Pam.) Erw. Sm.) was more prevalent in Ohio but less so in Iowa.

Club-root (*Plasmodiophora brassicae* Wor.) was locally prevalent in Illinois, New York, Ohio, West Virginia, and Vermont.

Watermelon.—Anthracnose (*Colletotrichum lagenarium* (Pass.) Ell. & Hals.). A severe epidemic caused much loss in West Virginia.

Wilt (*Neocosmospora vasinfecta* var. *nivea* Erw. Sm.) occurred as usual in the Southern States. It was very bad on Muscatine Island, Iowa.

CEREALS.

Barley.—Smut (*Ustilago hordei* (P.) Kell. & Sw.) increased in Nebraska, North Dakota, South Dakota, and Wisconsin, where it injured 7 per cent of the crop, causing a loss of $500,000.

Broom corn.—See Sorghum.

Corn.—Leaf-blight (*Helminthosporium inconspicuum* C. & E.) caused considerable loss in certain localities in Delaware, Ohio, Pennsylvania, and West Virginia.

Rust (*Puccinia sorghi* Schw.) was reported from Alabama, Iowa, Michigan, Nebraska, North Dakota, Ohio, and West Virginia. It appears to have been unusually prevalent, but not decidedly injurious.

Smut (*Ustilago zeae* (Beckm.) Unger) was reported from nearly all States as everywhere prevalent, but not very destructive.

Oats.—Rust (*Puccinia graminis* P.) was common from Vermont to Indiana, Iowa, and Wisconsin, but the loss was small, being estimated at from 1 to 3 per cent of the crop. In North Carolina and Ohio, however, the loss was set at from 10 to 20 per cent.

Smut (*Ustilago avenae* (P.) Jens.) was everywhere present, causing small losses, which amounted in the aggregate to immense sums. In Wisconsin the injury was 5 per cent of the crop, or $1,500,000, while it was 20 per cent before seed treatment was introduced. In many States this disinfection of the seed is still too much neglected.

Rice.—Blast has continued to prevail in South Carolina, but most of the land liable to the disease was not planted and the actual loss was therefore not great. Dr. Haven Metcalf, of this Department, has worked out a remedy which promises to be successful. (See South Carolina Experiment Station Bulletin No. 121.)

Rust, a disease apparently physiological in nature, is common, but the large losses it caused in previous years are now avoided by small applications of kainit.

Smut (*Tilletia horrida* Tak.) has not been observed since a locally severe outbreak in 1899 led to the adoption of remedial measures advised by Anderson and Walker in South Carolina Experiment Station Bulletin No. 41.

Sorghum.—Blight (*Bacillus sorghi* Burr.) has been the principal disease of sorghum and broom corn; reported from Iowa, Michigan, Nebraska, Ohio, and West Virginia.

Smut (*Sphacelotheca sorghi* (Tul.) Clint. and *S. reiliana* (Kühn) Clint.) was reported to be quite common in Ohio and Nebraska.

Wheat.—Leaf-blight (*Leptosphaeria tritici* Pass.) was reported by Dr. F. D. Heald from several counties in southeastern Nebraska. The loss was not great.

Leaf-rust (*Puccinia rubigo-vera* (DC.) Wint.) was widely distributed and abundant in the Northwest. In some localities, especially in North Dakota, the loss amounted to 30 per cent, but as a rule the injury was not more than usual.

Stem-rust (*Puccinia graminis* P.) was generally distributed, but was epidemic only in limited districts. The great wheat-growing States of the Northwest suffered no loss as compared with 1904. In Maryland, Ohio, West Virginia, and North Carolina, where the wheat crop is less important, losses of 15 to 30 per cent were reported. Rust was severe in Oklahoma, causing a loss estimated at $10,000,000. H. L. Bolley and F. J. Pritchard, of the North Dakota station, have found that the rust fungus may occur in the seed and possibly be spread in that manner.

Powdery mildew (*Erysiphe graminis* DC.) was abundant at Lincoln, Nebr., early in the season.

Scab (*Fusarium culmorum* (W. G. Smith) Sacc.) was increasingly prevalent in Minnesota, North Dakota, and South Dakota, especially on close-headed varieties, the loss being estimated at 1 per cent or more. In Iowa and Nebraska less trouble was experienced. Indiana, Michigan, Ohio, and Maryland also reported the disease.

Smut. Loose smut (*Ustilago tritici* (P.) Jens.) occurs to a minor degree as compared with stinking smut (*Tilletia foetens* (B. & C.) Trel.), which has been very abundant in some northwestern districts where seed treatment had been neglected.

FORAGE CROPS.

Alfalfa.—Dodder (*Cuscuta epithymum* Murr., etc.) was reported injurious in Nebraska, Ohio, West Virginia, and especially in Utah, where it is widespread.

Leaf-spot (*Pseudopeziza medicaginis* (Lib.) Sacc.) has been injurious in Wyoming and South Dakota and to a lesser extent in Michigan, Minnesota, Nebraska, Ohio, and South Carolina. It is controlled by early cutting and is particularly harmful to seed crops, which are often ruined.

Clover.—Anthracnose (*Colletotrichum* sp.) is a new fungous disease, which appears to be the principal cause of clover sickness in Tennessee and is causing the loss of 25 to 75 per cent of the crops sown. It is also prevalent in Ohio and West Virginia. It is being studied by S. M. Bain and S. H. Essary.

Dodder (*Cuscuta* sp.) has occurred in Ohio and West Virginia, though less frequently than on alfalfa.

Leaf-spot (*Macrosporium sarcinaeforme* Cav.) was common in Tennessee, but subordinate to anthracnose.

Black-spot (*Phyllachora trifolii* (Pers.) Fckl.) was reported from Iowa and Tennessee; a minor disease.

Rust (*Uromyces trifolii* (A. & S.) Wint.) was reported as of general occurrence in Iowa, Maryland, and Tennessee, but not very injurious.

Cowpea.—Root-knot (*Heterodera radicicola* (Greef.) Müll.) and wilt (*Neocosmospora vasinfecta* var. *tracheiphila* Erw. Sm.) are becoming more frequent in sandy soil in the Southern States, but are controlled by the use of resistant varieties.

Grasses have been attacked by ergot (*Claviceps purpurea* Tul.) to a noticeable extent in Minnesota and Wyoming, and numerous lesser fungous diseases have been reported.

FIBER PLANTS.

Cotton.—Angular leaf-spot (*Pseudomonas malvaccarum* Erw. Sm.) was everywhere present as a minor trouble. In Sea Island cotton in southern Georgia and Florida the same parasite causes a destructive disease of the stem known as black-arm.

Anthracnose (*Colletotrichum gossypii* Southworth) occurred in numerous restricted epidemics scattered over the cotton belt. The losses were small in proportion to the total crop, but considerable in themselves.

Areolate leaf-spot (*Ramularia areola* Atk.) occurred in Alabama, Tennessee, and other States, particularly in late fall, but did little harm.

Texas root-rot (*Ozonium* sp.) has again caused heavy losses in Texas, being worst in the black waxy lands of central and northern Texas.

Rust, a common physiological disorder, was common as usual on poor land lacking humus, drainage, or potash. It causes more loss to cotton growers than all other diseases.

Wilt (*Neocosmospora vasinfecta* (Atk.) Erw. Sm.) is slowly increasing each year, but the use of resistant varieties promises to reduce the loss.

Flax.—Rust (*Melampsora lini* (DC.) Tul.) did much injury in North Dakota.

Wilt (*Fusarium lini* Bolley) was general in Minnesota, North Dakota, and South Dakota, but the loss is now somewhat reduced by seed treatment and rotation of crops.

NUT, FOREST, AND SHADE TREES.

While but few data are at hand, the following diseases have been reported as indicated:

Ash.—Rust (*Puccinia fraxinata* (Lk.) Arthur), Lincoln, Nebr.; not abundant.

Leaf-spot (*Phyllosticta viridis* Ell. & Kell.), Lincoln, Nebr.; very abundant.

Black walnut.—Leaf-spot (*Marsonia juglandis* (Lib.) Sacc.), Nebraska.

Catalpa.—Powdery mildew (*Microsphaera elevata* Burr.), Nebraska.

Trunk-rot (*Polystictus versicolor* (L.) Fr.), Nebraska.

Balsam fir.—Witches'-broom (*Peridermium elatinum* Schum. & Kunge), Michigan.

Cedar.—Rust (*Gymnosporangium macropus* Lk.), Nebraska and South Dakota.

Cottonwood.—Trunk-rot (*Elfingia megaloma* (Lév.) Murr.), a new disease in Nebraska recently studied by Dr. F. D. Heald.

Elm.—Black-spot (*Dothidella ulmi* (Duv.) Wint.), Nebraska.

Honey locust.—Black-leaf (*Leptostroma hypophyllum* B. & Rav.), Nebraska.

Maple.—Black-spot (*Rhytisma acerinum* (Pers.) Fr.), Long Island, New York; Iowa, and Nebraska.

Leaf-scorch, probably due to unfavorable weather conditions, was serious in Michigan.

Mulberry.—Leaf-spot (*Cercospora pulvinulata* Sacc. & Wint.), Nebraska.

Oak.—Leaf-spot (*Marsonia martini* Sacc. & Ell.), Nebraska.

Pecan.—Scab (*Fusicladium effusum* Wint.) was somewhat serious in portions of the Gulf States, but not so prevalent as last year.

Rosette, a disease not yet described, is increasing in South Carolina and Georgia.

Pine.—Knot (*Peridermium* sp.) was destructive in upper South Carolina. Seedling blight (*Cladosporium herbarum* (Pers.) Link.) was reported by Dr. F. D. Heald as destroying seedlings in Nebraska.

Serious injury to pine trees has occurred in New England, associated with the attacks of the following parasitic fungi, probably due in part also to winter injury: *Septoria* sp., on *Pinus* spp., Massachusetts, Maine; *Hendersonia foliicola* (Berk.) Fckl. on *Pinus* sp., Massachusetts; *Cytospora pinastri* Fr., on *Pinus* sp., Maine; *Phoma harknessii* Sacc., on *Pinus* spp. and other genera, Massachusetts. *Pestalozzia funerea* Desm. has occurred on *Pinus* sp. in Virginia.

Black spruce.—Knot (*Peridermium abietinum* A. & S.) was reported from Michigan.

Walnut.—Blight (*Pseudomonas juglandis* Pierce) was less prevalent in California during the past season.

GREENHOUSE AND ORNAMENTAL PLANTS.

Aster.—Yellows occurred as usual in Maryland, but was considerably less prevalent in New England.

Carnation.—Spot (*Alternaria* sp.), a new disease, has done considerable damage to tender varieties of the Lawson type.

Stem-rot, due usually to *Rhizoctonia* but sometimes to *Fusarium*, has prevailed about as usual on poorly drained soils.

Chrysanthemum.—Leaf-spot (*Septoria chrysanthemi* Cav.) was reported in Delaware, Maryland, and Nebraska.

Rust (*Puccinia chrysanthemi* Roze) caused complaint in Delaware and New York.

Pansy.—Downy mildew (*Peronospora violae* De By.), Nebraska.

Peony.—Leaf-spot (*Cladosporium paeoniae* Pass.), Nebraska.

Root-knot (*Heterodera radicicola* (Greef.) Müll.), Nebraska.

Rose.—Powdery mildew (*Sphaerotheca pannosa* (Wallr.) Lév.) occurred commonly everywhere, especially on Crimson Rambler.

Root-knot (*Heterodera radicicola* (Greef.) Müll.) was very injurious in some instances to greenhouse roses in Alabama, Nebraska, and other States.

GAME PROTECTION IN 1905.

By T. S. PALMER, *Assistant, Biological Survey.*

The record of game protection in 1905 is chiefly noteworthy for volume of legislation, more effective enforcement of laws, and experimental and practical work in maintaining and increasing the stock of game. Several States made substantial progress in solving the problem of restricting hunting by unnaturalized foreign-born residents; at least two—Kansas and Missouri—were added to those which placed their warden service on a self-sustaining basis; and Missouri, in practically closing the game markets of Kansas City and St. Louis, exerted an important influence on the game trade of the West. Maintenance of the stock of game by winter feeding was conducted more extensively and systematically than ever before, importations of foreign game birds were marked by the introduction of several important and promising species, and a notable advance was made in establishing game preserves and refuges under Federal, State, and private auspices.

LEGISLATION.

Of the various bills before Congress only two affecting game became laws. One of these was an act creating the Wichita game preserve in Oklahoma, the other a provision in the appropriation act of the Department of Agriculture requiring officials of the Forest Service to aid State officers in the enforcement of fish and game laws and authorizing arrests for violation of the laws and regulations relating to forest preserves and national parks. The Shiras bill (H. R. 15601) to place the protection of migratory game under the jurisdiction of the Federal Government aroused much interest and discussion among sportsmen, but did not pass either branch of Congress, not having been reported by the House committee to which it was referred.

State laws were more numerous than usual, as 41 States and Territories held legislative sessions, and in all but two of these changes were made in the game laws. Exclusive of appropriation bills, about 180 laws relating to game were passed in the United States, but of these 16 in New York and 67 in North Carolina were chiefly local measures changing the seasons for certain kinds of game in one or more counties. New general game laws were enacted in 6 States—Idaho, Indiana, Kansas, Minnesota, Missouri, and Utah, and in the Territory of Arizona—and the statutes of North Carolina were codified for the first time since 1883. Comprehensive laws protecting nongame birds were passed in California, Michigan, Missouri, and South Carolina; laws prohibiting spring shooting of waterfowl in Montana, Utah, and Wisconsin; and laws protecting shore birds in California, Colorado, Indiana, Pennsylvania, and Utah. Among the novel features of the year may be mentioned a clause in the Minnesota law prohibiting the placing of game in cold storage; a provision in the Montana law making a uniform open season for all game; an amendment to the penal code of New York prohibiting aliens from carrying arms at any time in public places; an authorization in the Wyoming law for the issue of a $1 permit for photographing big game in winter; and a requirement in the Wisconsin law that each deputy warden must carry an identification card bearing his photograph, his signature, the seal of the department, and a miniature of his commission.

License legislation proved to be an important feature, as several States adopted hunting licenses for the first time. Arizona, Kansas, Missouri, and Oregon established nonresident licenses; Kansas, Missouri, Montana, Oregon, and Manitoba, resident licenses; and Massachusetts, Utah, Washington, Wyoming, and Manitoba alien licenses. Numerous changes were made in license fees, among which may be mentioned the adoption by Tennessee of a uniform fee of $10 in place of the former variable fee; increases in the resident licenses of Michigan from 75 cents to $1.50, of

South Dakota from $1 to $2.50, of Wyoming from $1 to $2, and in the nonresident licenses of Utah from $10 to $25 and of New Brunswick from $30 to $50; and reductions in the resident license of Illinois from $1 to 75 cents; in the small-game nonresident license in Montana from $15 to $10; and in the nonresident licenses of Indiana and Nova Scotia from $25 to $15 and from $40 to $30, respectively. The $5 hunting license in Hawaii, which has been in force in Oahu since 1896, was abolished.

Several important changes were made in the laws restricting trade in game. Missouri and British Columbia extended their nonexport laws to cover all protected game, and Maine its laws prohibiting export of a few ducks to include practically all kinds of ducks. Arizona added ducks, New Hampshire birds, and Utah shore birds to the list of game which can not be shipped out of the State. In the case of sale, Missouri and Manitoba extended their laws to prohibit sale of all protected game; California of doves and shore birds; Idaho of birds; Kansas of red squirrels, plover, ducks, geese, and brant; Maine of practically all ducks; Massachusetts of deer taken in the State; New Mexico of doves and pigeons; Pennsylvania of woodcock and wild turkeys; Utah of quail; Wyoming of big game heads; and Manitoba of female and young elk and caribou, big game heads of all kinds, blue grouse, swans, and ducks. Pennsylvania fixed a season for the sale of ruffed grouse imported from other States, and Illinois made the season for sale of imported game, which formerly applied to certain cities and towns, general throughout the State.

The warden system was adopted for the first time in Kansas, South Carolina (county wardens only), and British Columbia, and important changes were made elsewhere. Manitoba authorized the appointment of an assistant warden and New Brunswick of a chief ranger, Illinois increased the number of her wardens, Michigan authorized the selection of four deputy wardens by the Audubon Society, California and Ontario made more liberal provision than heretofore for warden service, Minnesota and Missouri conferred the power of search on their game officials, Wisconsin placed the warden service under civil-service rules, and Wyoming authorized arrest and seizure without warrant.

DECISIONS OF THE COURTS.

In comparison with the record of 1904 the number of game decisions handed down by the higher courts was small, only six decisions of importance apparently having been rendered during the year. Of these a decision rendered by the supreme court of Vermont construed the law relating to deer with horns (State *v.* St. John, 59 Atl., 826); one by the supreme court of Minnesota sustained the law prohibiting the sale of grouse irrespective of place where killed (State *v.* Shattuck, 104 N. W., 719); and a second decision by the same court sustained the right of a person to have deer and moose skins taken from animals lawfully killed, and to ship them out of the State to be tanned and returned (Allbright *v.* Northern Pacific Rwy. Co., 104 N. W., 827). The question whether the general public has the right to hunt on overflowed lands was decided by the supreme court of Illinois (Schulte *v.* Warren, 75 N. E., 783). This decision, which upheld the right of land owners to prohibit trespassing on their property when overflowed, was a matter of great importance to the ducking clubs of the State, whose preserves were threatened with destruction if the right to invade and hunt on overflowed lands could be exercised at will by the general public. A decision of far-reaching importance was that rendered by the court of appeals of the first district of California, involving the constitutionality of county ordinances fixing seasons for game. Since 1897 the boards of county supervisors had enjoyed the privilege of shortening the open seasons by local ordinances when necessary, but the court held that in view of the constitutional amendment adopted in 1902, dividing the State into game districts, and the failure of the legislature to enact any laws under this amendment, an ordinance of Los Angeles County, fixing the season for doves, was unconstitutional.[a] The case of greatest general importance was that in New York (People ex rel. Silz *v.* Hesterberg, Sheriff) to determine whether the State law prohibiting sale of game in close season applied to game imported from Europe as well as to that taken within the State. The decision was rendered in favor of the State in the supreme court, but in favor of the dealer in the appellate branch of the same court. The decision of the court of appeals, sustaining that of the supreme court, was not rendered until February, 1906, and proved to be a strong vindication of the right of the State to legislate concerning imported as well as native game.

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[a] Sometime after this decision was rendered, application was made by the attorney-general for a hearing by the supreme court of the State, and the case was still pending at the close of the year.

ADMINISTRATION AND ENFORCEMENT OF LAWS.

Changes in the personnel of the warden service were numerous during the year and included the offices of State warden in Idaho, Missouri, Oklahoma, West Virginia, and Wisconsin, those of forest, fish, and game commissioner and chief game protector in New York, district warden in North Dakota, the chairmanship of the commission of birds in Rhode Island, minister of marine and fisheries in Newfoundland, and minister of colonization, mines, and fisheries in Quebec. Minor changes also occurred in the boards of commissioners in Maine, Minnesota, Pennsylvania, and Ontario. Under the new laws a State warden was appointed in Kansas, a provincial warden in British Columbia, an assistant warden in Manitoba, and a chief ranger in New Brunswick.

Ordinarily the terms of State wardens run from two to six years. It is questionable whether the highest degree of efficiency can be attained under the shorter term of office, and the action of Tennessee in extending the term of its warden to eight years has peculiar significance, not only because this is the longest term of any warden in the United States, but because it is a recognition of the principle that frequent change is incompatible with the most efficient service. An important step toward raising the standard of the warden service was taken in Wisconsin in placing deputy wardens as well as other State officers under civil-service rules. As the law did not take effect until December 16, and the date fixed for examinations was early in January, 1906, the result of the experiment can not be determined for some time, but its importance lies in the recognition of the necessity of removing warden service as far as possible from partisan politics. In this connection mention may be made of the fact that applicants for the position of deputy warden in Massachusetts are required to pass a competitive written examination, a system inaugurated by the commissioners of fisheries and game in 1903.

Beside special deputies paid by part of the fines, or by the day during the time they actually serve, about a dozen States now have, in addition to their game commissioners or other superior officers, chief wardens or supervising deputies employed throughout the year, at salaries ranging from $600 to $1,200 per annum. Salaried officers of this kind employed in 1905 were as follows: Colorado, 5 chief game protectors; Illinois, 10 game wardens; Michigan, a chief deputy and 10 deputies; Missouri, 1 or more deputy wardens for each of the 16 Congressional districts; Montana, 8 special deputies; Nebraska, 1 chief deputy and 3 regular deputies; New Jersey, 1 protector and 24 wardens; New York, 50 protectors, including 1 chief and 3 assistants; Pennsylvania, a chief protector, who is also secretary of the board of game commissioners, and 9 protectors; Wisconsin, 2 Congressional district wardens for each of the 11 Congressional districts; and Wyoming, 3 assistant wardens.

It is worthy of note that 9 of the 36 States having State officers have now placed their warden service on a self-sustaining basis from the income derived from license fees, thus obviating the necessity of any appropriation from the State treasury. These States are: Idaho, Illinois, Michigan, Missouri, Montana, North Carolina, North Dakota, Washington, and Wisconsin. Florida, Tennessee, and Virginia also maintain their warden service without cost to the State. North Carolina received from nonresident licenses nearly $10,000. Idaho collected from all sources nearly $16,000, and at the close of the year had a balance of over $6,000. Missouri's account showed an excess of nearly $50,000 at the end of the year; Wisconsin, besides maintaining the warden service, devoted $10,000 of the license fund to the State fish hatcheries; and Illinois, after paying all the expenses of the warden service, had a balance of about $100,000 in the game-protection fund. On the other hand, appropriations for salaries and expenses of the warden service in 10 States where license receipts were small or licenses are not required were as follows for the biennial term 1905 to 1907: California, $25,000; Connecticut, $16,000; Massachusetts, $47,665 (1905 only); Nebraska, $24,230; New Jersey, $27,450; New York, $75,400;[a] Ohio, $11,000; Oregon, $8,400; Pennsylvania, $20,000, and West Virginia, $2,600.

The increased effectiveness of the license system is shown by the fact that nonresident licenses were required in 36 States as compared with 31 in 1904, and resident licenses in 17 as compared with 13 in 1904. The number of nonresident licenses issued in Florida, Maine, Michigan, Nebraska, New Hampshire, and Ontario showed substantial increases, the number in Michigan and Ontario being nearly twice as many, and in New Hampshire nearly four times as many as in 1904. Large increases in the number of resident licenses were also reported from Colorado, Indiana, Minnesota, Idaho, and New Brunswick, the numbers in Indiana and Minnesota being nearly double those of the previous year. A falling off in nonresident licenses was

[a] For 1905–6, exclusive of expenses for fish hatcheries, shell fisheries, and forestry.

noticeable in Delaware, Maryland, Minnesota, New Jersey, Ohio, Utah, Vermont, and New Brunswick. This was probably due in Utah and New Brunswick to the increase in the license fees, in Minnesota to the restriction prohibiting hunters from carrying their trophies home, and in Vermont to the reduction of the hunting season from ten to six days. Similarly in Michigan an increase in the resident license fee from 75 cents to $1.50 resulted in a decrease of nearly 33 per cent in the number of persons who took out licenses. In 6 of the Northern States and 2 of the Canadian Provinces which attract most nonresident sportsmen, the returns show some interesting facts in regard to the number of persons hunting big game. These States and Provinces, with the number of nonresident licenses issued in each, are as follows: Maine, 2,109; New Hampshire, 469; Vermont, 28; Michigan, 105; Wisconsin, 449; Minnesota, 84; New Brunswick, 283; Ontario, 443—a total of 3,970 licenses, of which more than 50 per cent were issued in Maine. In Michigan, New Brunswick, and Ontario, licenses for hunting big game were issued to residents as follows: Michigan, 14,878; New Brunswick, 3,821; Ontario, 5,825 licenses and 2,495 settlers' permits—a total of 27,019. In other words, about 31,000 persons were licensed to hunt big game in the States and Provinces above mentioned, without taking into account the residents in Maine, New Hampshire, Vermont, Wisconsin, and Minnesota, concerning whom statistics are not available. This would average 1 licensed hunter for each 4 square miles in Michigan, 1 for each 7 square miles in New Brunswick, and a nonresident for each 14 square miles in Maine.

Full statistics regarding the enforcement of the laws in the several States are not available, but from facts and figures which are published from time to time it is noticeable that the character of offenses for which convictions are secured varies widely in different States. Thus, in Massachusetts a large proportion of convictions are secured for hunting on Sunday; in New Jersey and Pennsylvania many are for violations of laws peculiarly applicable to foreigners; in Illinois the offenses consist, in large part, of hunting without license. In several cases extradition proceedings were resorted to successfully to enforce the game laws. Thus two hunters from Pennsylvania who violated the laws of West Virginia were brought back to the latter State for trial and were convicted, and ten residents of Kentucky who hunted in Indiana without license were likewise brought back under extradition.

Detailed reports of convictions are published in annual reports or in sportsmen's journals by the game commissioners of California, Illinois, Minnesota, Missouri, Massachusetts, and New Jersey. From these and from other sources it is noticeable that heavier fines than formerly are now secured in game cases. This fact is shown by the following list of a few cases reported from 13 different States during the year: In Illinois, for shipping 20 quail, two defendants, $155 each; for shipping 240 quail, $200 and costs; in Indiana, for killing 6 meadow larks, four hunters, $140; in Iowa, for shipping 200 prairie chickens and other birds, $400; in Massachusetts, for killing 1 deer on December 31, 2 defendants, $100 each; in Minnesota, for shipping 20 quail, $200 and costs; in New Hampshire, for killing a deer, $100; in New Jersey, for exporting game, $140 and costs, and for possession of 100 rail, $2,000 and costs; in New York, for possession and sale of quail and grouse in close season, several fines ranging from $300 to $600 each; in Oregon for killing deer, two defendants $100 each and three defendants $125 each; in Pennsylvania, for shooting 11 robins, one hundred and ten days' imprisonment; for selling grouse, $200 and costs; in Vermont, for killing deer, three defendants, each $120.38; in West Virginia, for shipping quail, $120; and in Wyoming, for killing elk for tusks, six months' imprisonment.

CONDITION OF GAME.

Accurate statistics of the abundance of game in the United States are not available, and even in the case of big game figures showing approximately the number killed can be given in only a few instances. Nevertheless, enough data are available to throw some light on conditions in the more important regions.

Deer.—Deer seem to have maintained their usual numbers in most parts of the country, and in a few sections, especially in Maine, Michigan, the Adirondacks, and certain parts of Pennsylvania, were more abundant than usual. In Maine the number shipped through Bangor, 4,656, exceeded that of any previous year, and the total number brought out of the State by the railroads was 6,799.[a] In Vermont 495 were killed during the six days of the open season. In Massachusetts and Connecticut deer are increasing, and in New Jersey the experiment of restocking the southern

[a] Exclusive of shipments via Portland and Rumford Falls Railway, but including some from points in New Hampshire on the Maine Central System.

counties of the State has apparently been entirely successful. Reports from the Rocky Mountain region show a slight increase in the number of deer in New Mexico and no apparent decrease in Wyoming. In Ontario the number of deer carried by the express companies, 3,310, showed an increase of 270 over the number transported in 1904.

Other big game.—Moose are increasing in Wyoming and apparently not decreasing in Maine, 253 having been shipped from the latter State during the year, as compared with 222 in 1904. Reports from Ontario show that the number shipped was 150 and the total number killed probably 200. The elk liberated in the Adirondacks wintered well and those in Wyoming maintained their normal abundance, notwithstanding the fact that the record of licenses shows that nearly 800 were killed. Antelope, however, are rapidly disappearing in Wyoming, and the State warden reports that about 200 were killed during the year. The band on Green River, supposed to be one of the largest in the United States, will soon dwindle to insignificant proportions unless afforded better protection. In the Yellowstone National Park antelope now number about 1,500, mountain sheep about 100, and deer and elk are abundant. The herd of wild buffalo near the head of Pelican Creek now contains about 30 animals, and the tame herd, established in 1902, 44.

Quail.—Quail suffered severely during the winter of 1904–5, particularly in southern New England and in some parts of Ohio, Indiana, and Illinois. On the other hand, in many sections of the South and West they still maintain their normal abundance. In Massachusetts, New Jersey, Ohio, and Indiana they have become so scarce that restocking is necessary to maintain the supply. Massachusetts experienced much difficulty in obtaining birds for propagation, but New Jersey obtained and liberated 8,178. Many of the birds secured for propagation in the autumn of 1905 came from Alabama and the Southwest.

Prairie chickens and woodcock.—Prairie chickens are increasing in Illinois and Nebraska, decreasing in South Dakota, and reported as almost exterminated in Iowa. An unusual autumn flight of woodcock occurred along the Atlantic coast, where in some places in Maryland and neighboring States the birds were more numerous than for several years past.

Wildfowl.—Ducks were remarkably abundant during the autumn throughout almost the entire country, and this flight following that of 1904 seems to indicate that restrictions on sale and on spring shooting are already showing some results. In Illinois it is gratifying to note that the wood duck was specially abundant. In a few localities, particularly in western Michigan, southern Wisconsin, and in Virginia, ducks were reported as scarce, and on Long Island and in Currituck Sound, N. C., although birds were abundant, the shooting was poor, chiefly on account of the mild weather early in the season, which enabled the birds to remain out on the open water away from the batteries and shore blinds.

FEEDING GAME.

The severity of the two winters 1903–4 and 1904–5 caused such mortality among upland game birds that the feeding of quail, which had been previously done in a more or less desultory way, was taken up and carried on systematically in a number of States. In New Jersey and West Virginia the deputy game wardens were assiduous in the work and in the District of Columbia the mounted police in the suburbs of Washington were impressed into the service. In Pennsylvania the game commission through the State zoologist sent 30,000 requests to farmers to feed the birds during inclement weather, and in Massachusetts the Fish and Game Protective Association distributed cards urging people to feed the quail, and furnished food without charge and instructions for placing it. The sportsmen of Spokane, Wash., issued a plea to farmers to feed the quail, and sportsmen in Maryland and farmers in Indiana organized associations for the purpose. In Massachusetts, Missouri, Nebraska, Virginia, and other States, more or less regular feeding of birds was undertaken by schools and by private individuals. In Illinois the State game commissioner authorized an expenditure of $50 in each county and a total of $3,300 was actually expended for feeding game birds during severe weather. The result of this activity has been the preservation of thousands of birds that otherwise would have perished for lack of food, and the spread of interest in the subject and information collected concerning suitable food and methods of distributing it most effectively can not fail to be of value in future.

As yet attention has scarcely been directed to the question of systematically feeding big game, but it is interesting to note that in the Yellowstone National Park, where the deer, antelope, and mountain sheep have been fed in winter for two

or three years, the animals have become exceedingly tame. Last season a field along the road at the north entrance of the park near Gardiner was planted in alfalfa and about 100 tons of hay for winter feeding was thus secured. The success of this experiment furnishes a useful suggestion for those States in which big game is apt to suffer for food during hard winters.

IMPORTATIONS OF LIVE MAMMALS AND BIRDS.

During the calendar year 1,287 mammals, 316,428 birds, and 2,330 eggs of game birds were imported into the United States under permit. Among the mammals were 800 guinea pigs and 10 beaver. Of the birds 271,416 were canaries, 1,099 pheasants, 4,881 other game birds, and 39,032 miscellaneous species. In comparison with the importations of 1904 these figures show an increase of about 45,000 birds, of which nearly 39,000 were canaries, and a decrease of about 500 eggs.

Among the game birds were 2,392 quail from Mexico, and 654 gray partridges, 117 capercailzie, 74 black game, 12 hazel grouse, and 7 willow grouse (dalryper) from Europe. The Mexican quail were imported as a direct result of the scarcity of native birds to meet the great demand for quail of any species for propagation. The willow grouse, or dalryper, apparently representing the first importation of this species, were consigned to the game preserve of the Cleveland Cliffs Iron Company on Grand Island, Michigan, and most of the capercailzie and black game were intended for the same preserve. A few capercailzie and black game, however, were imported for preserves in Massachusetts and New York. Of the partridges 450 were destined for North Carolina, about 75 for Massachusetts, and a few for Virginia and other States. Among the rarer pheasants were several each of the tragopans, 4 impeyan, 4 Siamese, 4 crossoptilon or Manchurian, a pair each of monaul and hoki, and 1 rufous-tailed pheasant. Several rare species of ducks and a Somali ostrich were also imported for the New York Zoological Park.

No injurious species were introduced into the United States, but the English sparrow, which has not yet reached all of the States, was reported for the first time from Arizona.[a]

PRESERVES.

Notable progress was made during the year in the establishment of game preserves, both Federal and State. By an act of Congress approved January 24, 1905, the President was authorized to set aside such portions of the Wichita Forest Reserve in Oklahoma as he deemed suitable for a game refuge, and on June 7, by Executive order, he established the entire Wichita Forest Reserve of 57,120 acres as a game preserve. This preserve is specially adapted for the propagation of deer, antelope, wild turkeys, and quail, and is available for many other kinds of game. Toward the close of the year the New York Zoological Society offered to place a herd of bison on the preserve if an inclosure was provided for its reception.

A part of the herd of dwarf elk in the San Joaquin Valley, California, presented to the Government several years ago by Miller & Lux, was successfully transferred to the preserve which was established for it in 1904 on the Kaweah River in the Sequoia National Park. About 20 animals were placed in this park, where, with ample feed and complete protection, it is hoped they will increase and insure the preservation of the species.

Three additional bird reservations were created by Executive proclamation on October 10. Two of these, the Huron and Siskiwit reservations in Lake Superior, Michigan, contain the largest breeding grounds of the herring gull thus far discovered in the interior; the other, Passage Key, at the mouth of Tampa Bay, Florida, is an important breeding ground and the resort of numbers of birds during migration, 50 species having been noted on the island in less than three months after the establishment of the reservation.

The attention given to preserves by several of the States shows the interest now taken in this feature of game protection, and marks the beginning of an important line of work in the future. The State game commissioner of Illinois has leased for ten years 160 acres south of Springfield, in Sangamon County, as a preserve for the propagation of pheasants, quail, and grouse. The fish and game commission of New Jersey, which had purchased 27 deer in 1904 and 83 in 1905, and liberated them on leased lands in the southern counties of the State, reports that its efforts have met with success, and that the deer are rapidly increasing. In Pennsylvania the board of game commissioners was authorized, with the consent of the commissioner of

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[a] Auk, XXII, p. 417, Oct., 1905.

forestry, to establish public game preserves in the State forest reservations "for the protection and propagation of deer, wild turkey, partridge, quail, woodcock, and wild pigeons," and was granted an appropriation of $6,000 for the purpose of establishing, stocking, and maintaining these preserves (Laws 1905, No. 320). Washington authorized the creation of game preserves by county commissioners on islands, and gave absolute protection to deer on all islands, and to waterfowl on the Columbia and Snake rivers in most of the counties east of the Cascades. The legislature of Wyoming set aside a tract of some 576,000 acres immediately south of the Yellowstone National Park as a State game preserve, where the elk and other big game might be free from pursuit and find ample protection. As the first large preserve of the kind established under State auspices, the Wyoming experiment merits special attention and will doubtless be followed by similar action in other States.

In Maine the National Association of Audubon Societies has secured from the State the lease of an island on the coast, called Old Man Island, the only known breeding place of the eider duck in the United States. In Louisiana the Audubon Society of that State has leased 22 islands, with an approximate area of 5,000 acres, and is purchasing Battledore Island, which contains about 1,000 acres. All of these islands are important breeding places for sea birds, and will be maintained as bird refuges.

That interest in private preserves continues unabated is shown by the additions made to the long list of those already established. The fact is becoming generally recognized that the game preserve furnishes the most promising method of maintaining a stock of game for the future, and that refuges, whether controlled by individuals, the State, or the Federal Government, can easily be made centers from which game of various kinds may be obtained or may overflow naturally to restock adjoining areas.

AREAS SURVEYED AND MAPPED BY THE BUREAU OF SOILS.

By A. G. Rice, *Chief Clerk, Bureau of Soils.*

The following statement shows the location and extent of soil surveys made up to December 31, 1905. Lithograph maps drawn on a scale of 1 mile to the inch, covering each area surveyed, indicate in colors the distribution of the various soil types. The accompanying sketch map (fig. 129) gives the location of these areas.

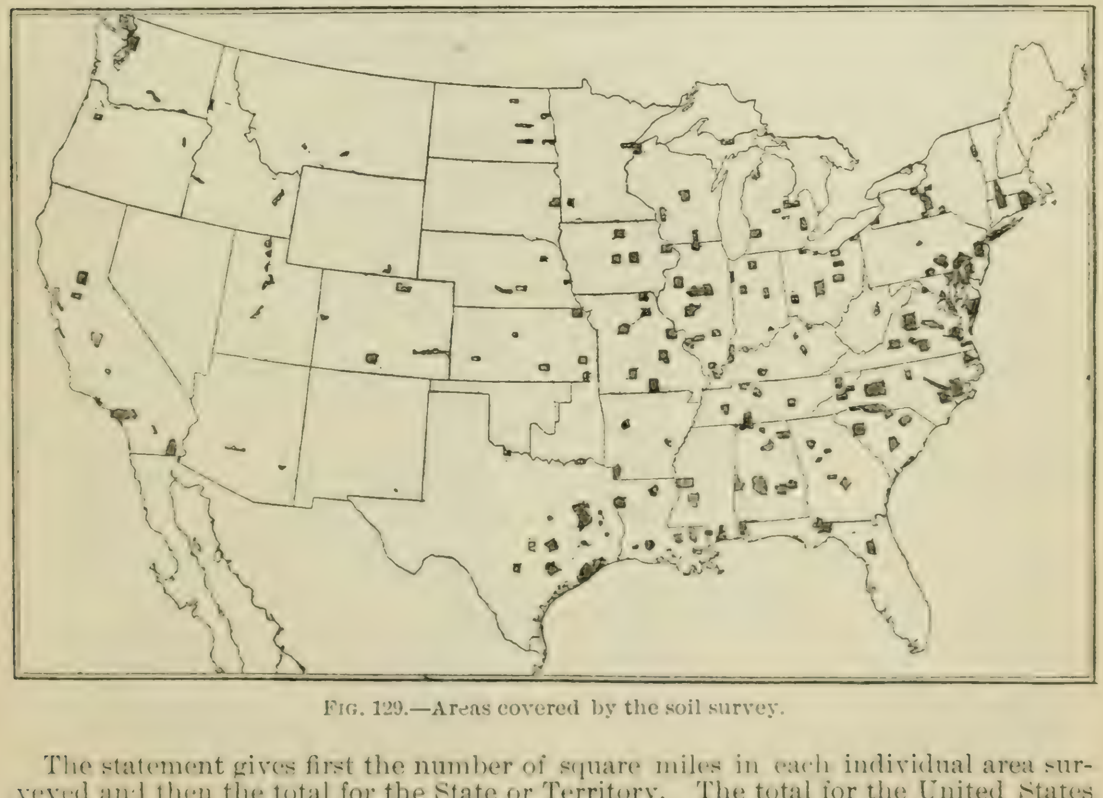

Fig. 129.—Areas covered by the soil survey.

The statement gives first the number of square miles in each individual area surveyed and then the total for the State or Territory. The total for the United States is 109,347 square miles or 69,982,080 acres.

Areas of soil surveys in the United States to December 31, 1905.

	Square miles.	
Alabama:		
Blount County	625	
Dallas County	992	
Fort Payne area	509	
Huntsville area	506	
Lauderdale County	708	
Macon County	621	
Mobile area	461	
Montgomery County	780	
Perry County	762	
Sumter County	893	
		6,857
Arizona:		
Buckeye sheet	43	
Phoenix sheet	243	
Solomonsville area	108	
Tempe sheet	163	
Yuma area	340	
		897
Arkansas:		
Miller County	626	
Stuttgart area	251	
		877
California:		
Bakersfield area	195	
Fresno area	628	
Hanford area	216	
Imperial area	1,084	
Indio area	234	
Los Angeles area	570	
Sacramento area	924	
Salinas sheet	189	
San Bernardino area	755	
San Gabriel area	259	
San Jose area	313	
Santa Ana area	275	
Solidad sheet	155	
Stockton area	521	
Ventura sheet	240	
		6,558
Colorado:		
Arkansas Valley area	945	
Grand Junction area	168	
Greeley area	687	
San Luis area	628	
		2,428
Connecticut:		
Connecticut Valley		505
Delaware:		
Dover area		314
Florida:		
Gadsden County	548	
Gainesville area	485	
Leon County	675	
		1,708
Georgia:		
Bainbridge area	364	
Cobb County	346	
Covington area	225	
Dodge County	489	
Fort Valley area	186	
Spalding County	205	
		1,815
Idaho:		
Boise sheet	155	
Blackfoot area	428	
Caldwell sheet	244	
Lewiston area	308	
		1,135
Illinois:		
Clay County	460	
Clinton County	491	
Johnson County	339	
Knox County	717	
McLean County	1,159	
O'Fallon area	68	
Sangamon County	866	
St. Clair County	650	
Tazewell County	645	
Winnebago County	526	
		5,921
Indiana:		
Boonville area	264	
Madison County	435	
Marshall County	445	
Newton County	393	
Posey County	387	
Scott County	197	
Tippecanoe County	499	
		2,620
Iowa:		
Cerro Gordo County	567	
Dubuque area	440	
Story County	576	
Tama County	720	
		2,303
Kansas:		
Allen County	504	
Brown County	573	
Garden City area	335	
Parsons area	398	
Russell area	270	
Wichita area	465	
		2,545
Kentucky:		
McCracken County	242	
Madison County	437	
Mason County	225	
Scott County	280	
Union County	361	
Warren County	533	
		2,078
Louisiana:		
Acadia Parish	636	
De Soto Parish	825	
East Baton Rouge Parish	451	
Lake Charles area	202	
New Orleans area	410	
Ouachita Parish	605	
Tangipahoa Parish	788	
		3,917
Maryland:		
Calvert County	217	
Cecil County	376	
Harford County	418	
Kent County	293	
Prince George County	480	
St. Mary County	363	
Worcester County	463	
		2,610
Massachusetts:		
Connecticut Valley		809
Michigan:		
Allegan County	828	
Alma area	282	
Munising area	407	
Oxford area	210	
Owosso area	270	
Pontiac area	307	
Saginaw area	984	
		3,288
Minnesota:		
Carlton sheet	413	
Marshall area	233	
		646
Mississippi:		
Biloxi area	615	
Crystalsprings area	231	
Jackson area	737	
Mayersville sheet	193	
McNeill area	198	
Smedes area	463	
Yazoo sheet	463	
		2,900
Missouri:		
Crawford County	747	
Howell County	919	
O'Fallon area	552	
Saline County	748	
Scotland County	440	
Shelby County	511	
Webster County	605	
		4,522

Areas of soil surveys in the United States to December 31, 1905—Continued.

	Square miles.	
Montana:		
Billings area	107	
Gallatin Valley area	324	
		431
Nebraska:		
Grand Island area	446	
Kearney area	792	
Sarpy County	227	
Stanton area	323	
		1,788
New Jersey:		
Salem area	493	
Trenton area	810	
		1,303
New Mexico:		
Carlsbad sheet	80	
Roswell sheet	49	
		129
New York:		
Auburn area	461	
Bigflats area	223	
Binghamton area	229	
Long Island area	845	
Lyons area	515	
Syracuse area	416	
Tompkins County	493	
Vergennes area	160	
Westfield area	260	
		3,609
North Carolina:		
Alamance County	365	
Asheville area	497	
Cary sheet	63	
Clayton sheet	214	
Craven area	897	
Duplin County	824	
Hickory area	988	
Kinston sheet	257	
Mount Mitchell sheet	497	
Newbern sheet	46	
New Hanover County	174	
Parmele area	236	
Perquimans and Pasquotank counties	461	
Princeton sheet	248	
Saluda area	190	
Statesville area	784	
		6,741
North Dakota:		
Cando area	283	
Carrington area	720	
Fargo area	406	
Grand Forks area	314	
Jamestown area	496	
		2,219
Ohio:		
Ashtabula area	340	
Cleveland area	509	
Columbus area	472	
Coshocton area	551	
Montgomery County	480	
Toledo area	403	
Westerville area	476	
Wooster area	469	
		3,700
Oregon:		
Baker City area	158	
Salem area	284	
		442
Pennsylvania:		
Adams County	534	
Chester County	760	
Lancaster area	269	
Lebanon area	669	
Lockhaven area	278	
Montgomery County	496	
		3,006
Porto Rico:		
Arecibo to Ponce		330

	Square miles.	
Rhode Island:		
State		1,085
South Carolina:		
Abbeville area	1,006	
Campobello area	515	
Charleston area	352	
Cherokee County	361	
Darlington area	599	
Lancaster County	486	
Orangeburg area	709	
York County	669	
		4,697
South Dakota:		
Brookings area		484
Tennessee:		
Clarksville area	547	
Davidson County	501	
Greenville area	664	
Henderson County	499	
Lawrence County	618	
Pikeville area	440	
		3,269
Texas:		
Anderson County	1,069	
Austin area	705	
Brazoria area	845	
Houston County	1,192	
Jacksonville area	100	
Lavaca County	995	
Lee County	666	
Lufkin area	99	
Nacogdoches area	97	
Paris area	548	
San Antonio area	484	
Vernon area	277	
Waco area	495	
Willis area	215	
Woodville area	100	
		7,887
Utah:		
Bear River Valley	334	
Provo area	373	
Salt Lake sheet	249	
Sevier Valley	235	
Weber County	310	
		1,501
Vermont:		
Vergennes area		227
Virginia:		
Albemarle area	1,410	
Appomattox County	340	
Bedford area	632	
Hanover County	475	
Leesburg area	419	
Louisa County	505	
Norfolk area	303	
Prince Edward County	430	
Yorktown area	598	
		5,112
Washington:		
Island County	233	
Everett area	525	
Sunnyside sheet	224	
Walla Walla area	201	
Yakima sheet	85	
		1,268
West Virginia:		
Upshur County		330
Wisconsin:		
Janesville area	451	
Portage County	797	
Superior area	482	
Viroqua area	[illegible]	
		2,231
Wyoming:		
Laramie area		309
Total		109,347

PROGRESS IN FRUIT GROWING IN 1905.

By W. H. Ragan, *Expert in Pomological Nomenclature.*

Thirty thousand carloads of oranges and lemons were shipped from California during the forwarding season of 1904-5. This is the grand climax of a progressive industry that had its beginning in 1876, when a single carload, consisting of only 300 boxes, was sent forward from the same field of production. The foregoing statement, together with the fact that, during the season of 1905, about 5,000 carloads of peaches were shipped out of Georgia, as against 700 carloads ten years before, will fairly illustrate the rapidly growing magnitude of our fruit industry.

The Lewis and Clark Exposition at Portland, Oreg., during the past season showed the marked progress which is being made in fruit growing. In some particulars the display of fruits at this great exposition excelled that at any of its predecessors. This was especially true in regard to cherries, and largely so in case of many others of our leading fruits. There has perhaps never been such a magnificent showing of sweet cherries. Many of the varieties displayed were native to that section of our country, notably the Bing, Republican, Lambert, and Lewelling, though the Napoleon (*Royal Ann*), Tartarian, and many others of the old and well-known sorts were to be seen at their best and in quantities rarely, if ever, met with at eastern exhibitions.

Apparently good and satisfactory progress is being made in the development of hardier citrus fruits by hybridization. Many promising new varieties are now on trial and a few—the Rusk and Willits citranges—have already been distributed for further trial throughout the more northern sections of possible citrus fruit growing. Much of this work with citrus fruits is being conducted under the auspices of the United States Department of Agriculture, yet the cooperation of private individuals is by no means wanting. As another writer has recently said, "We who are wishing to test or see good oranges far north of the present limit of successful citrus culture should be patient and hopeful."

In September last (1905), the American Pomological Society held its biennial session in Kansas City, Mo. For almost two-thirds of a century this society, founded by Wilder, Downings, Thomas, Mannings, and others equally deserving of note, has labored to establish a better knowledge of fruits and fruit growing among the American people, as well as to encourage the production of better varieties and more of them. In this line of work no other organization has accomplished so much good. The recent meeting at Kansas City was the first one (except that of 1895, which was held in California) to be held so far west, and it very naturally brought together much that was new in its personnel and in the fruits shown and discussed. In these particulars and in many others this meeting may properly be regarded as an important step in the progress of fruit growing during the period now being considered.

The public interest in nut culture seems to grow with the lapse of time. We now have several journals devoted to this interest, and also at least one leading society, the National Nut-Growers' Association, which is composed of men devoted to the building up of a special industry of this character. There are also individuals and associations engaging in nut culture in a commercial way. Formerly our native nut-bearing trees, with the exception of a few foreign-grown species, furnished a satisfactory supply for the home demand, but now that the woodman's ax has laid low much of our native forest which produced that abundant supply and the consumption of nuts has become so general through a better knowledge of their food value, this demand must be supplied from other sources. This has led to the culture and improvement of varieties, for even among our wild species varietal differences were very apparent, some being much better than others. Already we have many named varieties, as well as nursery-grown trees and plants for the supply of this growing demand. Throughout the larger portion of the Appalachian region the chestnut and its diminutive relative, the chinquapin, are best adapted for cultivation. In a large portion of the South, especially in the Gulf region and the valley of the lower Mississippi, the pecan takes the lead; in a large section of the Ohio Valley the shellbark and other hickories, the butternut, and the black walnut are especially productive; and on the Pacific coast the introduced walnuts and the almonds are already grown in immense quantities.

It is more and more apparent to the observing fruit grower that the future apple for the cold Northwest, if not already discovered, is to be found among the hardy seedlings produced or yet to be produced in that region. This subject, after patient trial of many introduced varieties, most of which have been found wanting, is now engaging the earnest attention of some of our most intelligent, practical men. The Wealthy still takes the lead among many others of this class that have been produced, but which have as yet had less extensive trial. At the meeting of the American Pomological Society held in Boston in 1903, a large number of varieties of these new

seedlings (perhaps a hundred or more) were on exhibition from Minnesota, many of which were exceedingly promising. During that exhibition this collection was a center of attraction to many practical fruit growers. This collection of new and promising seedling apples was awarded the Wilder silver medal by the committee. At the recent meeting of the same society, held in Kansas City in September last, another very interesting collection (of a very different type, however) of new and promising seedlings was exhibited by a gentleman from northern Iowa. This collection was also awarded the Wilder medal. Of course, the great and paramount object of all this experimental work is to secure varieties that will withstand the severe climatic conditions of that section. The work of *production*, as also the work of *testing*, requires patient, intelligent skill and years of time.

Two important publications relating to the apple have issued from the press during the last year. The State of New York, through the Geneva Experiment Station, has compiled and published a very interesting and useful volume on the apples of that State. In this volume there has been a successful bringing together of the varieties that have been found growing within the limits of the State of New York. The volume is liberally illustrated, the descriptions are full and accurate, the synonymy almost complete, and references are generous. The work is the result of several years' arduous and painstaking labor, by Prof. S. A. Beach, assisted by Profs. N. O. Booth and O. M. Taylor. The other publication, the "Nomenclature of the Apple," is a bulletin of the Bureau of Plant Industry of the United States Department of Agriculture, and is an approximately complete catalogue of the known varieties of this important fruit. It gives the leading name of each variety in its alphabetic order, with its synonyms and a brief description, and the origin of the variety and its season, where known, together with references to the place of first publication. The list as made up, embracing as far as known all synonyms, includes about 14,000 names, and covers almost 400 printed pages. These publications, if properly appreciated by the apple-growing public, will aid very materially in the untangling of the somewhat confused nomenclature of this, our leading fruit, an end much desired by all true pomologists. A thorough schooling in the correct nomenclature of fruits will be a long step in the direction of protecting the public against impositions so often practiced by unscrupulous venders of trees and plants who frequently offer a variety under a wrong name, or under a synonym of its true name.

BOUNTY LEGISLATION FOR THE DESTRUCTION OF NOXIOUS ANIMALS, 1905.

By D. E. LANTZ, *Assistant, Biological Survey.*

Legislation designed to encourage the destruction of noxious mammals and birds, during 1905, was of considerable importance, 14 States and Territories having amended their bounty laws.

In New England the trend of legislation is toward the repeal of bounty laws. After two years' trial, resulting in serious drains upon the State treasuries, Maine, New Hampshire, and Vermont repealed the laws providing for porcupine bounties. In the Western States there seems to be a tendency to abandon State bounties and to substitute county payments with a view of relieving the burden of State taxation. In most cases where county bounties are provided for, payment is optional with the governing boards. The unsatisfactory results of the bounty system are best shown by the frequency with which the laws are amended. The changes, although often experimental in character, usually improve the conditions. A prominent exception is the recent act of Rhode Island placing a bounty on hawks and owls without discrimination as to beneficial and harmful species.

Following is a synopsis of bounty legislation for 1905. Two laws for 1904 are included, they being the only ones of that year.

ARIZONA.—Paragraphs 4209 and 4211 of the Civil Code of 1901 are amended. Paragraph 4209 provides that boards of supervisors of counties shall pay the following bounties: Lobos or timber wolves, $20 each; mountain lions, pumas, or panthers, $20 each; bears, $10 each; raccoons, 25 cents each; and jack rabbits, 5 cents each. Paragraph 4211 provides for methods of proof and manner of payment of the bounty. [Chapter 29, 1905.]

This act continues county payment, increases the bounty on timber wolves from $5 to $20, and provides, for the first time in the Territory, a bounty on raccoons and jack rabbits.

CONNECTICUT.—Under the act of 1901 the legislature of 1905 appropriated $6,000 for payment of the bounty on foxes for 1905 and 1906. This is an increase of $1,000 over the sum provided for the two preceding years, and was required by the increasing number of claims. [Special Law 324.]

IDAHO.—The act of 1901 providing for bounties on coyotes, lynxes, and wild-cats is repealed, and all funds in the "special county bounty fund" of each county are transferred to the current expense fund of the county. [House Bill 71, 1905.]

Later an act was passed providing for the payment of a bounty of $15 on each cougar, lion, or panther, to be paid out of current expense funds of the county in which the animal is killed. [House Bill No. 182, 1905.]

KANSAS.—A new law amends the coyote and wolf bounty act of 1899 by making the payment of the bounty by county commissioners optional instead of obligatory. [Chapter 73, 1905.]

Under the original act nearly a dozen of the boards of county commissioners refused to pay bounties, and in one or more cases legal proceedings were instituted to compel payment. Although the coyote bounty is but $1 for each animal killed, the burden was regarded as too heavy for some of the thinly settled counties. The total of county payments for the State has averaged over $20,000 per year, and the cost seems to be increasing.

Another law was enacted which permits county commissioners at their discretion to pay a bounty of not over 5 cents each for crows. [Chapter 74, 1905.]

MAINE.—Section 15, chapter 32, of the Revised Statutes relating to a bounty on porcupines is repealed. [Chapter 8, 1905.]

The repealed law, passed in 1903, provided a State bounty of 25 cents each for porcupines killed within the State. During 1903 claims amounting to nearly $20,000 were presented for payment, and the treasurer in his report to the legislature of 1905 estimated that $40,000 would be required to meet the claims. No appropriation, however, was made.

The law relating to a bounty on seals was amended by a provision forbidding the killing of them in Casco Bay, during June, July, and August, with a rifle or long-range weapon. [Chapter 67, 1905.]

A law was passed providing for a State bounty of $5 for bears killed in Franklin County. [Chapter 160, 1905.]

An act of 1903 had the same provisions applying to Oxford County. The general law fixing a bounty on bears was repealed in 1901. Up to that time the State had spent upward of $100,000 in bounties for the destruction of bears alone.

MICHIGAN.—The bounty of 2 cents each for killing English sparrows was restored. The clerks of townships or cities issue certificates to the county clerk, who draws warrants on the county treasurer for payment. [Chapter 118, 1905.]

The original act providing for sparrow bounties was passed in 1887 and repealed June 8, 1901.

MONTANA.—Sections 3070, 3071, 3072, and 3076 of the political code of Montana, as amended by the act of 1903, are again amended.

Section 3070, as amended, fixes the State bounty on each grown wolf at $10; on each coyote, coyote pup, or wolf pup, at $3, and on each mountain lion, at $10.

Section 3071 changes the method of proof before bounty inspectors.

Section 3072 provides for the appointment of bounty inspectors by the district court and prescribes their duties.

Section 3076 increases the rate of assessment on live stock from 3½ to 4½ mills on the assessed valuation, to provide a State bounty fund. [Chapter 49, 1903.]

Each of the last four legislatures of Montana has amended the bounty law. Both the rate of bounty and the rate of taxation have been changed by the several acts. Governor Toole, in his message of 1903, called attention to the rapid increase of the cost of the bounty system. Claims against the State filed during the years 1901 and 1902 amounted to $450,000 of which $360,000 had been paid. He advised a reduction in the amount of bounties per head. The legislature of 1903 reduced the bounty on coyotes and young wolves, but the law just passed increases the reward for grown wolves and mountain lions.

NEBRASKA.—The State passed a general bounty law providing a State bounty on the following: Gray wolf, $5; coyote, $1.25; wild-cat, $1. Payment is made by the State treasurer on certificate of the county clerk. [Chapter 4, 1905.]

A provision in chapter 226 makes an appropriation of $15,000 for payment of bounties for 1906 and 1907.

NEW HAMPSHIRE.—The law of 1903 providing a bounty of 25 cents on hedgehogs is repealed. [Chapter 44, 1905.]

During the year ended June 30, 1904, claims paid under the act of 1903 amounted to $9,678.25 for 38,713 hedgehogs (porcupines) killed. Up to March 8, 1905, when the law was repealed, additional claims of $8,490.75 for 33,963 animals killed were paid. For the two years the law was in force $18,169 were paid in porcupine bounties.

NEW MEXICO.—A new law repeals section 1 of chapter 80 of the laws of 1903, and increases the rate of taxation on live stock to provide a county "wild animal bounty

fund." For 1905 and 1906 the rate is not to exceed 10 mills on the assessed valuation, and thereafter not to exceed 4 mills annually. The bounty is fixed as follows: Coyote, wild-cat, or lynx, $1; gray wolf or lobo, or bear, $20; panther or mountain lion, $10. [Chapter 77, 1905.]

Chapter 112 carries items of deficiency appropriation amounting to $523.50 to pay outstanding county claims against the Territory. Like Montana, New Mexico has enacted new county laws in 1899, 1901, 1903, and 1905.

Rhode Island.—A State bounty of 25 cents each on "wild hawk, except fish hawk, wild crow, or wild owl" is established, payable from the general treasury. An appropriation of $500 is made to pay the bounties for 1904. [Chapter 1160, 1904.]

South Dakota.—A general law changes the rate of bounty and continues State payment. The bounties are fixed as follows: Grown buffalo, black, or gray wolf, $5; coyote or wolf pup, $2; mountain lion, $3. The annual appropriation for payment is increased from $5,000 to $10,000, and, if the amount of the claims for any year exceeds the appropriation, proportional payment must be accepted in full. [Chapter 177, 1905.]

The law of 1899 did not provide for proportional payment. The appropriation of $5,000 was entirely inadequate and the legislature of 1903 had to appropriate $30,000 to pay deficiences from February 8, 1899, to July 1, 1901, when the act of 1901 went into effect. Under the law of 1901 the claims always exceeded the appropriation, so that in 1903, for instance, the actual payment for a coyote was reduced to 61 cents.

Texas.—The legislature passed a law amending the general bounty act of 1903, by excepting 171 counties from its provisions. [Chapter 71, 1905.]

Utah.—The legislature enacted a general law providing a State bounty of $1 each for coyotes, lynxes, or wild-cats, and $2.50 for mountain lions, and permitting counties to pay an additional bounty not to exceed half of the State bounty. An annual appropriation of $10,000 is made to pay State bounties. When the appropriation for any year is exhausted the State auditor notifies the county clerks, and no further certificates may be issued for that year. [Chapter 114, 1905.]

Another law was passed requiring the State auditor and State board of examiners to examine into the validity of outstanding certificates for payment of bounties under the laws of 1901 and 1903, and authorizing the payment of such as are found to be valid. An appropriation of $25,000 is made for their payment. [Chapter 109, 1905.]

Vermont.—The legislature repealed all existing laws for payment of bounties on noxious animals. [Chapter 131, 1904.]

The cost of bounties in Vermont had been steadily increasing. The act of 1898 had reduced the bounty on wolves, panthers, bears, and lynxes, but that of 1902 had increased the bounty on foxes from 60 cents to 75 cents and had added a bounty of 30 cents on porcupines. The total claims for 1903–4 were $12,714, over half of which was for porcupines. The bounty on foxes had more than doubled in four years and for 1903–4 was $4,652.

Washington.—In January, 1905, an act was passed over the governor's veto, providing for payment of bounties by the various counties, each county to receive a credit on its State taxes of the amount of bounty paid by it, the total of payment to be limited to $50,000.

In March the legislature amended the act of January by providing for payment from the current expense fund of each county and omitting the provision of reimbursement from the State taxes. The bounty is fixed as follows: Coyote or wolf, $1; lynx or wild-cat, $2.50; cougar, $5. [Chapter 63, 1905.]

This law received the approval of the governor.

Wyoming.—A new law provides a State bounty of $1 for coyotes, $3 for gray wolves, and $5 for mountain lions. Counties may offer an additional bounty not exceeding the State bounty. An appropriation of $40,000 is made to pay the bounties for 1905 and 1906. Proof may be made before the county clerk or a notary public. Former acts are repealed. [Chapter 37, 1905.]

The great mass of testimony as to the efficacy of bounties in controlling the depredations of wild animals is either neutral or against the system. One of the few favorable expressions concerning the effect of bounty laws is found in the message of Governor Richards to the legislature of Wyoming in 1903. He says: "The wisdom of the legislatures of the past in appropriating money to exterminate wild animals is demonstrated by the well-authenticated fact, which is vouched for by stockmen generally throughout the entire State, that there has been a gradual decrease in the number of wild animals such as wolves and coyotes that prey on and devour live stock."

PROGRESS OF ROAD LEGISLATION AND ROAD IMPROVEMENT IN THE DIFFERENT STATES.

Prepared in the Office of Public Roads.

In the following paragraphs a brief synopsis is given of the road laws in force at this time in the States designated, together with a short statement of work under such legislation. This review has been prepared in cooperation with State officials in each State. No reports are given from States in which no new legislation has been enacted nor substantial progress in road improvement made within the past year.

California.—The legislature of 1895 created the State bureau of highways, with three commissioners, appointed by the governor, to hold office two years, and appropriated $83,500 for carrying on State road work; in 1897, by legislative enactment, the bureau of highways was superseded by the State department of highways, with three commissioners to hold office for two years, these to be succeeded by one commissioner, appointed by the governor, for a term of four years and every four years thereafter. In 1897 the legislative appropriations for State road work aggregated $44,900; in 1899, $74,500; in 1901, $23,060; in 1903, $58,360; in 1905, $95,310. Most of the public roads are constructed under the direction of the boards of supervisors of the counties, by direct taxation for that purpose. During the twenty years, 1885 to 1904, inclusive, an aggregate of $49,567,201.31 was expended upon the county roads by the supervisors. There are 50,000 miles of county roads (of which 2,500 miles are "oiled roads") and 147 miles of State roads in use. The roads constructed and maintained by the State are in mountainous regions where the population is sparse and where direct communication between more productive sections is desirable. While California has no "State aid" road law, the legislature of 1905 appropriated $32,000 for the construction of 75 miles of specified county roads upon condition that the counties in which the roads are located add 50 per cent of the amount, the roads to revert to and be maintained by the counties after construction.

Connecticut.—The legislature of 1903 appropriated $225,000, to be expended under the direction of the State highway commissioner during the years 1903 and 1904. In this work the State pays two-thirds of the cost and in some cases three-fourths. About 450 miles of road have been built under the direction of the State highway commissioner since 1895, at an average cost of $3,000 per mile for gravel roads and $6,500 for 16-foot macadam roads. This cost includes grading and culverts.

Delaware.—Under a law passed in 1903 the State appropriation for road building in 1904 was $30,000. The State pays one-half the expense of building certain public roads.

Illinois.—An act was passed by the last general assembly and approved May 18, 1905, establishing a State highway commission consisting of three persons to be appointed by the governor, the duty of the commission being to investigate and carry on experimental work in road building, kinds of material, systems of drainage, etc. No compensation was provided for, but the actual expenses of the commissioners were to be paid. The act carried an appropriation of $25,000 per annum. Another act was passed at the same session and approved May 18, 1905, authorizing and empowering the employment of convicts and prisoners in the penal and reformatory institutions of the State in the manufacture of tile and culvert pipe for road drainage, in the manufacture of machinery, tools, and appliances for the building, maintaining, and repairing of the wagon roads of the State, and in preparing road building and ballasting material upon the requisition of the State highway commission.

Iowa.—The act providing for the State highway commission became effective April 13, 1904, the Iowa State College being designated as the highway commission. The duties of the commission are to devise plans of highway construction and maintenance, to conduct demonstrations in highway construction, and to act as a bureau of information. Another act provided the commission with $7,000 for the biennial period July 1, 1904, to July 1, 1906.

Maine.—Legislation was enacted in 1901 providing that any city or town may receive from the State treasury one-half the sum actually appropriated and expended on some road within its corporate limits to be designated by the county commissioners as State road; the work had to be done under supervision of the county commissioners and to be accepted by them; and the maximum amount to be drawn by any town was $100. In 1903 the legislature raised this maximum to $200, and in 1905 to $300.

The legislature in 1905 created the office of commissioner of highways, whose duties are to act in an advisory capacity when consulted by county and municipal authorities, and "to compile statistics relating to the public ways and make such

investigation relating thereto as he shall deem expedient, in order to secure better and more improved highways in the State." The law also provides that "said commissioner shall hold each year under the auspices of the county commissioners a meeting in each county, for the open discussion of questions relating to the building and maintaining of public ways, of which due notice shall be given to the towns and cities in each county by the said county commissioners."

Maryland.—Since 1898 $10,000 has been appropriated each year for carrying on the work of the highway division of the State geological survey. A careful and searching inquiry into the road question of the State has been made and several exhaustive reports issued. The highway division reports, among other things, that there are 16,000 miles of roads in the State, of which 497 miles are toll roads. There are about 900 miles of stone, shell, and gravel roads maintained by the counties. It is estimated that the counties spend for road maintenance $600,000 annually, and that the people of the State pay about $140,000 annually in tolls. It is estimated that the average hauling distance is 6.7 miles; that the average amount hauled per horse is 0.58 of a ton; that the average cost of hauling 1 ton per mile in Maryland is 26 cents, and that the cost of properly built macadam roads in Maryland, graded to a width of 20 feet, with macadam 12 feet wide, varies from $4,000 to $6,000 per mile.

The general assembly of 1904 passed an act which provides $200,000 annually for the construction of modern macadam roads. The court of appeals in February, 1905, decided that this law is constitutional. This law provides that plans and specifications are to be prepared by the State geological survey, and that one-half of the cost of construction is to be paid by the State and one-half by the county. The amount received by each county from the State bears the same ratio to the total State appropriation as the public-road mileage of the county bears to the total public-road mileage of the State.

Massachusetts.—Massachusetts appropriates annually $450,000 for construction and $60,000 in 1905 for maintenance. The State pays the entire cost of the road, but 25 per cent of the cost is assessed on the counties. The Commonwealth has appropriated in the aggregate for the building of roads $6,000,000. The Massachusetts highway commission, which was established in 1893, has received contributions from towns and individuals to assist in building roads which amount to $330,000, making a sum total of $6,330,000. The recent legislature appropriated $2,250,000 to be expended for State highways during a period of five years. The average cost per mile of 12 to 15-foot stone roads in Massachusetts in 1904 was $5,750, the depth varying from 3 to 12 inches. Gravel roads 15 feet wide and 6 to 8 inches deep cost from $3,000 to $4,000 per mile. Up to October 1, 1905, 615 miles were built or under contract. It is estimated by the Massachusetts highway commission that there are 20,000 miles of roads in the Commonwealth, and that 1,900 miles will ultimately be improved by State aid.

Michigan.—The State reward road law enacted by the 1905 legislature provides State rewards to be paid to townships and counties that build gravel or macadam roads—$250, $500, $750, and $1,000 a mile, according to the kind of road built, when the same has been approved by the State highway commissioner.

The functions of the State highway department are to instruct, to inspect, and to reward.

Minnesota.—The legislature of 1905 passed an act, approved April 13, providing for the appointment by the governor of a State highway commission whose duties it shall be to study the best methods of road construction and improvement and to investigate the location of road-building materials in the State, and to give such advice, assistance, and supervision in the construction of roads as their time and opportunity will permit. For the purpose of aiding in the construction of roads a tax of one-twentieth of 1 mill on all taxable property is made, which is to be apportioned by said commission among the several counties.

New Hampshire.—In 1905, the legislature enacted a law intended to secure a more uniform system for the improvement of the main highways of the State.

The general supervision of the work so far as the State is concerned is committed to the governor and council who are authorized to appoint a State engineer; and so far as municipalities are concerned the work is placed under the control of the county, town, and city authorities.

The general plan involves two important features, the first being a provision under which each town is required to set apart for use on the main highways a portion of the money raised by local taxation for road purposes. The portion required to be set apart is as follows: In towns having a total valuation of less than $2,000,000, $1 on each $1,000 valuation; in towns having from $2,000,000 to $3,000,000 valuation, 75 cents on each $1,000 valuation; in towns having from $3,000,000 to $5,000,000 valuation, 50 cents on each $1,000 valuation; in towns having from $5,000,000 to $15,000,000

valuation, 33⅓ cents on each $1,000 valuation; and in towns having $15,000,000 and upward, 25 cents on each $1,000 valuation.

The second important feature is that providing for State aid, and appropriating for this purpose $125,000 annually for six years. The local authorities of counties, cities, or towns may apply for a share of this fund. In order to secure this State aid, the local authorities must raise an additional sum equal to 50 per cent of the portion set apart as indicated above. Application must be filed with the governor and council on or before May 1 of any year in order to secure State aid during that year.

The amount of State aid which may be granted depends on the valuation of the city, town, or unincorporated town or place for which the application is made. In cases where the valuation is less than $100,000, State aid may be given at the rate of $3 for every $1 locally raised and set apart under this act. This ratio decreases as the valuation increases until a city or town having a valuation of $3,000,000 or more gets only 20 cents for every $1 set apart from funds locally raised.

Of the 235 cities and towns in the State, 194 have applied for State aid for the year 1905. All permanent improvements are to be made on such main roads as shall eventually result in continuous lines throughout the State.

The law of 1905 also converted about 125 miles of road into State roads, to be maintained by the State, such roads being entirely in the summer resort regions. The above act was passed as a result of a law of 1903, providing for the investigation of conditions in the State, and appropriating $15,000 therefor.

New Jersey.—The total mileage of completed roads constructed under the provisions of the State aid act was, on July 1, 1905, 1,065. The total cost of these roads to that date was $5,430,000. From 1891 to December 1, 1904, the State expended $1,766,595.10, and the total cost of the work was $5,745,515.28. The counties' expenditure is more than double that of the State. This is due to the fact that all bridges and culverts as well as engineering and supervision fees have been paid for by the counties without any assistance from the State. The State's appropriation for road improvement increased from $25,000, in 1892, to $250,000 in 1902, at which point it has since remained until this year (1905), when it was increased $20,000 to pay the salary of the supervisors of the new work. The revised State aid law enacted by the last legislature provided: (1) That a road must be at least 33 feet in width to receive State aid; (2) that no survey shall be commenced until the consent of the State commissioner of public roads shall have been first obtained; (3) that within thirty days after the approval of the plans by the commissioner it shall be the duty of the freeholders to advertise for bids; (4) that the State shall pay the supervisors appointed by the commissioner, and not the counties, as they have heretofore done; (5) that the power and control over the improved roads shall be vested in the board of chosen freeholders to the exclusion of all township, town, borough, village, or other municipal officers; (6) that the county supervisor, upon whom devolves the duty of keeping the roads in repair, may be summarily dismissed at any time by the State commissioner or the board of chosen freeholders whenever in his or their judgment such supervisor is incompetent or neglectful in performing his duties; (7) that the county board be given full power to construct and improve all the necessary approaches to dwellings along the line of any road which may have been destroyed or damaged by any alteration in the existing grade, whether within or without the line of such road; and (8) that any road or section of road lying within the corporate limits of a city may be transferred by the board of freeholders to the city authorities upon the latter entering into a written agreement to keep up and maintain the same in good repair.

Since 1891, 796.14 miles of stone and 247.39 miles of gravel roads have been built. In addition to all this the local authorities have been encouraged to improve as many more miles without waiting for the State's aid, so that at the present time New Jersey has over 2,200 miles of improved roads.

New York.—Under the Higbie-Armstrong Act the appropriations by the State and counties for the years 1898 to July 1, 1905, were $10,746,707.

Under the Fuller-Plank Act the appropriations by the State and towns for the years 1899 to 1905, inclusive, were about $5,540,000, making a grand total of $16,284,000 appropriated by the State, the counties, and the towns for the improvement, repair, and maintenance of public highways within the State.

Under the Higbie-Armstrong Act there are now on file in the office of the State engineer and surveyor petitions from the various counties of the State for nearly 5,466 miles of road.

The legislature of the State twice passed a constitutional amendment which provides that the State may bond itself for $50,000,000, $5,000,000 of which is to be available each year for ten years, for the improvement of the public roads. This amendment was submitted to the popular vote in 1905, and was ratified.

The average cost of macadam roads in 1901 was $7,950 per mile in 1902, $8,819 per mile; and in 1903, $8,063 per mile. The usual width of such highways is from 12 to 16 feet and the usual thickness 6 inches after rolling. The average cost of 32 miles of gravel roads in Orange County was $2,146 per mile, the usual width 12 to 16 feet, and the average depth 6 inches after rolling. All grading, small bridges, culverts, etc., are included in the cost. There are 14,097 miles of public highways in the State.

OHIO.—Under the law establishing the highway department, enacted April, 1904, an appropriation of $10,000 was made for the expenses of the department. The law provides that all appropriations for State aid shall be divided equally among the 88 counties of the State. The act establishing the highway department provides for compiling statistics, investigating materials and methods, and gathering and disseminating information in regard to road building. In the construction and improvement of roads under the provisions of this act, one-fourth of the expense is to be paid by the State and three-fourths by the county; one-third of said three fourths, however, is to be paid by the township. In apportioning the 25 per cent which is to be paid by the township, 10 per cent will be a charge upon the whole township and 15 per cent a charge upon the abutting property.

PENNSYLVANIA.—The legislature of 1905 reenacted the State aid law of 1903, with a number of important changes designed to facilitate the actual work of the State highway department. The State's proportion of the expense of road construction was changed from two-thirds, as fixed by the law of 1903, to three-fourths. Additional engineers and clerks were provided for, as the work of the department was too heavy to be kept up by the force originally provided. The appropriation of $6,500,000 made in 1903 was left unchanged. The legislature also passed a new law making uniform the system of electing road supervisors, and also provided that townships which abolish the "work tax" shall receive in cash from the State a sum equal to 15 per cent of the amount of cash tax collected. Beginning with January 1, 1906, the licensing of all automobiles operated in the State will be in the hands of the State highway department. One of the important provisions of the new State aid law is that no street-railway tracks may be laid on any public road in the State without the approval and consent of the State highway commissioner. The department had under construction July 1 about 150 miles of road, with over 300 applications on file.

RHODE ISLAND.—The general assembly of the State of Rhode Island has, during the three years 1903, 1904, and 1905, appropriated $100,000 annually for the construction, improvement, and maintenance of the State highways. This money was to be expended under the direction of the State board of public roads, and it has constructed in the three years, for the above sums, about 65 miles of macadam highway 14 feet wide. The different towns in the State have built out of their annual highway appropriations about 30 miles in the same three years. The legislature at its last session passed a bill submitting to the voters at the November election the proposition of issuing highway bonds.

VERMONT.—No change was made in road legislation at the last session of the legislature, except that the proceeds of the automobile tax were added to the State highway fund.

WASHINGTON.—In 1903 an act was passed providing for the collection of all road, poll, and property taxes in cash. The legislature of 1905 created the office of highway commissioner, and vested the appointing power in the governor. It also created a State highway board, to be composed of the State auditor, the State treasurer, and the State highway commissioner. There was also created a public highway fund to be raised by the levy of one-fourth of 1 mill tax upon all the taxable property in the State. Washington has no State aid road law, and the duties of the State road officials are at present confined to the construction of 12 State roads under specific appropriations.

WISCONSIN.—Legislation was enacted in 1901 authorizing the levy of special highway taxes in addition to the taxes previously provided for, which in the aggregate might reach 17½ mills on the dollar. In certain cases where a town grades a highway to a width of 24 feet, and wishes to cover not less than 8 feet in width to a depth of 4 inches with gravel, crushed rock, or clay and gravel, the county is required to bear one-half the expense of such covering. In 1905 the legislature took the first step toward an amendment to the constitution, which, if ratified by the electors, will enable the State to appropriate money for the construction and improvement of public highways. The sentiment in favor of road improvement has been gathering strength for many years and is manifest in nearly every county in the State.

IMPROVEMENTS IN FARM PRACTICE.

By W. J. Spillman, *Agriculturist.*

The most important change going on in systems of farming at the present time is the very marked tendency toward diversified farming in the cotton belt. This is due to a number of factors. For many years the college and experiment station authorities and the agricultural press of the South have urgently advocated such a change. The exceedingly low price of cotton a few years ago and the depleted condition of the soil, due to continued cultivation in cotton, rendered a change imperative. Most important of all, however, in its influence on the tendency toward diversification, has been the spread of the cotton boll weevil. Since it has become evident that the weevil will spread over all or nearly all of the cotton area, diversified farming in the South has become a very live topic and forms a prominent feature of the discussions at all farmers' meetings. This diversification has taken three general directions:

(1) The production of small fruits is developing at a rapid rate, and is adding much to the income of the South. So far markets for fruit have been very satisfactory.

(2) The development of winter trucking has gone forward with very rapid strides. Generally speaking, truck crops have been sold to advantage, but in some instances there has been overproduction.

(3) A very marked increase of interest in live-stock farming is noticeable throughout the South. Beef cattle, dairy cattle, hogs, and poultry are receiving more attention at the present time than at any previous time since the war.

The continued and growing scarcity of farm laborers in all sections of the country is becoming almost a matter of alarm to farmers. There is no section of the country where the need of them is not urgent. In several of the Southern States systematic efforts are being made to secure immigration of a type that will furnish competent farm labor, and the results thus far have been encouraging.

Accompanying the development of the work in farm management in the Department of Agriculture, there has been a marked increase in the interest in work of this character in the agricultural colleges and experiment stations of the country. A good many of the colleges were previously doing much work in this direction. At the present time most of the colleges offer courses of lectures in farm management, and nearly all of them conduct more or less demonstration work.

Another phase of farm practice receiving considerable attention in all parts of the country is that of cover crops for orchards and winter cover crops for bare fields in ordinary farm-cropping systems. This interest is most noticeable in the fruit regions of southern California, where the use of cover crops is developing rapidly. In the cotton-growing States hairy vetch, common vetch, crimson clover, bur clover, and the various cereals are receiving attention as winter pasture, as a means of preventing washing of soils and for the purpose of adding humus to the soil.

THE PRINCIPAL INJURIOUS INSECTS OF 1905.

Prepared in Bureau of Entomology.

In previous years it has been customary to present the records of the principal injurious insects of the year in alphabetical order, without relation to food plant or host. This year the records are so classified that at a glance the principal insect enemies of the year of any special crop or product may be readily noted. The reports for the subject covered by each division or section of the Bureau have in each case been prepared by the expert in charge, and cover not only the records made directly by the Department but all the records available for the year. The report on the insect enemies of truck crops and stored products is by F. H. Chittenden; that on the insect enemies of cotton and other southern field crops is by W. D. Hunter; that on the insect enemies of cereal and forage plants, by F. M. Webster; that on the insect enemies of deciduous fruits, by A. L. Quaintance; and that on the insect enemies of forests and forest products, by A. D. Hopkins. Other subjects covered are: Insects as animal parasites and in relation to disease; insects injurious to shade trees; insects injurious to ornamental plants; and insects which detrimentally affect the nut industry.

The year 1905 was not marked by any noteworthy outbreak of insects destructive to deciduous fruits. A few species were locally more abundant than usual, and others which in certain sections had been especially abundant seemed to be decreasing to more normal numbers. Many of the more important enemies of fruit trees, such as the codling moth, apple and peach tree borers, scale insects, etc., ordinarily do not greatly vary in numbers from one year to another, the extent of their destructive-

ness depending principally upon the greater or less thoroughness with which remedial work is carried out. This work, especially in the case of insects treated by spraying, is often interfered with by unfavorable weather conditions.

In the case of citrus insects there is little variation from year to year. The white fly in Florida is there the notable pest, and seems to be increasing, at least in its northern range. The conditions in California and elsewhere remain substantially unchanged.

Among insects injurious to cereal and forage crops there were noticeable outbreaks locally of such insects as the Hessian fly and army worm, while certain other pests of this class, such as the southern grain aphis (*Toxoptera graminum*), were conspicuous by their absence. Grasshoppers also were unusually scarce, taking the country as a whole. The same is true to a certain extent of insects of other classes. The root-maggots and common stalk-borer were among the most conspicuous insects affecting vegetable crops, while the harlequin cabbage bug is still rare in its northern range. The pea aphis was reported from only two localities. One of the most serious outbreaks was that of the sugar-beet leaf-hopper in the West.

INSECTS INJURIOUS TO VEGETABLE AND TRUCK CROPS.

The common asparagus beetle (*Crioceris asparagi* L.) continues its spread westward. It was unusually destructive in new localities in the States of Michigan and Illinois, as also in Virginia and Maryland. The reported occurrence of this species in California in 1904 can not be verified, by reason of its apparent extermination in the locality where it was supposedly established.

The harlequin cabbage bug (*Murgantia histrionica* Hahn), though quite injurious in the Gulf region and in California, is still rare in the North except in very limited localities.

A leaf-beetle (*Diabrotica balteata* Lec.) injured vegetable crops, especially beans, okra, and cucumber, in several localities in Texas. Although troublesome in Mexico, this insect does not appear to have been recorded as injurious hitherto in the United States.

Blister beetles vary somewhat in destructiveness from year to year. The common eastern species were normally troublesome from Ohio to the Gulf region, but the western species appeared, on the whole, much less numerous.

The cabbage aphis (*Aphis brassicæ* L.) has become a menace to the cabbage industry of Texas. It was notably abundant in British Columbia and in a few other portions of Canada.

The imported cabbage webworm (*Hellula undalis* Fab.) was reported injurious in Texas for the first time. It was learned that it was generally distributed in the southern portion of that State, where cabbages are raised on a large scale, being particularly destructive along the coast in the vicinity of Corpus Christi. It was observed also at Beeville, 50 miles from the coast.

The variegated cutworm (*Peridroma saucia* Hbn.), probably the most destructive of all cutworms, attracted attention in North Dakota and Oregon from its injuries to various vegetable and ornamental plants.

The melon aphis (*Aphis gossypii* Glov.) did more or less injury to melons and okra over a considerable area in Texas and occurred abundantly elsewhere as far north as New Hampshire. Field experiments have been carried on during the year looking to its control by tobacco fumigation.

The melon caterpillar (*Diaphania hyalinata* L.) and pickle worm (*Diaphania nitidalis* Cram.), always pests in the Gulf region, were both concerned in injury to cucumbers in Florida and the former injured other cucurbits in Texas and South Carolina.

The pea aphis (*Nectaropho a destructor* Johns.), which ravaged the pea fields of this country a few seasons ago, causing a total loss in two years of about $7,000,000, was injurious during 1905 near Baltimore, Md., and Haverford, Pa.

The pepper weevil (*Anthonomus æneotinctus* Champ.), which was only recently introduced into this country and which was first recorded as a pest in 1904, apparently has not increased its range. At Boerne, where it was first noticed in Texas, it could no longer be found. Near San Antonio, however, it occasioned as much damage as formerly.

Root maggots have continued as destructive as during the last three or four years. The onion maggot (*Pegomya cepetorum* Meade) appeared to be more prevalent than ever before in its history. It was exceedingly troublesome from Massachusetts to Wisconsin and Michigan and in New Jersey. Injury to onions in Texas was attributed to the same species. The cabbage maggot (*Pegomya brassicæ* Bouché) has continued its destructive work from New England to Maryland and westward. Remedial

measures advised do not appear to have been generally adopted. The seed-corn maggot (*Pegomya fusciceps* Zett.) destroyed garlic and young cabbage in Texas and various garden plants in Pennsylvania. Maggot injury to cabbage and cauliflower in Louisiana and South Carolina is attributed to this species. Very serious and general injury to root crops by maggots was reported from Alaska.

The common stalk borer (*Papaipema nitela* Guen.) has continued in injurious numbers from Canada and Maine as far south as Mississippi and westward to Iowa and Minnesota, injuring a great variety of crops, notably potato, tomato, sweet corn, peppers, bush fruits, and ornamental plants. In the South it attacked cotton.

The sweet-potato weevil (*Cylas formicarius* Fab.) was more injurious in Texas than in 1904 and appears to be extending its range.

White grubs and wireworms were decidedly destructive, at least locally—white grubs unusually so. In one locality in Vermont the latter destroyed 90 per cent of the beet crops grown for market, besides other vegetables. Wireworms destroyed radish and strawberry in Pennsylvania, potatoes, corn, and oats in Ohio, and potatoes in Washington State. Vegetable and other crops were injured also in South Carolina and Maine.

The sugar-beet leaf-hopper (*Eutettix stricta* Ball), locally known as "the white fly," and by its work called "blight," caused great damage in Utah, southern Idaho, and western Colorado during the season of 1905. The estimated damage amounted to $500,000. Late-planted beets were principally affected, the early planted being little injured.

The sugar-beet leaf-beetle (*Monoxia puncticollis* Say) was injurious to young sugar beets in Colorado.

The sugar-beet webworm (*Loxostege sticticalis* L.), an imported beet pest in Colorado, has extended its ravages to Alberta, Canada, and has done serious injury there also.

The strawberry weevil (*Anthonomus signatus* Say) was quite injurious in New Jersey, destroying almost entire crops in many cases. Its ravages extended into Canada, where it did great damage in the vicinity of Toronto.

The strawberry crown girdler (*Otiorhynchus ovatus* L.) was the cause of considerable annoyance in the North, especially in Maine, by entering dwellings, as well as by its injury to strawberry. It was notably destructive in strawberry fields in British Columbia and was reported in Washington State.

Few other insects injurious to strawberry and bush fruits attracted attention by the severity of their attacks.

INSECTS INJURIOUS TO STORED GRAIN AND OTHER PRODUCTS.

The occurrence of the Mediterranean flour moth (*Ephestia kuehniella* Zell.) in new localities in several States has been reported. More recent information shows that this species is spreading still more rapidly than was believed, causing the greatest trouble in the principal milling districts of Minnesota and Wisconsin. It was discovered also at Portland, Oreg. Every known remedy for this "scourge of the flour mill" has been tested and millers generally do what they are able toward eradicating the insect.

The cigarette beetle (*Lasioderma serricorne* Fab.), which has been gradually increasing in destructiveness in spite of remedial measures which are becoming somewhat generally adopted, was the occasion of losses from its ravages in stored tobacco, from New York to Florida, and westward to Kansas and Missouri. In the District of Columbia and in Missouri it was complained of as a pest in upholstered furniture coming from Baltimore, Md., Pennsylvania, and Michigan.

The tobacco seed beetle (*Catorama impressifrons* Fall) was identified during the year with injury to tobacco seed in Cuba and Texas in earlier years.

A foreign grain beetle (*Ostoma pusilla* Klug) was destructive to stored rice at Charleston, S. C., where it has apparently become established from oriental importations.

The European grain moth (*Tinea granella* L.) was found in abundance in a mill in Ontario, Canada, but there is as yet no positive evidence of its establishment as a pest in America.

INSECTS INJURIOUS TO COTTON AND OTHER SOUTHERN FIELD CROPS.

Damage by the cotton boll weevil (*Anthonomus grandis* Boh.) was, on the whole, less noticeable than during the preceding season. Unusual conditions during the preceding winter, as well as unfavorable climatic conditions during the fall of 1904, caused a comparatively small number of weevils to hibernate successfully. In cer-

tain areas in Louisiana into which the insect did not make its advent until late in the fall of 1904, it failed to make its appearance in 1905 until migrations from other regions had taken place. The comparative scarcity of weevils throughout Texas and Louisiana, together with favorable drought at the critical time, reduced the damage much below the usual amount. While it was estimated that damage during the year 1904 amounted to approximately $22,000,000, it is not likely that the loss during 1905 reached $18,000,000.

The cotton bollworm (*Heliothis obsoleta* Fab.) was somewhat more numerous than during the preceding season, although the damage done did not amount to nearly as much in Texas, Indian Territory, and Louisiana as in certain years during the past decade. Local damage was greatest in the two northern tiers of counties in Texas, although considerable injury was occasioned in Indian Territory and Oklahoma.

The cotton aphis (*Aphis gossypii* Glov.) has been very abundant. Its injury is of far greater importance than formerly, since now it is desired to have the cotton plant produce an early fruit in order to escape the ravages of the boll weevil. The young plants have not only been seriously retarded in growth by the cotton aphis, but in several localities they have been entirely destroyed by it.

The tobacco thrips (*Euthrips nicotianæ* Hinds), hitherto referred to as the strawberry thrips (*Thrips tritici* Fitch), continued to cause very considerable injury to shade-grown tobacco in Florida and southern Georgia. The work of the insect causes "white veins," which greatly reduce the selling price of the leaf. In addition to this direct loss, some trouble is caused on account of the necessity of sorting out the damaged leaves. The insect was the subject of investigation by the Bureau of Entomology. Kerosene emulsion has been found a practically perfect remedy.

The conchuela (*Pentatoma ligata* Say), besides being destructive to cotton, has established a reputation at Barstow, Tex., as a serious enemy of seed crops of alfalfa and to peaches, grapes, grains, and garden vegetables. Injury to cotton at that place amounted to about 5 or 6 per cent of the crop. In some fields damage was considerably higher, in one case reaching as high as 15 per cent.

The rice weevil (*Lissorhoptrus simplex* Lec.) was reported from many localities in the southern portion of Texas, where rice is being cultivated on a large scale. In individual cases the damage was of such extent as to make replanting necessary.

The cotton-boll cutworm (*Prodenia ornithogalli* Guen.) was unusually abundant in northern Texas and in Indian Territory during the season.

In the spring of 1905 a sow bug (*Armadillidium vulgare* Latr.) was unusually abundant in Texas and caused considerable damage to young growing cotton, to garden vegetables, and to rose and other ornamental plants, including the palmetto. Large numbers entered houses and caused considerable annoyance. Another sow bug (*Porcellio lævis* Latr.), although very numerous, did not cause serious injury.

The cotton red spider (*Tetranychus gloveri* Bks.) was injurious in Georgia and South Carolina. Continued economic study was given it by the Bureau of Entomology.

The cotton leaf-beetle (*Luperodes varicornis* Lec. [*Luperus brunneus* Cr.]) was reported from many localities in Georgia and Alabama as doing injury in the beetle state to cotton by eating the leaves, blossoms, and forms. This species does not appear to have been hitherto recorded as attacking cotton.

Calocoris rapidus Say, the cotton leaf-bug, was accused of injuring cotton bolls in North Carolina and Alabama.

The cotton leaf caterpillar (*Alabama argillacea* Hbn.) was exceptionally abundant in Louisiana and Texas, but its defoliation of cotton plants operated as a benefit in exposing the boll weevil to the destructive effects of light and heat.

With the rotation of crops from cotton to corn and forage crops, the corn aphis (*Aphis maidis* Fitch) appeared. Not only does this insect injure Indian corn, but in many instances it prevents the fruiting of kafir corns and sorghums. Thus far the fodder has not been materially damaged as feed, but thousands of dollars' worth of seed has been prevented from maturing.

INSECTS AFFECTING FORESTS AND FOREST PRODUCTS.

The Black Hills beetle (*Dendroctonus ponderosæ* Hopk.) continued to be the most important enemy of the western yellow pine (or bull pine) in the eastern section of the Rocky Mountain region. According to estimates it has killed over 1,000,000,000 feet of timber in the Black Hills Forest Reserve of South Dakota, and it is extending its ravages through Colorado and northern New Mexico. Under recommendations furnished by the Bureau of Entomology, the Forest Service is taking active measures in the Black Hills of South Dakota and in the Pikes Peak Forest Reserve of Colorado, and heroic measures have been adopted under private auspices in the

vicinity of Colorado Springs and on a large estate in southern Colorado in efforts to control the pest.

The western pine-destroying barkbeetle (*Dendroctonus brevicomis* Lec.) is an important enemy of the western yellow pine and sugar pine in the northwestern section of the Rocky Mountain region and on the Pacific coast. A special study has been made of its occurrence in central Idaho, and the results will soon be made public.

The destructive pine barkbeetle (*Dendroctonus frontalis* Zimm.) continued to be the principal insect enemy of living pine forests in the States south of Virginia and Kentucky and westward to Texas, but especially in the longleaf pine belt in the Gulf States. It has received additional study, and a bulletin has been prepared giving the results of the investigation and recommendations for control.

The hickory barkbeetle (*Scolytus quadrispinosus* Say) is the most destructive enemy of living hickory trees in the States east of the Great Plains and has received continued attention. Many new points in its life history have been determined, and it has been found that with proper attention it is not a difficult pest to deal with.

The work of ambrosia beetles (Genera Xyleborus, Trypodendron, Platypus, etc.) in the sapwood and heartwood of dying and felled trees and sawlogs, girdled cypress, and crude forest products causes very great loss each year, much of which can be averted by improved methods of forest management and lumbering. Notable damage by this class of insects has been found in mahogany and other valuable exotic woods imported in the form of round logs with the bark on. The insects attack the logs before these leave the native woods, and continue the work after the logs reach this country and until they are converted into lumber. Then, after the lumber is cut and piled, some of our native ambrosia beetles attack and riddle it. A remedy will be found in proper methods of handling the timber before and after it is shipped from the tropical forest.

Timber worms (*Eupsalis minuta* Dru. and *Lymexylon sericeum* Harr.) are by far the most destructive enemies of the wood of living oak and chestnut, causing enormous losses each year. They enter wounds occurring from any cause in the bark of the living tree, and old trees which have been rendered worthless by their borings serve as breeding places for enormous numbers. Therefore, wherever possible, the old trees should be removed and great care should be taken to avoid ax and other wounds in living healthy trees.

Bark weevils (*Pissodes* spp.), a class of enemies of reproduction pine, spruce, and fir, caused serious losses both by killing trees and by causing a deformed growth.

The locust borer (*Cyllene robiniæ* Forst.), the most serious enemy of forest growth and commercial plantations of black locust, is receiving special attention in cooperative studies by the Bureau of Entomology and Forest Service, and is the subject of a special paper now in press.

The leaf-mining locust beetle (*Odontota dorsalis* Thunb.) continued to be a serious enemy of locust groves in the eastern United States, causing the leaves to have a seared, dead appearance during August and September, and apparently killing trees in certain localities. It attracted special notice in the locust groves of the Ohio River counties of Ohio and at Morganfield, Ky.

Powder-post beetles continued to cause enormous losses of seasoned forest products, such as handles, spokes, ash and hickory lumber, tan bark, etc.

INSECTS INJURIOUS TO DECIDUOUS FRUITS.

Achrastenus griseus Horn, hitherto not recorded as injurious, was found doing considerable damage to fruit trees in the eastern portion of Texas. It was found upon apple, peach, and pear trees, as well as upon rose bushes.

A plum aphis (*Aphis setariæ* Thos.) did great injury to the plum crop in Texas.

The apple maggot (*Rhagoletis pomonella* Walsh) increased in destructiveness in New York State.

The eye-spotted bud-moth (*Tmetocera ocellana* Schiff.) was rather more destructive than usual in western New York.

The apple leaf-hopper (*Empoasca mali* Le B.) continued to be abundant in Minnesota, though less so than during the previous year.

Numerous complaints of defoliation of apple and other trees by canker-worms were made during the spring and early summer of 1905. The fall canker-worm (*Alsophila pometaria* Harr.) continued troublesome in northern California and was reported as very destructive in western Pennsylvania. The spring canker-worm (*Paleacrita vernata* Peck) was reported from numerous localities in western Pennsylvania, and several orchards were completely defoliated in the neighborhood of Winchester, Va. Canker-worms were abundant in several orchards in Ohio and continued to be injurious in Kentucky.

The chain-spotted geometer (*Cingilia catenaria* Cram.) was unusually abundant in New Hampshire.

Owing to general shortness of the apple crop, injury from the codling moth (*Carpocapsa pomonella* L.) was more pronounced than usual, though the aggregate loss was perhaps less than during years of full fruit crops. In some sections growers failed to spray and in others rains interfered and injury from the second generation of larvæ was especially severe. The insect has just made its appearance in Arizona.

The eight-spotted forester (*Alypia octomaculata* Fab.) was unusually abundant on grape in the environs of Brooklyn, N. Y.

The grape-berry moth (*Polychrosis viteana* Clem.) was reported as seriously destructive in several localities in Ohio and in western Pennsylvania.

The grape curculio (*Craponius inæqualis* Say) was very abundant in West Virginia, and also reported from North Carolina. It was the subject of special investigation at the West Virginia Agricultural Experiment Station.

The grapevine root-worm (*Fidia viticida* Walsh) was notably less injurious in Ohio. It was said to have been generally distributed in the Chautauqua grape belt in western New York, and was locally injurious, especially in vineyards on lighter soils. It has become decidedly more abundant in vineyards on hills back from the lake.

The green June beetle (*Allorhina nitida* L.) was reported as very destructive at Hampton, Va., and also at Baldwin, Ga.

The New York weevil (*Ithycerus noveboracensis* Först) injured fruit trees in Minnesota and continued to be destructive in the Gulf region.

The rose-chafer (*Macrodactylus subspinosus* Fab.) was unusually abundant in portions of New York, New Jersey, Maryland, Virginia, and Delaware. It was also abundant in portions of Maine and Massachusetts.

The peach twig borer (*Anarsia lineatella* Zell.) was more abundant than usual in Georgia, attacking the young shoots of peach in spring.

The pear thrips (*Euthrips pyri* Daniels) became suddenly destructive in Santa Clara Valley and other portions of California in 1904, and was even more abundant in 1905, attacking buds, blossoms, and tender growth of most deciduous fruits. It has been the subject of special investigation by the Santa Clara County entomologist.

The pear psylla (*Psylla pyri* Schmidt) was quite injurious in pear orchards in western New York.

The plum curculio (*Conotrachelus nenuphar* Herbst) was very generally injurious in the southeastern United States, though perhaps not more so than usual. Through the Middle Atlantic States the curculio was very abundant, injuring stone fruits and apple. In Massachusetts and Connecticut it is increasing in numbers. In western New York the curculio was apparently less abundant than formerly. In Minnesota its injuries are on the increase. Numerous reports from Texas indicate its increasing destructiveness in that section.

The plum-leaf gall (*Eriophyes padi* Nal.) was reported as unusually abundant in Minnesota.

Pomphopœa texana Lec., a blister beetle, was injurious to peach and plum in Clay County, Tex.

The apple-tree tent-caterpillar (*Malacosoma americana* Harr.) was abundant in Virginia, Maryland, Delaware, and New Hampshire.

The saddle-back caterpillar (*Sibine stimulea* Clem.) was unusually abundant in the environs of Washington, D. C., injuring apple and plum.

The San Jose scale (*Aspidiotus perniciosus* Comst.), as shown by the records of the Bureau of Entomology, has now become generally distributed eastward of the Mississippi River, except in Wisconsin, being, however, much more abundant in the Atlantic Coast States. In the Middle West it is gaining a foothold, though it has not yet been recorded from Iowa, Nebraska, and States to the north. The lime-sulphur-salt wash continues to be a very satisfactory treatment for stone fruits. On apple, results have varied widely.

The trumpet leaf-miner (*Tischeria malifoliella* Clem.) was unusually abundant in the vicinity of Washington, D. C., and was reported also from localities in Maryland, Delaware, Virginia, Pennsylvania, and Vermont.

INSECTS INJURIOUS TO CEREAL AND FORAGE CROPS.

A most disastrous outbreak of the Hessian fly (*Mayetiola destructor* Say) occurred in western Kentucky and extreme northwestern Tennessee, where the wheat crop of 1905 was almost ruined by this insect. Young wheat in late autumn suffered in that section but little, except where sown very early. This decrease in destructiveness seems to have been due largely to late sowing and the effect of parasites. Among

the latter was *Platygaster herrickii* Pack., which was repeatedly observed depositing its eggs in those of the Hessian fly. That this parasite affected the Hessian fly in this manner has long been suspected, but doubted by many entomologists. The Hessian fly seems on the increase in Virginia, Ohio, western Pennsylvania, and southern Michigan, and on the decline elsewhere, including the spring-wheat regions of the Northwest.

The wheat midge (*Contarinia tritici* Kby.) was reared indoors during January from bunches of young wheat sent December 21, 1904, from Guthrie, Okla., and seemed to be quite abundant there. Larvæ, apparently of this species, were numerous about Lincoln, Nebr., in March. The midge was very abundant about Richmond, Ind., in June, and injuriously so in the northern part of that State, in Ohio, and in southern Michigan. It was common in North Dakota in July and also on the Pacific coast, becoming a serious pest in British Columbia. No injuries were reported south of the Ohio and Missouri rivers.

Serious injuries by the wheat joint-worm (*Isosoma tritici* Fitch) were observed in southern Virginia, western Pennsylvania, eastern and northern Ohio, northern Indiana, and southern Michigan. Injuries were reported also from Kansas.

The greater wheat straw-worm (*Isosoma grande* Riley) was abundant in young wheat during April in North Carolina and northern Texas. As stems of wheat attacked at this season are totally destroyed, it seems capable of doing serious injury, especially in the South, without itself attracting much attention. In Texas the work of this and the following species has very evidently been mistaken for that of the Hessian fly.

The greater wheat stem-maggot (*Meromyza americana* Fitch) noticeably affected the wheat crop of the year, locally, in northern Texas, southern Iowa, southern Indiana, and northern Ohio, especially in early sown fields.

Outbreaks of the army worm (*Heliophila unipuncta* Haw.) occurred in wheat fields of western Kentucky and western Tennessee in May and later in Virginia, New York, and Indiana; but no widespread ravages were reported.

The fall army worm (*Laphygma frugiperda* S. & A.) was notably injurious at Columbia, S. C., in August.

A serious outbreak of the southern corn leaf-beetle (*Myochrous denticollis* Say) occurred in Butler County, Kans., destroying and necessitating the replanting of hundreds of acres of corn. Even the second planting was seriously injured.

Hadena semicana Walk., usually classed among the rarer cutworms, occurred in destructive abundance in Mercer County, Pa., during June. A similar outbreak occurred in 1893 in an adjoining county in Ohio.

The glassy cutworm (*Hadena devastatrix* Brace) was reared from larvæ found attacking young wheat in southern Michigan in October. Lands devoted to timothy the previous year seemed most subject to attack.

The smaller corn stalk-borer (*Elasmopalpus lignosellus* Zell.) occurred in serious abundance in the neighborhood of Columbia, S. C. Sorghum planted as a fodder crop was a total loss in some places, and a second, and even a third, planting was destroyed. Cowpeas sown on the same land were destroyed, as also crab grass. All lands infested were previously in grass. It was reported generally and was severely injurious in Georgia to young cowpeas by eating the roots and killing the vines.

Outbreaks of the corn root-aphis (*Aphis maidi-radicis* Forbes) were reported from Loretto, Va., and Sandwich, Ill., the outbreak at the latter place being very serious. The State entomologist of Illinois reports good success in combating the insect with cultural methods, the ground being frequently stirred from time of plowing until the plants are sufficiently advanced to cultivate.

The corn ear-worm (*Heliothis obsoleta* Fab.) was observed as injurious in North Dakota, South Dakota, Wyoming, Kansas, Colorado, and Texas.

The timothy joint-worm (*Isosoma* sp.) was reared from grass collected from localities extending from New Hampshire to North Dakota and south to Tennessee and Maryland. It reduces the seed crop from 5 to 20 per cent and lessens the yield of hay. Two very important natural enemies seem to be restricting its abundance in some localities.

The bluegrass joint-worm (*Isosoma* sp.) was reared from stems of this grass in Maine and at Richmond, Ind.

An outbreak of the cottony grass scale (*Eriopeltis festucæ* Fonsc.) occurred in southern Maine, and was studied by the station entomologist. Where the two grasses *Poa pratensis* and *Agrostis alba* were severely attacked in meadows, there appeared irregular brown areas of dead grass as a result.

Mordellistena ustulata Lec. was reared at Richmond, Ind., from stems of timothy. Larvæ, apparently closely allied or identical, were observed in southern Ohio and western Tennessee infesting the same grass.

The clover root-borer (*Hylastinus obscurus* Marshm.) was destructively abundant in West Virginia, Ohio, and Indiana, especially the latter State, and the seed crop was seriously curtailed there. It was not abundant in New England or south of Virginia and Kentucky.

The clover-flower midge (*Dasyneura leguminicola* Lint.) was reared in more or less injurious numbers from Tyngsboro, Mass., Lincoln, Nebr., and other points as far to the southward as red clover is grown. It seems to have been very abundant throughout the Middle West. It blights the blossoms so that no seed is produced.

The clover-seed chalcis (*Bruchophagus funebris* How.) occurred generally where red clover is grown, working in the seed and destroying the same, but, judging from the numbers of parasites reared, excessive abundance was prevented.

Larvæ of the clover-leaf weevil (*Phytonomus punctatus* Fab.) were observed in North Carolina in April, feeding upon the foliage of red clover. The species occurs from North Carolina to Wisconsin and eastward, but on account of the attacks of a fungous disease, it seldom proves a serious menace to the clover crop.

The white-lined morning sphinx (*Deilephila lineata* Fab.) attacked fields of alfalfa in New Mexico.

Anabrus simplex seriously injured meadows of alfalfa in Idaho. Grasshoppers also were destructive to alfalfa in southeastern Kansas, and in New Mexico.

The chinch bug (*Blissus leucopterus* Say) has nowhere appeared in dangerous numbers. It was encountered under stones in wheat fields in North Carolina in April, and a farmer in Virginia complained of its migrating from his wheat field, where it seemed to do no material injury, to his sweet corn, and though it did not damage the latter, the owner complained that the odor of the bugs rendered the ears unsalable for food.

The southern grain aphis (*Toxoptera graminum* Rond.), so destructive several years ago, especially in Texas, seems to be kept below the danger point by its parasitic enemies, and no serious outbreaks were reported. We have found it, however, associated with *Macrosiphum trifolii* Perg. and *Siphocoryne avenæ* Fab., in fields of young wheat about Nashville, Tenn., early in April.

INSECTS INJURIOUS TO SHADE TREES.

The gypsy moth (*Ocneria dispar* L.) and the brown-tail moth (*Euproctis chrysorrhœa* L.) received extensive study by the Bureau of Entomology and its agents, a subject which is discussed in an article by Doctor Howard on pages 123–138. The latter insect also received considerable attention by State and other official entomologists of New England, New York, and New Jersey.

The imported elm leaf-beetle (*Galerucella luteola* Müll.) defoliated English elms at Louisville and Paris, Ky.—new western localities for the species.

Three scale insects attracted notice by their abundance on shade trees. The woolly maple-leaf scale (*Phenacoccus acericola* King) was a serious pest on sugar-maple shade trees in Connecticut towns and cities. The cottony maple scale (*Pulvinaria innumerabilis* Rathv.) continued its destructive work, as in 1904. The activity of its native ladybird enemy, *Hyperaspis signata* Ol., gives promise of reducing the numbers of this scale in coming years. The oyster-shell scale (*Lepidosaphes ulmi* L.) was quite abundant and destructive in western Pennsylvania, northeastern Ohio, and northern Maryland on shade trees, especially poplar, horsechestnut, and maple.

The cottonwood leaf-beetle (*Melasoma scripta* Fab.), locally injurious each year, was the cause of an outbreak in North Dakota, where it defoliated cottonwood.

INSECTS INJURIOUS TO ORNAMENTAL PLANTS.

A number of insects were conspicuous during the year on ornamental plants grown in greenhouses and in gardens.

A blister beetle, *Cantharis sphæricollis* Say, defoliated honeysuckle and lilac in Washington State.

The canna leaf-roller (*Calpodes ethlius* Cram.) appeared in numbers and did noticeable injury to cannas in public parks and gardens in the District of Columbia.

The Southern corn root-worm (*Diabrotica 12-punctata* Ol.) was destructive in its beetle state, despoiling many garden flowers, especially canna, in the District of Columbia, and completely ruining roses and dahlias in portions of Georgia.

Roses were much injured during the year by the rose-chafer (*Macrodactylus subspinosus* Fab.) and by rose slugs. The bristly rose-worm (*Cladius pectinicornis* Fourcr.) was much less complained of in the East, but the American rose slug (*Monostegia rosæ* Harr.) completely defoliated rose bushes at Manhattan, Kans., and was abundant at Washington, D. C.

A rose-beetle, *Apocellus sphaericollis* Say, which was recently injurious to violets and some other plants at Washington, D. C., became very abundant at St. Louis, Mo., in 1905, destroying pansies, lilies, dahlias, and other herbaceous plants.

The strawberry thrips (*Euthrips tritici* Fitch) was extremely injurious to climbing and other roses from the District of Columbia to Florida, and greatly damaged carnations. The cestrum thrips (*Heliothrips femoralis* Reut.) caused injury in Wisconsin greenhouses, attacking chrysanthemum and smilax.

The white ant, *Termes flavipes* Koll., although troublesome principally in dwellings, was the cause of considerable annoyance in gardens and in greenhouses near New York City by entering and tunneling the roots of begonia, geranium, and other plants with semi-woody stems.

INSECTS INJURIOUS TO THE NUT INDUSTRY.

During the year 1905 numerous complaints of pecan bud-worms were received from Florida, Georgia, and Texas. *Proteopteryx deludana* Clem. was the species responsible for most of the injury. The bulldog caterpillar (*Catocala mæstosa* Hulst) did great damage to pecan foliage in Florida. The pecan leaf-beetle (*Metachroma luridum* Ol.) attacked young sprouts and stripped the leaves of pecan at Tuscaloosa, Ala. The pecan Phylloxera (*Phylloxera notabilis* Perg.) has begun to ravage pecan orchards, attracting considerable attention and even becoming a serious pest in some sections. The pecan or hickory nut weevil (*Balaninus caryæ* Horn) appeared to be comparatively rare on pecan except in Texas, but in North Carolina it did considerable damage to hickory nuts.

Chestnut weevils were less complained of than in previous years, but nuts from Maryland and Virginia for the Washington market showed no abatement of injury, and a grower in New Jersey reported the product of cultivated chestnuts grown on 150 acres as almost worthless, owing to weevil attack.

Acorn weevils were abundant, but in some localities were largely controlled by a parasite.

INSECTS AS ANIMAL PARASITES AND IN RELATION TO DISEASE.

The various insect parasites of man and other animals do not vary greatly from year to year. Locally there may be an increase or decrease of mosquitoes or fleas, or other parasites of man, and this is true also of the biting flies and ticks parasitic on animals; but, in range of injury and annoyance the country over, the annual variation is in general slight. As conveyors of disease this holds true also with respect to the insects involved in the spread of malaria and typhoid fever, and, in the case of animals, with the cattle tick, annually responsible for the spread of Texas or splenetic fever in cattle throughout the whole southern section of the United States. It is not true, however, in the case of the yellow fever mosquito, and the serious outbreak of yellow fever in New Orleans last summer was a notable fact in this connection.

PROGRESS OF FORESTRY IN 1905.

By Quincy R. Craft, *Editorial Clerk, Forest Service.*

A large advance has been made during the year 1905 in the introduction of proper methods of using the National forest reserves and of permanently improving them, in the wider adoption of conservative methods by lumber operators, in the gathering of new and important facts concerning the forests and their best use, and in the broader publication of results of forest work and their ready acceptance by the people.

It is now plain that the surplus timber of the country has been marketed. To supply in sufficient quantities the wood products now being used, the present area of woodland must not only be maintained but must be brought to much greater productiveness. The day has passed when the quickest method of getting lumber from the tree to the market is the chief consideration. Care and system in cutting, logging, and sawing are now requisite for the greatest advantage of all concerned, including the lumberman. The advances in forest work have been so great in particular lines and so general throughout the country that forestry has obviously passed out of the stage of preparation and propaganda into that of actual work. The year marks an epoch in the history of American forestry.

At the Lewis and Clark Exposition the forest exhibit—the largest and most varied ever made—was examined and studied in detail by great numbers of people eager to know about the forest and its use. The practical observance of Arbor Day is extending, both here and in foreign lands. Twelve States issue Arbor Day annuals, some

of which in their descriptions and illustrations of native trees and information concerning their planting, protection, and use form instructive reports on forestry.

The variety and magnitude of the industries represented at the American Forest Congress, held in Washington during the first week of January, 1905—a large gathering for the discussion of forest problems by men prominent and influential in business and public life—showed how widespread and vital the interest in forestry has become.

THE NATIONAL FOREST RESERVES.

Soon after the Forest Congress, occurred the most important event in the history of the Federal forest policy—the transfer, on February 1, 1905, of the administration of the National forest reserves to the U. S. Department of Agriculture. It was thus placed under that branch of the Government service charged with the study, development, and application of practical forestry. Reserve problems at once commanded the services of foresters, trained technically and by experience to decide the details of management which would best conserve and develop the large and varied National forest interests. An efficient system of forest administration is thus being inaugurated upon a hundred million acres of forest lands.

The total area of the National forest reserves at the beginning of the year was 63,045,797 acres, and the changes made during the year brought a net addition of 34,727,820 acres. These changes, resulting both from new reserves and from readjustments of the boundaries of existing reserves, were based in every case upon careful examinations of the areas by members of the Forest Service. No addition or alteration was made without thorough knowledge of the actual conditions, secured by expert examination to determine the best use to which the land can be put.

Changes in National forest-reserve areas during 1905, and areas as they exist on December 31, 1905.

State or Territory.	Forest reserves.	Field administrative force.			Area of reserves created during 1905.	Area added during 1905.	Unsuitable area eliminated during 1905.	Area of reserves Dec. 31, 1905.
		Supervisors.	Rangers.[a]	Technical assistants.				
	No.	*No.*	*No.*	*No.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*
Alaska	2	1						4,909,880
Arizona	10	8	49	1	1,160,960	456,000		8,357,370
California	[b] 17	12	133	3	7,144,127	1,685,712	63,420	18,155,043
Colorado	14	11	68	2	7,734,240	2,129,844	75,040	12,661,643
Hawaii	5	1			38,844			56,757
Idaho	[c] 9	5	40	1	4,858,324	693,160		9,488,324
Kansas	1				97,280			97,280
Montana	[d] 10	8	49	1	2,297,780	404,880	30,720	10,517,860
Nebraska	2	1		1				208,902
Nevada	1					59,115		59,115
New Mexico	5	5	36	2	1,409,885	690,527	151,148	5,207,184
Oklahoma	1	1	1					57,120
Oregon	[e] 8	7	37	1	1,434,990			6,072,550
Porto Rico	1							65,950
South Dakota	[f] 4	1	16	1	19,040			1,263,880
Utah	10	11	26	1	822,920	1,065,680		4,611,360
Washington	[g] 5	4	22	1	318,400	560,120	33,680	7,785,600
Wyoming	[h] 4	5	42	2				8,197,799
Total	[i] 101	81	519	17	27,336,790	7,745,038	354,008	97,773,617

[a] The figures given for the number of rangers are approximately an average for the year. During the late summer, the period of the greatest danger from fire, twice as many rangers are employed as during the winter months.

[b] The Tahoe Reserve is situated jointly in California (838,837 acres) and Nevada (59,115 acres).

[c] The Bitter Root Reserve is situated jointly in Idaho (3,860,960 acres) and Montana (691,920 acres).

[d] The Yellowstone Reserve is situated jointly in Wyoming (6,580,920 acres), Montana (1,229,680 acres), and Idaho (177,960 acres).

[e] The Wenaha Reserve is situated jointly in Oregon (413,250 acres) and Washington (318,400 acres).

[f] The Black Hills Reserve is situated jointly in South Dakota (1,163,320 acres) and Wyoming (46,440 acres).

[g] The Priest River Reserve is situated jointly in Idaho (541,160 acres) and Washington (103,960 acres).

[h] The Medicine Bow Reserve is situated jointly in Colorado (1,155,909 acres) and Wyoming (418,759 acres).

[i] Six of the reserves are enumerated twice (see notes *b*, *c*, *e*, *f*, *g*, and *h*), and the Yellowstone (note *d*) three times, so that the total number is 101.

Kinds and amounts of timber sold from forest reserves, and receipts therefor, in 1905.

State or Territory.	Amounts and total value of timber sold.				
	Lumber.	Fuel wood.	Mine timbers.	Posts and poles.	Total receipts.
	Board feet.	*Cords.*	*Linear feet.*	*Number.*	
Alaska	351,371	1,000	20,000	....	$[illegible].08
Arizona	931,849	16,649	7,000	2,200	7,4[illegible].20
California	84,282	220⅓	....	....	207.42
Colorado	17,765,461½	10,795½	....	13,988	23,9[illegible]7.67
Hawaii	....	....	....	....	....
Idaho	1,850,000	1,023	....	6,047	3,340.82
Kansas	....	....	....	....	....
Montana	1,068,321	3,701	50,412	119,500	2,641.36
Nebraska	....	....	....	....	....
Nevada	....	....	....	....	....
New Mexico	1,840,038	5,859	29,861	2,500	4,270.53
Oklahoma	....	3	....	100	12.00
Oregon	130,000	139⅕	....	100	290.75
Porto Rico	....	....	....	....	....
South Dakota	71,466,537	29,844½	....	10,255	[a]78,958.24
Utah	5,327,443	856	29,000	3,300	5,952.04
Washington	1,320,900	2,076	....	....	2,315.90
Wyoming	68,255,916	1,953	....	30,750	143,894.81
Total	170,392,118⅓	74,120	136,273	188,740	273,659.82

[a] Most of the sales were of insect-infested and dead timber at a low stumpage price, 75 cents per 1,000 feet B. M.

Number of grazing permits issued, number of live stock grazed, and rates per head, in 1905.

State or Territory.	Stock grazed.					Range of grazing rates.[a]		
						Summer.		Year round.
	Permits for cattle and horses	Cattle.	Horses.	Permits for sheep.	Sheep.	Cattle and horses.	Sheep.	Cattle and horses.
	No.	*No.*	*No.*	*No.*	*No.*			
Alaska	......	......	......	......	......	....	....	....
Arizona	449	71,915	11,462	66	218,000	$0.20 to $0.25	$0.05	$0.35
California	1,168	115,177	8,604	47	105,307	.25 to .40	.06 to $0.07	.40 to $0.50
Colorado	803	104,920	6,784	......	......	.20	.05	.35
Hawaii	......	......	......	......	......	....	....	....
Idaho	58	1,646	285	......	......	.20 to .25	.05	.35
Kansas	......	......	......	......	......	.35	....	.50
Montana	637	55,845	6,906	23	81,250	.25 to .30	.06 to .07½	.40 to .45
Nebraska	......	......	......	......	......	.35	....	.50
Nevada	......	......	......	......	......	....	....	....
New Mexico	373	64,573	6,396	48	130,449	.20 to .25	.05 to .06	.35 to .40
Oklahoma	47	2,790	161	......	......	.35	....	.50
Oregon	133	12,632	383	54	187,975	.25 to .35	.06 to .08	.40 to .50
Porto Rico	......	......	......	......	......	....	....	....
South Dakota	461	18,074	3,505	......	......	.20 to .30	....	.45
Utah	1,892	61,628	5,170	502	469,556	.20 to .25	.05 to .06	.35 to .40
Washington	318	10,391	1,028	82	183,010	.25	.06 to .07	.40
Wyoming	719	113,202	8,647	101	334,440	.20 to .25	.05 to .06	.35 to .40
Total	7,058	632,793	59,331	923	1,709,987	....	....	....

[a] In Arizona, California, Colorado, and New Mexico special rates, varying from 8 to 10 cents, are made for goats.

In the administration of the forest reserves mining is welcomed as a decided help in utilizing timber and other resources. The lands may be occupied under permit by hotels, mills, and residences.

In California the aggregate amount of land in reserves was nearly doubled in 1905, and now exceeds 18,000,000 acres. Here the State has cooperated with the Government in studying forest conditions, and as forest problems are better understood the conviction grows firmer that National control of large areas of forest land is necessary for the highest present and future welfare of the people.

RELATION OF THE RESERVES TO WESTERN STREAMS AND IRRIGATION.

The forest reserves of the Rocky Mountain system and the Cascades and Sierra Nevadas act as giant reservoirs for the supply of springs and streams.

The promoters of the Government irrigation works are among the warmest supporters of the forest-reserve policy, asserting that the preservation and extension of the forests on the hillsides are vitally necessary to the highest permanent usefulness of the reclamation projects.

SYSTEMATIC PROTECTION AND IMPROVEMENT OF THE RESERVES.

In general, the system of reserve patrol has proved highly effective. Destructive fires were greatly lessened in 1905. In regions of the Pacific States the value of fire trails, and especially of patrol, was well illustrated by the fact that the reserves were comparatively free from fires, though near-by private holdings suffered severely. Of the total area of the reserves—93,000,000 acres, exclusive of Alaska and Porto Rico—152,557 acres were burned over, while in the preceding year, when the total area was only 58,000,000 acres, 388,872 acres were burned over. This means that the proportion of burned-over forest to the whole was last year reduced from

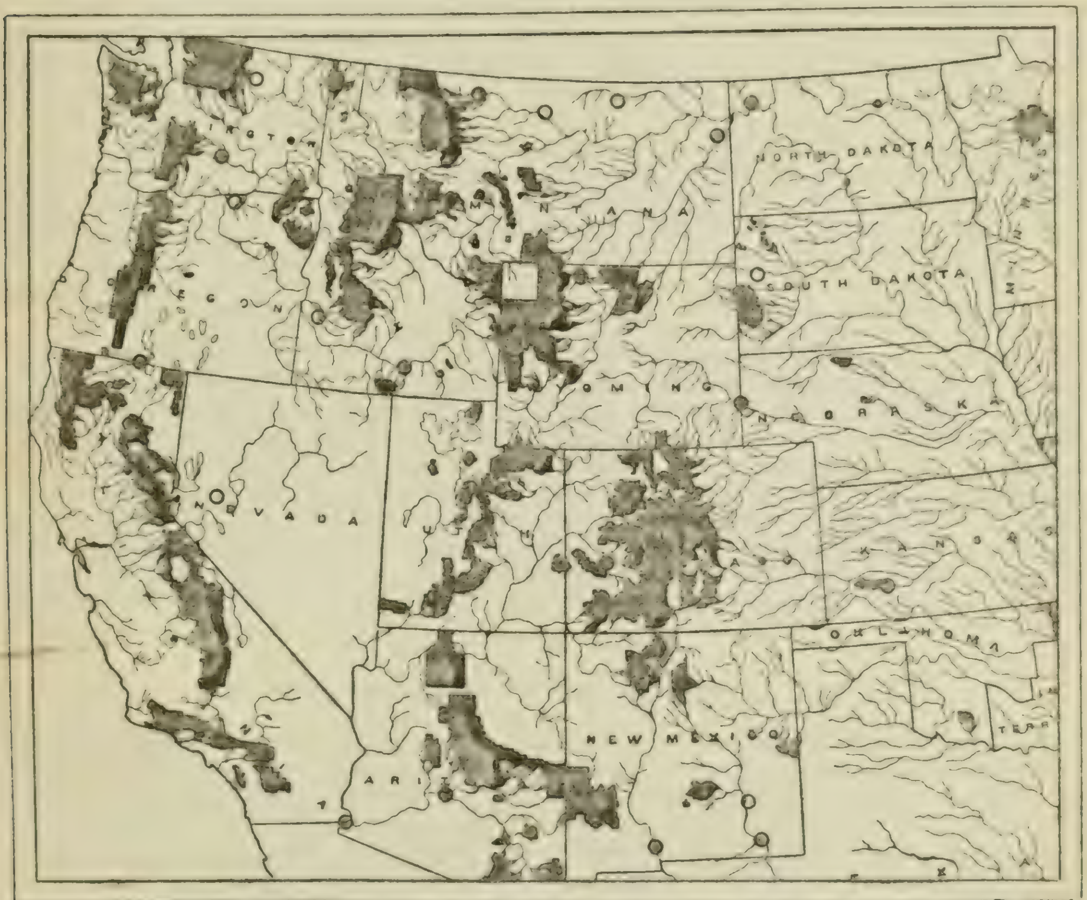

FIG. 130.—Relation of the forest reserves to the western streams and the reclamation projects: Solid black, forest reserves; circles, reclamation projects.

sixty-six one-hundredths to sixteen one-hundredths of one per cent. This success shows that work is proceeding along the right lines, though very much remains to be done. The installation of telephone lines in the reserves should greatly help in the prompt location of fires. The first of these is being installed in the Big Horn Forest Reserve, in Wyoming.

Over ninety rangers' cabins were built during the year, and the construction of roads and trails went steadily forward.

A working plan was made for 46,000 acres in the Wyoming division of the Medicine Bow Reserve, the first to be made for a specific area within the Federal forest reserves under the policy adopted by the Forest Service soon after the transfer. It insures the perpetuation of the forest by requiring the lumbering, soon to commence there, to be done under such regulations as will guarantee renewal. Working plans have also been made for portions of the Sierra and the Santa Barbara reserves in California.

Forest planting on the reserves has been carried on in an experimental way since 1902, and on a commercial basis in cooperation with the cities of Los Angeles and Pasadena to foster and protect their water supply. An attempt is now being made to bring the reserves to their highest productive capacity by securing forest growth on large areas suited by nature to the production of timber, but barren or sparsely wooded owing to fire and other causes. This result will be brought about as rapidly as practicable by planting trees, sowing seed, and in other ways encouraging reproduction. The success which accompanied broadcast sowing in the Black Hills Reserve last spring indicates that young growth may be secured by this method at a minimum expense in this region and in others where similar conditions exist.

Work in establishing nurseries or in actual planting was conducted on six reserves—at Fort Bayard, N. Mex., Clyde and Bear Creek (near Pikes Peak), Colo., in the Wasatch Mountains of Utah, and in the San Gabriel and Santa Barbara mountains of California, the prime object of the planting being to improve watersheds. The oldest and largest of the reserve planting stations is at Halsey, Nebr., on the Dismal River Reserve, a sand-hill country typical of a large area not well adapted to either agriculture or grazing. Certain trees grow well in this soil, which, with effective and cheap methods of planting, promise much to the future of this reserve and the surrounding country. The seed beds at this station now contain over 2,000,000 seedlings, of which 350,000 will be planted on the reserve the coming spring. A total of 350 acres have already been planted on this reserve. This season the Halsey nursery supplied 50,000 trees for planting along the interstate irrigation canal in Wyoming and Nebraska, 20,000 for the Pikes Peak Reserve, 30,000 for a forest park at Helena, Mont., and 1,000 for the Wichita Forest Reserve. Ninety thousand trees were also planted in the Garden City Forest Reserve, in Kansas, 50,000 of which were grown at Halsey.

INCREASED TIMBER SALES UNDER PROPER FOREST REGULATIONS.

During the year Government timber sales aggregated 170,000,000 board feet, largely exceeding those of any previous year. It is highly encouraging that the mature timber, selected after a careful study of the silvical needs of the forest and the requirements of the region for forest cover, and removed by careful logging methods which safeguard the young growth and utilize all usable material, brings prices which compare favorably with those from private lands subject to no restrictions. Two timber sales of over 50,000,000 feet each have been made, one of which included a large amount of lodgepole pine, until a few years ago almost without a market, which under proper seasoning and preservative treatment has been found to be serviceable as tie timber and for other uses. A million ties to be cut in one of these sales are to be treated with preservatives.

ATTITUDE OF STOCKMEN TOWARD RESTRICTION OF GRAZING.

The regulation of grazing on the forest reserves meets with almost universal approval. Opposition to the fee is disappearing. There is no longer any doubt as to the advantage of preventing conflict and overgrazing on the ranges. Under restricted grazing cattle and sheep keep in better condition and yield a better profit, and the range is not injured, but the best condition of the pasturage is maintained. In several reserves improved conditions have been secured by temporarily reducing the number of stock for which permits are issued. Every effort is being made to give the stockmen the fullest practicable use of the range. Small near-by owners have the preference, larger regular occupants come next, and owners of transient stock come third.

COOPERATION OF STATE AND PRIVATE INTERESTS WITH THE GOVERNMENT.

The demand for cooperative forest work between the Government, on the one hand, and States, corporations, and private individuals, on the other, grows year by year.

A forest survey of the State of Iowa was made in cooperation with the Iowa State College of Agriculture and Mechanic Arts.

A study of forest conditions in southern New Hampshire, to supplement the study of the northern part of the State, made in 1903, was pushed nearly to completion. From the data secured three forest maps will be prepared, classifying the forest and showing forest and cleared land and the commercial range of the five principal species. Suggestions for taxation, the prevention of fires, the management of lands, and the marketing of products are among the results of the work.

Several of the specific studies in cooperation with the State of California begun during the past three years have been completed. These are a study of the lumber mar-

ket, a forest-type map of the State, and reports on the value of chaparral as a forest cover and on natural forest reproduction in southern California and in the Sierras. Among the new lines of work taken up during the past year are a study of planted timber throughout the State, for the purpose of securing information to guide prospective planters of commercial groves and windbreaks, an investigation of the State forest lands, experiments to determine the influence of forest and brush cover on the run-off of streams, and an investigation of the qualities of eucalyptus wood, in which it is expected, by strength tests and experiments with the creosote preservative treatment, to demonstrate that this wood can be made to serve many purposes for which slower growing and more expensive woods are now demanded. Fence posts of eucalyptus have been treated successfully and at small cost.

Arrangements have been made for eight forest experiment stations, designed to afford information regarding new species, nursery methods, mixtures, spacing, and cultivation, which can not be obtained from studies of existing plantations.

The Forest Service collaborates with the State foresters or those engaged in teaching forestry in many of the States, a plan which has proved mutually advantageous in securing more thorough study of special problems and wider publication of the results.

During 1905 States and private interests contributed funds aggregating $28,250 as their share in cooperative work with the Forest Service.

Under the Government's plan of cooperation planting plans were made for 35,569 acres in 21 different States and Territories and preliminary examinations and working plans were made for 41 large tracts and a large number of woodlots. A fire-protection plan was prepared for one tract of 300,000 acres. In addition, special studies, as of the tie supply in Wisconsin and Minnesota, and of methods of seasoning railway, telephone, and telegraph timbers and mining timbers and of treating them with preservatives, were made in conjunction with several companies who wish to apply the results as soon as their business value is shown. Methods of seasoning and treating hemlock and tamarack ties in Michigan and red fir and western hemlock in Idaho and Washington have been investigated, and the recommendations made by the Forest Service have been adopted by several railroads.

An exhaustive study of methods of seasoning mine props and treating them in several ways with different preservatives is being carried on with a large coal company at Pottsville, Pa., which uses $900,000 worth of timber annually.

Not only are lumber concerns and landowners now paying the traveling and field expenses of Government foresters to examine their woodlands and recommend methods of handling to insure steady and perpetual supplies of timber, but in many cases they are securing trained foresters as permanent assistants. The lumbering associations, in their annual conventions, are raising a fund of $150,000 to endow a chair of lumbering in the school of forestry at Yale University.

FORESTRY A FACTOR IN THE GREAT INDUSTRIAL DEVELOPMENT OF THE SOUTH.

Much capital is invested in the utilization of the timber of the South. The lesson taught by the declining industry and dismal outlook in portions of the northern pineries has not been lost upon the South, as is clearly indicated by the active interest which large concerns are taking in forestry.

At Charleston, S. C., a large lumber company had a working plan made for part of its holdings a few years ago, and this year had another plan made for new lands, amounting to 35,000 acres, bought upon the recommendations of the earlier plan to provide a sustained yield—that is, an annual growth of wood equal to the yearly cut of the mill. In this way it has provided for the permanence of its business. Logging is done in such a way as to insure a recurring growth of the most desirable species, and young growth is protected from fire.

The desire for instruction in forestry in the South is shown in the establishment of a chair of forestry in the Mississippi Agricultural and Mechanical College and the endowment of a chair of forestry in the University of Georgia, as well as in the general demand for lectures on forest topics before student bodies, boards of trade, and farmers' institutes.

LARGE PLANTING PROJECTS UNDERTAKEN.

A number of causes have recently stimulated very greatly the establishment of forest plantations. In the Middle West many farmers are now using or selling with profit fence posts and firewood from hedges and planted groves, and in Kansas, where young trees are distributed in small quantities from two forestry stations, 600,000 trees were required in 1905 to satisfy the farmers' demand.

Helena, Mont., and Los Angeles, Cal., are planting large parks in true forest style. In northern Illinois, where "forest districts" are created under a new law establishing driveways lined with trees, it is proposed to plant the trees in belts and thus combine beauty with commercial profit. The Panhandle Forestry Association, of northwest Texas, an organization of 600 members, formed for the purpose of encouraging systematic tree planting, reports over 200,000 trees already planted in this arid and naturally treeless region.

Commercial profit having been assured by the success of smaller examples, forest plantations are now being established on a vastly larger scale. In Wayne County, Pa., a tract of 1,500 acres is being reforested. In the Adirondacks a railroad company has established a large forest nursery and begun planting the blank places under a plan for the conservative management of 26,000 acres. A railroad company has already planted over 1,000 acres of trees in central Pennsylvania, and other railroads have planted large areas in Kentucky, Illinois, Kansas, and Louisiana. Two companies owning lands in western Pennsylvania from which coal has been mined, leaving the ground unsuited for agriculture because of altered moisture conditions, are undertaking to reforest large areas. In eastern Pennsylvania a large enterprise is undertaking the reforestation of an important watershed in order to improve its water-conserving power and secure a revenue from lands now unproductive.

The president of the American Forestry Association emphasized the importance of planting in a recent address, when he said: "Reforestation is the coming work of the American forester. We are now planting thousands of acres of trees every year, but it is not enough. We must plant a million acres every year."

RECENT INVESTIGATIONS OF THE FOREST SERVICE.

Recent investigations of the Forest Service include the following important projects: A study of the hardwoods of the southern Appalachians; the value and best means of handling tupelo; the trees composing the "Big Thicket" forest of Texas; the tree flora of the Pacific States; the range, quantity, and characteristics of white fir, four-leaf pine, Torrey pine, and acacias, in California; the different methods of kiln-drying timber; the woods used in slack and in tight cooperage, in box making, in wood paving, in the implement and vehicle industry, and in pulp manufacture, to learn what woods can be used with the greatest economy to supply these great demands, and the methods by which they are best prepared; and a study of the characteristics of resins and turpentines derived from American pines. To these must be added the attempt to secure statistical data for a first annual statement of the lumber cut in the United States, the arrangements for which were concluded at the close of the year.

The Forest Service has for some time been conducting a series of experiments to secure trustworthy and comprehensive data upon the strength of woods in all sizes, market run, and upon wood preservatives and preservative processes, and the increasing interest not only of architects and engineers, but of business men engaged in the manufacture or sale of structural materials, has led to cooperation between the Government and representatives of engineering and allied societies, through which the present and prospective tests will secure the criticism and suggestions of men whose daily work calls for the solution of practical problems.

FOREST FIRES.

As in 1904, the East escaped large forest fires. State forest officers attribute the improvement in this respect mainly to well-distributed rainfall, though no doubt the campaign of education has tended to control the fires. In the West, during the dry seasons, fires started and, fanned by high winds, inflicted heavy damage in some instances. In many cases fires were extinguished before they had done much damage.

In northern California the success which attended the systematic effort to prevent fires on the reserves, and on two tracts on which fire-protection plans had been installed, showed clearly that the maintenance of an adequate number of fully equipped guards, keeping in close touch with each other, is an economy in the end.

Lumbermen and landowners are giving more and more attention to the prevention of forest fires. Vigilant patrol is general, and has proved very effective. Cooperation on the part of local associations or communities has enabled individuals to maintain a system which would otherwise be too costly. In the Moosehead Lake region of Maine three telephone stations were established on high mountains where, with the aid of powerful glasses, the first appearance of fires could be detected over a large territory. The State forest commissioner reports that one of these sta-

tions was the means of saving tens of thousands of acres of woodland, and that fifty such signal stations in the wooded sections of the State would be of incalculable service in the prevention of forest fires.

STATE FOREST WORK.

Fourteen States now maintain offices to guard their forest interests. Six of these employ one or more technically trained foresters. In addition to these, the State of Washington at the last session of the legislature provided for a forest commission and a State forester, and the State of Maryland has just enacted an excellent law providing for a State forester and granting power to purchase lands suitable for forest reserves.

New York planted 500,000 young trees on open places in the State preserve, and added about 40,000 acres by purchase, the present area aggregating about 1,500,000 acres.

Pennsylvania employed an additional forester, to conduct the training school at Mont Alto and direct the cutting on the State reserves, which now include 700,000 acres.

The Massachusetts State forest office employs two technically trained men. Lectures were begun at the State Agricultural College, 29 students electing the course. A State forest library was established. Thirty-four plans of management were made for an area of 6,545 acres, and a valuable report was published on the work of a commission appointed to investigate the subject of forest taxation.

In Connecticut 80 towns appointed forest fire wardens. Seven hundred acres were added to the State reserve. During the spring of 1906, 100,000 white pine and several thousand other species are to be planted on the reserve.

The State of Michigan has increased its forest reserve to 39,000 acres, and two permanent buildings have been erected. Eighty acres were planted with 79,000 seedlings last spring, and the State nursery is now stocked with 2,000,000 seedlings.

Wisconsin made the greatest advance in the enlargement of her State reserve, the increase being from 71,000 to 300,000 acres. A State fire-warden service was organized, and a forest survey of reserve lands undertaken.

The Indiana State forest reserve of 2,000 acres is being steadily improved by planting and by improvement thinnings and by the building of roads and reservoirs.

In Minnesota a nursery is being well stocked preparatory to planting the Pillsbury tract of 1,000 acres in Cass County. Work is also progressing on the preparation of working plans for the State reserve of 20,000 acres in St. Louis County.

In California a technically trained forester was appointed July 1, to whom the forest interests of the State and the care of the California Redwood Park are intrusted. The fire question is here in many respects the most important problem, though several forest investigations are under way.

Under the appropriation of $10,000 for the purchase of forest-reserve lands by the State of New Jersey, 970 acres have been secured and other purchases are pending.

In Iowa, as an encouragement to forest extension, a law has just passed providing that a landowner is entitled to an assessed valuation of $1 per acre for land permanently reserved in forest.

The Society for the Protection of New Hampshire Forests has set an example worthy of imitation in the employment of a trained forester, who is actively engaged in the preparation of plans for the management of forest lands throughout the State.

Forest work in Hawaii, under the direction of the superintendent of forestry, is conducted along two general lines—forest reserves and the introduction of new and important trees. While the reserve limits include 210,322 acres, only 56,757 acres have actually been set apart; however, much of the private land is being managed according to conservative forest methods under the cooperative assistance of the forest office. A public forest nursery is maintained, where forest seeds and seedlings can be obtained at cost price.

FOREST LAW.

In 1905 many laws were passed to advance forest interests, a comprehensive summary of which is as follows:

United States.—Part of Wichita Reserve set apart as a game refuge (33 Stat., 614.) Care of forest reserves transferred from Department of the Interior to Department of Agriculture (33 Stat., 628). Forest officers empowered to arrest (33 Stat., 700 and 872). Part of Yosemite National Park added to Sierra Reserve (33 Stat., 702). Reclamation Service permitted to use material from forest reserves (33 Stat., 706). Export of timber from forest reserves, except from South Dakota and Idaho, permitted (33 Stat., 872). President to make such part of Uintah Indian Reservation as

he deems best into a forest reserve (33 Stat., 1070). Lieu-selection law repealed (33 Stat., 1264).

CALIFORNIA.—Appropriation of $10,000 to be used with equal amount from United States in a continued study of State forests by the Forest Service (ch. 157). Provision for a State board of forestry; a State forester; fire-warden service, with compulsory assistance from citizens; penalties for setting fires, leaving camp fires unextinguished, burning slashings during "dry season," operating engines without spark arresters, and failure to keep railroads and county roads clear of inflammable material; civil liability for damages done by forest fires; and an appropriation of $17,600 (ch. 264). Tax by counties to aid in preservation of forests (ch. 337).

COLORADO.—Authorizing State land board to exchange State lands within forest reserves for public land outside (ch. 134).

CONNECTICUT.—Making the State forester State fire warden; town fire wardens provided to control and extinguish forest fires; citizens compelled to assist in fighting forest fires; amendment of sections 1218, 1222, and 1237 in order to increase penalties for setting forest fires and cutting trees in trespass; and fire-warning notices to be posted (ch. 238).

HAWAII.—Appropriation of $2,000 for immediate use in fighting forest fires (act 12). Governor, with approval of forestry board, may set aside unappropriated land for forest purposes (act 65). Superintendent of forests made chief fire warden; district fire wardens created; citizens compelled to assist in fighting forest fires for remuneration; and penalty for setting fires (act 71).

IDAHO.—Cutting of timber on State lands regulated; peace officers to act as fire wardens with power to arrest; and railroads to use spark arresters, and to pay for timber burned (p. 145).

ILLINOIS.—Creation of forest-reserve districts, principally to improve roads, pleasure driveways, etc. (p. 279).

INDIANA.—Providing penalty for setting forest fires, with civil liability for damages; road supervisors created forest fire wardens, and citizens compelled to assist in fighting forest fires for remuneration (ch. 49).

MAINE.—Providing for fire-warden service to patrol and extinguish forest fires, and citizens compelled to assist in fighting forest fires for remuneration (ch. 44).

MASSACHUSETTS.—Commission appointed to investigate forest taxation and recommend law therefor (ch. 60).

MINNESOTA.—Increasing chief fire warden's salary to $1,500 (ch. 310). Accepting grant of 20,000 acres from United States (ch. 83). Providing penalty and prosecution for timber trespass; for sale of timber on State lands at public auction, and defining timber (ch. 204). Appropriation for forest interests, total $32,350 (ch. 337). Increased area for Itaska State Park (ch. 277). Establishment of Minnesota State Park (ch. 297). Providing that county must pay one-half instead of one-third of fire-fighting expenses (ch. 82).

NEW HAMPSHIRE.—Forest fire warden service established (ch. 97). Continued appropriation for State forest survey (ch. 144).

NEW JERSEY.—Forest park reservations established with forest commission in charge (ch. 47). Camp-meeting grounds to be guarded to prevent the starting of forest fires (ch. 222).

NEW YORK.—Superintendent of forests empowered to enforce timber-trespass laws, and State officers empowered to arrest without warrant (ch. 285).

NORTH DAKOTA.—Bounty of $3 per acre for tree planting and $2 per 80 rods for hedge planting (ch. 187).

OREGON.—Creation of forest fire warden service; during "dry season, slashings to be burned under permit only;" penalty provided for setting forest fires or operating engines without spark arresters during "dry season," and fire rangers authorized to arrest (ch. 227).

PENNSYLVANIA.—Compensation for fighting forest fires increased (No. 65). Water rights to be granted in forest reserves (No. 114). Unappropriated State lands to become part of forest reserve (No. 50). Amendment of law for rebate of taxes upon forest land (No. 88). Maintenance of second-growth timber encouraged (No. 179).

PHILIPPINE ISLANDS.—Collection of revenues from forest products transferred from bureau of forestry to bureau of internal revenue; name of chief of bureau of forestry changed to director of forestry; residents given timber free for domestic use (No. 1407).

WASHINGTON.—State board of forest commissioners with State forester and fire warden as its secretary created; forest fire warden service provided for; slash burning in "dry season" allowed only under permit; penalty for setting forest fires and operating engines without spark arresters, and appropriation of $25,000 for State forest purposes (ch. 164).

WISCONSIN.—State forest law amended; board of State forest commissioners reorganized as State board of forestry; State forester made State forest fire warden, and State fire warden service created (ch. 264). State board of forestry to investigate available water power (ch. 95).

FOOD LEGISLATION AND INSPECTION.

By W. D. BIGELOW, *Chief of Division of Foods, Bureau of Chemistry.*

The information in the following table was obtained from State and municipal food-law officials, as far as they could be reached. The inspectors whose work is reported are usually men of good judgment and considerable experience in selecting food samples, and only foods suspected were sampled; also only such samples were analyzed as seemed likely to show violations of law. Accordingly the table does not show the ratio of adulterated foods to pure foods on the American market. The great mass of high-grade foods is excluded from any calculation that may be made upon the figures here given. Unless otherwise stated, the report submitted is for the calendar year 1905. In several localities statistics are prepared on the basis of some other year than the calendar year, however, and in some cases the records for a complete year could not be obtained.

The time included in the report from San Francisco is for milk from July 1, 1905, to March 1, 1906, and for other foods from February 1, 1905, to March 1, 1906. The figures submitted by the State of Washington are for 11 months, beginning May 1, 1905, and ending April 1, 1906.

In Los Angeles, Cal., and Cambridge, Mass., the year for which statistics are reported closed December 1, 1905. The year for which statistics are reported from St. Louis, Mo., closed April 1, 1905.

In the District of Columbia, the Passaic, N. J., and the South Dakota State food-inspection work, the year closed June 30, 1905.

In Providence, R. I., the year covered by the statistics ended August 3, 1905.

But little chemical work is reported from Idaho owing to the fact that the laboratory was being extensively repaired, and could not be used. In Indiana the laboratory of the State board of health has been organized during the year, and is now in active operation.

This information was secured as a result of a circular letter which was sent to the officers charged with the enforcement of the food laws in all States and to the boards of health in all cities having a population of 25,000 or over. In some few cases no replies were received. In many cases, owing to a lack of appropriation, no attempt is made to examine the foods on sale in the markets other than by such rough tests as inspectors without chemical training are able to perform. In some cases no provision is made for a food inspector; in others no laboratory facilities are provided. Hence a considerable number of responses to the circular letter merely gave the information that no food samples had been examined.

The State and city offices making such reports are as follows: Colorado, State dairy commissioner; Florida, State commissioner of agriculture; Georgia, State commissioner of agriculture; Indiana, State board of health; Iowa, State food and dairy commissioner; Missouri, State dairy commission; New York, State department of health; South Carolina, State board of health; Tennessee, State board of health; Texas, State health officer; and the health boards of the following cities: Bridgeport and Meriden, Conn.; Kansas City and Wichita, Kans.; Newport, Ky.; Gloucester, Haverhill, Lawrence, Malden, New Bedford, North Adams, Quincy, and Taunton, Mass.; Kalamazoo, Mich.; St. Paul, Minn.; Joplin, Mo.; Camden, Elizabeth, Hoboken, Orange, and Trenton, N. J.; Elmira, Newburg, and Troy, N. Y.; Lima and Springfield, Ohio; Portland, Oreg.; Altoona, Chester, Johnstown, Newcastle, Reading, Scranton, Williamsport, and York, Pa.; Charleston, S. C.; Chattanooga and Knoxville, Tenn.; Fort Worth, Galveston, and San Antonio, Tex.; Tacoma, Wash.; Wheeling, W. Va.; La Crosse and Superior, Wis.

Statistics of food examinations and prosecutions under laws, 1905.

State and city.	Samples examined.		Samples below standard.		Prosecutions.		Convictions.		Cases still pending.		Organization or officer charged with enforcing law.
	Milk.	Other foods.	Milk.	Other foods.	Milk.	Other foods.	Milk.	Other foods.	Milk.	Other foods.	
Alabama—Montgomery	6,321	9	5	0	5	0	4	0	0	0	Sanitary department.
California:											
Los Angeles	723	768	16	89	16	23	15	21	...	...	Health department.
Sacramento	730	...	0	...	0	...	0	...	0	...	Board of health.
San Francisco	2,191	1,274	822	a357	42	31	24	31	9	0	Do.
Colorado:											
Colorado Springs	720	29	2	0	2	0	2	0	1	0	Department of public health.
Denver	5,261	...	...	...	7	...	5	...	0	0	Health department.
Connecticut:											
State inspection	446	901	169	219	...	216	...	216	...	0	Agricultural experiment station and dairy commission.
New Haven	645	...	38	...	...	...	...	...	...	...	Board of health.
Delaware—Wilmington	5,106	0	135	0	5	0	5	0	0	0	Milk inspector.
District of Columbia	8,279	542	1,788	145	346	102	341	96	4	0	Health department.
Hawaii—Territorial inspection	960	94	48	38	1	0	1	0	0	0	Territorial board of health.
Idaho—State inspection	163	32	1	13	...	...	...	...	...	...	Dairy, food, and oil commission.
Illinois:											
State inspection	495	1,907	90	703	65	203	28	134	25	69	Food commission.
Chicago	25,727	960	1,592	80	1,296	12	1,176	12	102	0	Health department.
Peoria	465	...	38	...	7	...	7	...	0	...	Milk inspector.
Rockford	400	0	20	0	20	0	20	0	0	0	Health department.
Springfield	230	...	7	...	7	...	3	...	4	...	Board of health.
Indiana:											
Evansville	200	0	6	0	0	0	0	0	0	0	Do.
Indianapolis	1,032	...	26	...	3	...	3	...	...	...	Do.
Terre Haute	25	20	6	2	6	0	1	0	0	0	Do.
Kentucky:											
Covington	100	0	0	0	0	0	0	0	0	0	Do.
Lexington	25	...	0	...	0	...	0	...	0	...	Do.
Louisville	269	21	12	13	19	7	15	7	3	0	Do.
Louisiana—New Orleans	4,459	...	102	...	139	...	137	...	2	...	Do.
Maine:											
State inspection	...	131	...	51	...	0	...	0	...	0	Agricultural experiment station.
Portland	1,500	250	(b)	(b)	0	0	0	0	0	0	Board of health.
Maryland—Baltimore	309	331	114	186	1	3	0	2	0	1	Department of health.
Massachusetts:											
State inspection	4,997	2,779	...	278	50	6	47	6	...	...	State board of health.
	65	188	0	1	8	147	8	147	0	0	Dairy bureau.
Boston	18,582	2,071	(b)	(b)	287	93	268	82	1	...	Bureau of milk inspection.
Brockton	62	20	8	8	0	0	0	0	0	0	Board of health.
Cambridge	4,048	161	1,548	0	6	...	6	0	...	...	Inspector of milk.
Chelsea	293	19	30	0	0	0	0	0	0	0	Do.

Everett	150	0	25	0	0	0	0	0	0	0	Do.
Fall River	78	4	9	4	0	0	0	0	0	0	Board of health.
Fitchburg	322	2	7	0	1	0	1	0	0	0	Inspector of milk.
Holyoke	1,907	...	69	...	10	0	10	0	1	...	Board of health.
Lowell	2,570	...	...	...	6	...	6	...	3	...	Milk and vinegar department.
Lynn	1,889	96	15	...	15	...	12	...	...	...	Board of health.
Newton	1,423	198	...	...	...	...	...	...	...	...	Do.
Salem	1	2	...	2	4	2	4	2	2	0	Do.
Somerville	945	7	0	1	15	...	15	...	1	...	Do.
Springfield	952	...	...	...	12	...	9	...	...	...	Do.
Worcester	1,349	241	258	77	4	5	4	4	0	1	Inspector of milk.
Michigan:											
State inspection	562	337	42	167	9	8	8	8	1	12	Dairy and food commission.
Detroit	1,524	74	68	22	8	...	8	...	...	...	Board of health.
Grand Rapids	1,942	0	33	0	8	0	8	0	0	0	Milk inspector.
Minnesota:											
State inspection	642	6,783	491	2,315	48	616	48	616	...	...	Dairy and food commissioner.
Minneapolis	1,707	34	569	...	28	...	27	...	0	...	Department of health.
Missouri:											
Kansas City	1,120	94	42	56	42	30	37	27	...	3	Department of food inspection.
St. Joseph	216	12	5	10	0	0	0	0	0	0	Board of health.
St. Louis	3,969	...	329	...	329	...	114	...	215	...	Do.
Nebraska:											
State inspection	13	121	1	62	0	0	0	0	0	0	Food commissioner.
Lincoln	379	...	3	...	3	...	3	...	...	...	Board of health.
South Omaha	208	...	10	...	5	...	2	...	0	...	Milk inspector.
New Hampshire:											
State inspection	45	1,122	15	550	...	...	...	...	...	...	State board of health.
Manchester	648	0	35	0	0	0	0	0	0	0	Board of health.
New Jersey:											
State inspection	1,381	1,381	345	415	176	55	...	...	14	3	State board of health.
Atlantic City	200	16	3	0	4	0	3	0	0	...	Board of health.
Jersey City	93	...	17	...	17	...	16	...	1	...	Do.
Newark	445	18	91	14	22	...	22	...	...	...	Do.
Passaic	114	...	0	...	0	...	0	...	0	...	Do.
Paterson	4,000	4	25	2	4	2	4	0	1	2	Inspector of food and drugs.
New York:											
Auburn	876	...	...	...	...	...	...	...	...	...	Board of health.
Binghamton	46	285	7	35	0	0	0	0	0	0	Do.
New York	118,924	501	2,061	31	853	36	779	35	47	...	Department of health.
Rochester	3,267	107	69	...	41	0	35	0	0	0	Health bureau.
Schenectady	99	...	65	...	...	...	0	0	0	0	Board of health.
Syracuse	9,209	57	5	0	5	0	5	0	0	0	Department of public safety.
North Carolina—State inspection.	...	266	...	136	...	...	...	...	...	...	Department of agriculture.
North Dakota—State inspection.	34	3,200	3	992	0	7	0	7	0	0	Agricultural experiment station.
Ohio:											
State inspection	1,027	1,403	198	772	85	158	62	151	11	...	Dairy and food commissioner.
Canton	2	1	...	...	0	0	0	0	0	0	Board of health.
Cincinnati	[b] 400	0	...	0	...	0	...	0	...	0	Do.
Cleveland	5,982	276	[c] 10	43	10	4	6	2	...	...	Health department.

[a] Does not include arsenic found in wine.

[b] Not reported.

[c] Exclusive of watered milk.

Statistics of food examinations and prosecutions under laws, 1905—Continued.

State and city.	Samples examined.		Samples below standard.		Prosecutions.		Convictions.		Cases still pending.		Organization or officer charged with enforcing law.
	Milk.	Other foods.	Milk.	Other foods.	Milk.	Other foods.	Milk.	Other foods.	Milk.	Other foods.	
Ohio—Continued.											
Columbus	1,004	....	83	....	4	....	3	....	0	....	Board of health.
Dayton	74	4	10	....	....	....	....	....	....	....	Health department.
Hamilton	150	6	2	0	0	0	0	0	0	0	Board of health.
Toledo	1,427	98	118	25	10	6	9	5	0	0	Department of health.
Youngstown	523	10	6	7	....	....	....	....	....	....	Board of health.
Pennsylvania:											
State inspection	2,312	2,500	75	1,150	70	1,015	850		....	165	Department of agriculture.
Allentown	86	....	2	....	2	....	2	....	....	....	Board of health.
Erie	1,664	50	1	7	1	7	1	0	....	6	Do.
Lancaster	400	....	2	....	2	....	2	....	....	....	Do.
Philadelphia	15,100	23	212	20	14	5	1	0	13	5	Bureau of health.
Pittsburg	3,460	18	200	2	200	2	200	2	0	1	Do.
Wilkes-Barre	300	720	1	....	1	....	1	....	....	....	Board of health.
Rhode Island—Providence	7,493	1,064	253	191	25	1	23	1	2	0	Milk department.
South Dakota—State inspection	....	256	....	117	0	0	0	0	0	0	Food and dairy commission.
Tennessee—Nashville	2,025	80	8	8	8	6	6	6	0	0	Health department.
Texas—Houston	91	0	1	0	1	0	1	0	0	0	Board of health.
Utah:											
State inspection	983	430	27	70	....	....	....	2	....	1	Dairy and food commissioner.
Salt Lake City	505	284	....	....	....	....	....	....	....	....	Board of health.
Vermont—State inspection	15	174	6	62	....	....	....	....	....	....	State board of health.
Virginia—Richmond	1,140	45	11	0	11	0	11	0	1	0	Board of health.
Washington:											
State inspection	54	61	4	28	2	2	2	1	....	....	Dairy and food commission.
Seattle	5,202	50	39	20	4	0	4	0	0	0	Board of health.
Spokane	120	14	3	....	3	....	3	....	....	....	Health department.
Wisconsin:											
State inspection	4,137	842	154	554	....	....	36	88	....	....	Dairy and food commission.
Milwaukee	5,328	106	147	17	9	0	8	0	0	0	Health department.
Wyoming—State inspection	63	164	4	59	2	1	2	1	0	0	Dairy, food, and oil commission.

ADVANCEMENT IN THE PUBLIC CONTROL OF WATER IN 1905.

By R. P. Teele.

The year 1905 marked a notable extension of the laws governing the use of water for irrigation in the arid States. New codes were adopted in North Dakota and South Dakota, Oklahoma, and New Mexico; the office of State engineer was created in Oregon, while the laws of other arid States were amended to make their systems more complete. The following table summarizes the present provisions for controlling the acquirement of water rights and the distribution of water in the arid States:

Provisions of law relating to public control of the use of water in irrigation.

State or Territory.	Defining of rights.	Acquirement of rights.		Distribution.
		Initiation.	Proof of completion.	
Arizona	No provision	Post and file notice.	No provision	No provision.
California	do	Post and file claim	do	Do.
Colorado	Courts—On application of interested party.	Post and file notice.	do	Public officials.
Idaho	Courts—Surveys by State engineer when ordered by court.	Application for permit.	Inspection by State engineer.	Do.
Kansas	Courts	Post and file notice.	No provision	Court officers.
Montana	Courts—All claimants parties. No surveys.	Post and file claim	do	Do.
Nebraska	Administrative—Secretary, board of irrigation.	Application for permit.	Sworn statement and inspection.	Public officials.
Nevada	Administrative—State engineer.	do	Rules not made	Do.
New Mexico	Administrative—Board of control.	File notice	No provision	No provision.
North Dakota	Courts — Surveys by State engineer.	Application for permit.	Inspection by State engineer.	Public officials.
Oklahoma	Courts — Surveys by Territorial engineer.	do	Inspection by Territorial engineer.	Do.
Oregon	Courts — Surveys by State engineer when ordered by court.	Post and file claim	No provision	No provision.
South Dakota	Courts — Surveys by State engineer.	Application for permit.	Inspection by State engineer.	Public officials.
Utah	do	do	Sworn statements	Do.
Texas	No provision	File notice	No provision	No provision.
Washington	Courts — On application of any interested party.	Post and file notice.	do	Public officials.
Wyoming	Administrative—Board of control.	Application for permit.	Inspection by superintendent.	Do.

FARMERS' INSTITUTES.

Farmers' institutes were held during the year ended June 30, 1905, in all of the States and Territories excepting Alaska, Florida, Indian Territory, Porto Rico, South Dakota, and Tennessee.

The following table gives a summary of the work for the year:

Statistics of farmers' institutes for season ended June 30, 1905.

State or Territory.	Meetings.					Speakers on State force.	Funds for institutes.		Reports of proceedings.	
	Total number.	One day.	Two days or more.	Number of sessions.	Total attendance.		Appropriated for year ended June 30, 1905.	Appropriated for year ended June 30, 1906.	Published.	Number of copies.
Alabama	24	23	1	48	3,820	9	$600.00	$600.00	No	
Arizona	1		1	12	250	1			No	
Arkansas	30	30		60	7,650	4	400.00	250.00	No	
California	110	37	73	429	43,494	19	8,934.00	6,000.00	Yes	12,500
Colorado	20	16	4	52	2,700	12		4,000.00	No	
Connecticut	14	14		28	1,200	30	428.00		No	
Delaware	20	20		23	4,199	9	750.00	750.00	Yes	5,000
Georgia	44	34	10	108	18,000	13	3,500.00	3,500.00	Yes	5,000
Hawaii	4	4		8	350	4	35.00	35.00	Yes	
Idaho	25	5	20	113	4,000	10	1,000.00	1,000.00	Yes	5,000
Illinois	100		100	635	69,759	114	20,960.39	17,650.00	Yes	20,000
Indiana	250	133	117	883	79,964	46	10,000.00	10,000.00	Yes	1,000
Iowa	60	5	55	207	18,000		7,425.00	7,425.00	No	
Kansas	55	26	29	144	11,455	19	2,000.00	2,000.00	No	
Kentucky	17		17	73	3,350	15	1,206.16	3,000.00	Yes	10,000
Louisiana	67	65	2	208	14,541	23	2,500.00	2,000.00	Yes	3,500
Maine	44	44		93	5,731	21	5,000.00	3,000.00	Yes	6,000
Maryland	26	8	18	73	5,741	16	6,000.00	6,000.00	No	
Massachusetts	115	115		167	12,372	71	2,700.00	3,000.00	No	
Michigan	270	200	70	827	55,004	47	9,300.00	7,500.00	Yes	9,000
Minnesota	105	105		227	52,125	10	18,000.00	18,000.00	Yes	35,000
Mississippi	153	150	3	311	30,000	24	3,000.00	3,000.00	Yes	
Missouri	104	58	46	256	2,560	26	3,100.00	5,000.00	Yes	10,000
Montana	47	41	6	100	6,946	18	4,500.00	4,000.00	Yes	5,000
Nebraska	150	88	62	480	67,241	29	6,000.00	6,000.00	No	
Nevada	10	7	3	20	665	6	379.00		Yes	750
New Hampshire	13	11	2	28	2,900	14	1,600.00	1,500.00	Yes	2,000
New Jersey	30	23	7	111	5,538	10	1,838.15	3,500.00	No	
New Mexico	1	1		3		10			No	
New York	261	129	132	967	87,439	60	20,000.00	20,000.00	Yes	25,000
North Carolina	61	58	3	226	11,168	18	2,150.00	1,700.00	Yes	25,000
North Dakota	61	47	14	140	12,838	8	4,171.94	6,000.00	Yes	10,000
Ohio	281	2	279	1,399	92,593	29	19,598.68	16,747.62	Yes	20,000
Oklahoma	58	39	19	156	5,500	8			No	
Oregon	18	12	6	54	5,500	8	620.00	2,500.00	No	
Pennsylvania	196	44	152	862	150,932	56	20,500.00	20,500.00	Yes	31,600
Rhode Island	1		1	6	400	12	100.00	1,500.00	No	
South Carolina	33	33		56	7,460	12	1,194.56	5,000.00	No	
Tennessee						9				
Texas	110	104	6	146	8,500	24	3,850.00	1,500.00	No	
Utah	15	3	12	40	8,000	15	1,500.00	1,500.00	Yes	7,000
Vermont	40	40		80	7,500	26	5,000.00	5,000.00	Yes	3,000
Virginia	35	35		70	8,000	9	5,500.00	5,500.00	No	
Washington	46	17	29	150	7,282	15	3,000.00		No	
West Virginia	63	16	47	199	9,450	22	2,455.26		Yes	12,000
Wisconsin	82		82	270	43,000	31	14,942.75	12,000.00	Yes	60,000
Wyoming	1		1	7	75	3		1,000.00	No	
Total	3,271	1,842	1,429	10,555	995,192	995	225,738.89	219,157.62		323,350

LEGAL WEIGHTS PER BUSHEL.

[From Bureau of Standards, Department of Commerce and Labor.]

Legal weights (in pounds) per bushel.

State or Territory.	Apples.			Beans.										Coal.					
	Apples.*	Dried apples.	Barley.	Beans.*	Castor beans, shelled.	Beets.	Blue-grass seed.	Bran.*	Broom-corn seed.	Buckwheat.	Carrots.	Charcoal.	Clover seed.	Coal.*	Anthracite coal.	Bituminous coal.	Cannel coal.	Mineral coal.	Stone coal.
U. S			48		50					42						80			
Ala		24	47	60															
Ariz			45	*a* 55															
Ark	*b* 50	24	48	*a* 60			14	20	48	52			60						
Cal			50							40									
Colo			48	60			14			52			60	80				80	
Conn	48	25	48	60		*c* 60		20		48	50	20	60		80				
Del												20							
Fla	*b* 48	24	48	*d* 60	48			20											
Ga		24	47	*e* 60			14	*f* 20		52			60						80
Hawaii			48																
Idaho	*b* 45	28	48							42			60						
Ill		24	48	*e* 60	46		14	20		52			60						80
Ind		25	48	60	46		14			50			60					80	
Iowa	48	24	48	60	46		14	20	30	52		20	60						80
Kans	*b* 48	24	48	60	46		*g* 14	20		50			60						80
Ky		24	47	*e* 60	* 45		14	20		56			60	76	76	76	76	76	76
La			48																
Me	44		48	60		60				48	50								
Md												20							
Mass	48	25	48	*h* 60				20		48	50		60						
Mich	48	22	48	60	46		14			48			60					80	
Minn	*b* 50	28	48	60		50	14		57	50	45	20	60	80					
Miss		26	48	*e* 60	46		14	20		48			60						80
Mo	48	24	48	*i* 60	46		14	20		52	50		60					80	
Mont	45		48	60		50	14	20		52	50		60					76	
Nebr		24	48	*e* 60	46		14	20		52			60						80
N. H				62															
N. J	50	25	48	60						50			64						
N. Mex																			
N. Y	48	25	48	60				20		48	50		60						
N. C			48							50			60						
N. Dak	50		48	60		60		20	30	42			60						80
Ohio	50	24	48	60		56				50	50		60			80	70		
Okla			48	60		60		20	30	42			60						80
Oreg	45	28	46							42			60						
Pa			47							48		*k* 18	60	*l* 75		76			
R. I	48	25	48	60	46	50		20		48	50	20	60	80					
S. Dak			48	60		60		20	30	42			60						80
Tenn	*b* 50	24	48	*m* 60	46	50	14	20	42	50	50	22	*n* 60						80
Tex	45	28	48	*e* 60				20		42		22	60						80
Vt	46		48	62		60				48	50		60						
Va		28	48	*e* 60			14			52			60						80
Wash	*b* 45	28	48							42			60						
W. Va		25	48	60						52			60			80			
Wis	50	25	48	60		50		20		50	50		60						

* Not defined.
a Small white beans, 60 pounds.
b Green apples.
c Sugar beets and mangel-wurzels.
d Shelled beans, 60 pounds; velvet beans, 78 pounds.
e White beans.
f Wheat bran.
g English blue-grass seed, 22 pounds; native blue-grass seed, 14 pounds.
h Soy beans, 58 pounds.
i Green unshelled beans, 30 pounds.
k Commercially dry for all hard woods; 15 pounds commercially dry for all soft woods.
l Standard weight in borough of Greensburg.
m Dried beans; green unshelled beans, 30 pounds.
n Red and white.

Legal weights (in pounds) per bushel.—Continued.

State or Territory.	Coke.	Corn.*	Corn. Corn in ear, husked.	Corn. Corn in ear, unhusked.	Corn. Shelled corn.	Corn meal.*	Corn meal, bolted.	Corn meal, unbolted.	Cotton seed. Cotton seed.*	Cotton seed. Sea island cotton seed.	Cotton seed. Upland cotton seed.	Cranberries.	Flaxseed (linseed).	Gooseberries.	(Plastering) hair.	Hemp seed.	Herds grass.	Hungarian grass seed.	Indian corn or maize.
U. S.		56				48							56						
Ala			70	75	56				32										
Ariz		54																	
Ark			70	74	56	48			33⅓				56						
Cal																			52
Colo			70			50										44			56
Conn										44	30		55				45		56
Del							44	48											56
Fla				70	56	48			32	46									
Ga			70		56	48			30				56		8	44			
Hawaii																			56
Idaho													56						56
Ill			70		56	48							56		8	44			
Ind			a 68		56	50						33				44			
Iowa	38		b 70		56								56	40		44		50	
Kans			c 70			50							56		d 8	44		50	e 56
Ky			f 70		56	50							56		8	44		50	
La		56																	
Me		56				g 50									11		45		
Mass					h 50	50				44	30		55				45		e 56
Mich			b 70		56	50						40	56			44		50	
Minn			70		56							36		40	d 8	50		48	
Miss			72		56	48	44	48	32				56			44		50	
Mo				70	56	50			33				56			44		48	
Mont			70		56	50							56			44		50	
Nebr			70		56	50							56		8	44		50	
N. H		56				50													
N. J													55						56
N. Y						50				44	30		55				45		56
N. C							46	48	30				55						56
N. Dak			70		56								56						
Ohio	40		68		56								56			44		50	
Okla			70		56								56						
Oreg																			56
Pa	40	58																	56
R. I	40		70		56	50				44	30		56			44		50	
S. C						i 48	46	48	30	(k)									
S. Dak			70		56								56						
Tenn	40		70	l 74	56		50	48	28				56	48	8	44		48	
Tex			70	72	56				32				56			44		48	
Vt																	45		56
Va			70		56	50			32				56		8	44	12	48	
Wash													56						56
W. Va		56											56						
Wis						50				44	30		56		8	44		48	56

* Not defined.

a Corn in ear, 70 pounds until Dec. 1 next after grown; 68 pounds thereafter.

b On the cob.

c Indian corn in ear.

d Unwashed plastering hair, 8 pounds; washed plastering hair, 4 pounds.

e Shelled.

f Corn in ear from Nov. 1 to May 1 following, 70 pounds; 68 pounds from May 1 to Nov. 1.

g Indian corn meal.

h Cracked corn.

i Standard weight bushel corn meal, bolted or unbolted, 48 pounds.

k Matured.

l Green unshelled corn, 100 pounds.

Legal weights (in pounds) per bushel—Continued.

State or Territory.	Lime.		Malt.	Millet.	Oats.	Onions.		Orchard grass seed.	Osage orange seed.	Parsnips.	Peaches.			Peanuts.	Pears.*	Pease.		
	Lime.*	Unslaked lime.				Onions.*	Onion sets.				Peaches.*	Dried peaches, peeled.	Dried peaches, unpeeled.			Ground pease.	Green pease, unshelled.	Peas.*
U. S			34		32													60
Ala					32							38	33					60
Ariz					32													
Ark				50	32	57						33	33					60
Cal					32													
Colo	80				32	57												
Conn	70				32	52				45		33	33					60
Fla				50	32	56					a 54	33						
Ga		80			32	57						38	33			25		60
Hawaii					32									22	60			
Idaho					36								28		b 45			
Ill		80	38		32	57							33					
Ind			c 35	50	32	48		14	33	55			33					
Iowa	80			50	32	57			32		48		33					
Kans		80	32	50	32	57							33					
Ky		35		50	32	57	d 36	14				39				24		60
Me					c 32	52				45								60
Md					26													
Mass	70				32	52						33						60
Mich	70			50	32	54		14	33			28						60
Minn	80			48	32	52		14		42		28						60
Miss		80	38	50	32	57						33				24		60
Mo			38	50	32	57	f 28	14	36	44	48	33			48		56	g 60
Mont		80	30		32	57				50					45			60
Nebr		80	30	50	32	57	25		32			33						60
N. H					32													60
N. J					30	57						33						60
N. Y	70				32	57						33						60
N. C					32									22				60
N. Dak	80			50	32	52												60
Ohio	70		34	50	32	55					48	33						60
Okla	80				32	52												60
Oreg					32							28			45			
Pa					32	50												
R. I	70		38	50	32	50				50	48	33						g 60
S. Dak	80				32	52												60
Tenn	(h)	80		i 50	32	j 56	k 28	14	33	50	l 50	26		23	m 56		30	60
Tex				50	32	57					50	28						
Vt					32	52												60
Va		80	38	50	30	57	28	14	34			40	32	22				n 60
Wash					32							28			b 45			
W. Va					32							33						
Wis	70	80	34	50	32	57				44		33						60

* Not defined.
a Green peaches.
b Green.
c Malt rye.
d Bottom onion sets.
e Strike measure.
f Top onion sets.
g Including split peas.
h Slaked lime, 40 pounds.
i German Missouri and Tennessee millet seed.
j Matured onions.
k Button onion sets, 32 pounds.
l Matured.
m Matured pears, 56 pounds; dried pears, 26 pounds.
n Black-eyed peas.

Legal weights (in pounds) per bushel—Continued.

State or Territory.	Potatoes.			Red top.	Rough rice.	Rice corn.	Rutabagas.	Rye meal.	Rye.	Salt.			Shorts.*	Sorghum seed.	Tomatoes.	Timothy seed.	Turnips.		Wheat.
	Potatoes.*	Sweet potatoes.	White potatoes.							Salt.*	Fine salt.	Coarse salt.					Turnips.*	Common English turnips.	
U. S.	60								56										60
Ala		55	60						56								55		60
Ariz									56										60
Ark	60	50		14					56	50				50		60	57		60
Cal									54										60
Colo	60								56	80						45			60
Conn	60	54	60		45		60	50	56		50	70	20					50	60
D. C	60																		
Del																			60
Fla		60	60						56	60				56			54		60
Ga		55	60		43				56							45	55		60
Hawaii									56										60
Idaho	60								56										60
Ill		50	60						56		55	50				45	55		60
Ind	60	55							56	50						45	55		60
Iowa	60	46							56	50				a 30		45			60
Kans	60	50				56			56	50				56		45	55		60
Ky	60	55	60						56	50	55					45	60		60
La									56										60
Me	60						60	50	50		60	70						50	60
Md	56														60				
Mass	60	54			45			50	56		50	70	20			45			60
Mich		56	60	b14					56	56						45	58		60
Minn		55	60	b14			52		56					57		45			60
Miss		60	60						56	50				42		45	55		60
Mo		56	60	b14			50		56	50				42	45	45		42	60
Mont	60								56	50						45	50		60
Nebr		50	60						56	50				30		45	55		60
N. H	60							50	56										60
N. J		54	60						56										60
N. Y		54	60		45			50	56		56	70	20			45			60
N. C					44				56										60
N. Dak		46	60						56	80						45	60		60
Ohio		50	60						56						56	45	60		60
Okla		46	60						56	80						42	60		60
Oreg	60								56										60
Pa	56								56		c62	85							60
R. I		54	60					50	56		50	70	20		56	45	50		60
S. Dak		46	60						56	80						42	60		60
Tenn		50	60	b14					56	50				50	56	45	50		60
Tex		55	60						56	50					55	45	55		60
Vt	60								56	70						45	60		d60
Va		56	56	12					56	50						45	55		60
Wash	60								56										60
W. Va	60								56							45			60
Wis		54	60		45		56	50	56		50	70	20			45	42		60

*Not defined.
a Sorghum saccharatum seed.
b Seed.
c Ground salt, 70 pounds.
d India wheat, 46 pounds.

Commodities for which legal weights per bushel have been fixed in but one or two States.

[From Bureau of Standards, Department of Commerce and Labor.]

Article.	Weight.	States.
	Pounds.	
Apple seeds	40	Rhode Island and Tennessee.
Beggarweed seed	62	Florida.
Blackberries	32	Iowa. Tennessee, 48 pounds; dried, 28 pounds.
Blueberries	42	Minnesota.
Bromus inermus	14	North Dakota.
Cabbage	50	Tennessee.
Canary seed	60	Do.
Cantaloupe melon	50	Do.
Cement	80	Do.
Cherries	40	Iowa. Tennessee, with stems, 56 pounds; without stems, 64 pounds.
Chestnuts	50	Tennessee. Virginia, 57 pounds.
Chufa	54	Florida.
Cotton seed, staple	42	South Carolina.
Cucumbers	48	Missouri and Tennessee. Wisconsin, 50 pounds.
Currants	40	Iowa and Minnesota.
Feed	50	Massachusetts.
Grapes	40	Iowa. Tennessee, with stems, 48 pounds; without stems, 60 pounds.
Guavas	54	Florida.
Hickory nuts	50	Tennessee.
Hominy	60	Ohio. Tennessee, 62 pounds.
Horseradish	50	Tennessee.
Italian rye-grass seed	20	Do.
Johnson grass	28	Arkansas.
Kafir corn	56	Kansas.
Kale	30	Tennessee.
Land plaster	100	Do.
Meal(?)	46	Alabama; unbolted, 48 pounds.
Middlings, fine	40	Indiana; coarse, 30 pounds.
Millet, Japanese barnyard	35	Massachusetts.
Mustard	30	Tennessee.
Plums	40	Florida. Tennessee, 64 pounds.
Plums, dried	28	Michigan.
Popcorn	70	Indiana and Tennessee. Ohio, in the ear, 42 pounds.
Prunes, dried	28	Idaho; green, 45 pounds.
Quinces	48	Florida, Iowa, and Tennessee.
Rape seed	50	Wisconsin.
Raspberries	32	Kansas. Tennessee, 48 pounds.
Rhubarb	50	Tennessee.
Sage	4	Do.
Salads	30	Do.
Sand	130	Iowa.
Spelt or spiltz	40	North Dakota. South Dakota, 45 pounds.
Spinach	30	Tennessee.
Strawberries	32	Iowa. Tennessee, 48 pounds.
Sugar-cane seed	57	New Jersey.
Velvet-grass seed	7	Tennessee.
Walnuts	50	Do.

STATISTICS OF THE PRINCIPAL CROPS.[a]

CORN.

Corn crop of countries named, 1900–1904.

Country.	1900.	1901.	1902.	1903.	1904.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	2,105,103,000	1,522,520,000	2,523,648,000	2,244,177,000	2,467,481,000
Canada (Ontario)	27,947,000	25,621,000	21,159,000	30,211,000	20,880,000
Mexico	92,204,000	93,459,000	78,099,000	90,879,000	90,000,000
Total North America	2,225,254,000	1,641,600,000	2,622,906,000	2,365,267,000	2,578,361,000
Chile	1,500,000	1,500,000	866,000	1,118,000	1,477,000
Argentina	55,612,000	98,842,000	84,018,000	148,948,000	175,189,000
Uruguay	3,035,000	5,576,000	5,060,000	5,289,000	3,035,000
Total South America	60,147,000	105,918,000	89,944,000	155,355,000	179,701,000
France	22,232,000	26,393,000	24,928,000	25,360,000	23,000,000
Spain	26,016,000	25,759,000	25,272,000	18,759,000	21,300,000
Portugal	16,000,000	15,000,000	16,000,000	14,000,000	15,000,000
Italy	87,969,000	100,455,000	71,028,000	88,990,000	87,000,000
Austria	15,446,000	17,535,000	13,462,000	16,056,000	12,529,000
Hungary	127,656,000	127,389,000	104,546,000	135,751,000	59,400,000
Croatia-Slavonia	18,691,000	20,469,000	15,255,000	23,776,000	11,366,000
Total Austria-Hungary	161,793,000	165,393,000	133,263,000	175,583,000	83,295,000
Roumania	85,047,000	116,945,000	68,447,000	80,272,000	19,598,000
Bulgaria and East Roumelia	18,000,000	25,000,000	18,109,000	22,836,000	18,000,000
Servia	18,472,000	18,849,000	18,396,000	19,479,000	9,498,000
Russia	34,256,000	68,400,000	48,647,000	50,732,000	26,032,000
Total Europe	469,785,000	562,194,000	424,090,000	496,011,000	302,723,000
Algeria	350,000	529,000	556,000	435,000	391,000
Egypt	25,000,000	30,000,000	30,000,000	30,000,000	30,000,000
Cape Colony	2,000,000	2,000,000	2,000,000	3,502,000	3,000,000
Total Africa	27,350,000	32,529,000	32,556,000	33,937,000	33,391,000
Australasia	10,025,000	10,168,000	7,847,000	5,615,000	10,519,000

RECAPITULATION BY CONTINENTS.

North America	2,225,254,000	1,641,600,000	2,622,906,000	2,365,267,000	2,578,361,000
South America	60,147,000	105,918,000	89,944,000	155,355,000	179,701,000
Europe	469,785,000	562,194,000	424,090,000	496,011,000	302,723,000
Africa	27,350,000	32,529,000	32,556,000	33,937,000	33,391,000
Australasia	10,025,000	10,168,000	7,847,000	5,615,000	10,519,000
Total	2,792,561,000	2,352,409,000	3,177,343,000	3,056,185,000	3,104,695,000

Visible supply of corn in the United States and Canada, first of each month for ten years.[b]

Month.	1896–1897.	1897–1898.	1898–1899.	1899–1900.	1900–1901.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	11,199,000	21,501,000	32,983,000	21,551,000	19,087,000
August	13,246,000	20,018,000	25,430,000	17,687,000	18,613,000
September	18,608,000	37,528,000	24,043,000	11,070,000	8,766,000
October	17,800,000	45,412,000	30,132,000	16,662,000	11,106,000
November	23,913,000	52,980,000	33,198,000	18,738,000	11,061,000
December	22,635,000	49,559,000	25,870,000	17,555,000	12,791,000
January	26,457,000	48,292,000	26,936,000	19,024,000	14,313,000
February	29,725,000	53,522,000	36,726,000	20,110,000	21,950,000
March	33,764,000	52,457,000	44,792,000	28,340,000	27,538,000
April	32,670,000	52,228,000	43,618,000	31,883,000	28,947,000
May	21,707,000	34,734,000	34,236,000	30,416,000	24,544,000
June	16,161,000	28,288,000	19,070,000	18,289,000	21,904,000

[a] The figures in these tables were furnished by the Bureau of Statistics, Department of Agriculture, except such as otherwise credited. All prices are on gold basis.

[b] These figures represent stocks available at 62 of the principal points of accumulation east of the Rocky Mountains, stocks in Manitoba elevators, and stocks afloat on lakes and canals, as reported by Bradstreet's.

Visible supply of corn in the United States and Canada, first of each month for ten years—Continued.

Month.	1901–1902.	1902–1903.	1903–1904.	1904–1905.	1905–1906.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	21,522,000	8,541,000	13,410,000	12,362,000	9,571,000
August	19,648,000	9,013,000	11,715,000	10,073,000	10,101,000
September	19,476,000	3,823,000	9,487,000	8,014,000	8,080,000
October	21,215,000	4,607,000	15,063,000	10,703,000	8,796,000
November	19,137,000	4,229,000	12,147,000	5,119,000	5,183,000
December	16,599,000	4,552,000	9,817,000	5,445,000	10,236,000
January	16,825,000	9,345,000	9,517,000	15,351,000	17,830,000
February	17,197,000	11,535,000	12,807,000	19,721,000	22,010,000
March	15,270,000	15,180,000	16,669,000	16,752,000	24,531,000
April	13,540,000	16,901,000	16,571,000	16,124,000	17,653,000
May	9,093,000	9,454,000	13,253,000	14,661,000	7,671,000
June	6,317,000	7,039,000	7,572,000	8,374,000	......

Condition of the corn crop of the United States, monthly, 1891–1905.

Year.	July.	Aug.	Sept.	Oct.	Year.	July.	Aug.	Sept.	Oct.	Year.	July.	Aug.	Sept.	Oct.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*		*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*		*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
1891	92.8	90.8	91.1	92.5	1896	92.4	96.0	91.0	90.5	1901	81.3	54.0	51.7	52.1
1892	81.1	82.5	79.6	79.8	1897	82.9	84.2	79.3	77.1	1902	87.5	86.5	84.3	79.6
1893	93.2	87.0	76.7	75.1	1898	90.5	87.0	84.1	82.0	1903	79.4	78.7	80.1	80.8
1894	95.0	69.1	63.4	64.2	1899	86.5	89.9	85.2	82.7	1904	86.4	87.3	84.6	83.9
1895	99.3	102.5	96.4	95.5	1900	89.5	87.5	80.6	78.2	1905	87.3	89.0	89.5	89.2

Acreage, production, value, prices, and exports of corn of the United States, 1866–1905.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1.	Farm value, Dec. 1.	Chicago cash price per bushel, No. 2. December. Low.	Chicago cash price per bushel, No. 2. December. High.	Chicago cash price per bushel, No. 2. May of following year. Low.	Chicago cash price per bushel, No. 2. May of following year. High.	Domestic exports, including corn meal, fiscal years beginning July 1.
	Acres.	*Bush.*	*Bushels.*	*Cents.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*
1866	34,306,538	25.3	867,946,295	47.4	411,450,830	53	62	64	79	16,026,947
1867	32,520,249	23.6	768,320,000	57.0	437,769,763	61	65	61	71	12,493,522
1868	34,887,246	26.0	906,527,000	46.8	424,056,649	38	58	44	51	8,286,665
1869	37,103,245	23.6	874,320,000	59.8	522,550,509	56	67	73	85	2,140,487
1870	38,646,977	28.3	1,094,255,000	49.4	540,520,456	41	59	46	52	10,676,873
1871	34,091,137	29.1	991,898,000	43.4	430,355,910	36	39	38	43	35,727,010
1872	35,526,836	30.8	1,092,719,000	35.3	385,736,210	27	28	34	39	40,154,374
1873	39,197,148	23.8	932,274,000	44.2	411,961,151	40	49	49	59	35,985,834
1874	41,036,918	20.7	850,148,500	58.4	496,271,255	64	76	53	67	30,025,036
1875	44,841,371	29.5	1,321,069,000	36.7	484,674,804	40	47	41	45	50,910,532
1876	49,033,364	26.2	1,283,827,500	34.0	436,108,521	40	43	43	56	72,652,611
1877	50,369,113	26.7	1,342,558,000	34.8	467,635,230	41	49	35	41	87,192,110
1878	51,585,000	26.9	1,388,218,750	31.7	440,280,517	30	32	33	36	87,884,892
1879	53,085,450	29.2	1,547,901,790	37.5	580,486,217	39	$43\frac{1}{4}$	$32\frac{3}{8}$	$36\frac{1}{8}$	99,572,329
1880	62,317,842	27.6	1,717,434,543	39.6	679,714,499	$35\frac{5}{8}$	42	$41\frac{1}{2}$	45	93,648,147
1881	64,262,025	18.6	1,194,916,000	63.6	759,482,170	$58\frac{1}{2}$	$63\frac{1}{2}$	69	$76\frac{7}{8}$	44,340,683
1882	65,659,545	24.6	1,617,025,100	48.5	783,867,175	$49\frac{1}{4}$	61	$53\frac{1}{4}$	$56\frac{3}{4}$	41,655,653
1883	68,301,889	22.7	1,551,066,895	42.4	658,051,485	$54\frac{1}{4}$	$63\frac{1}{8}$	$52\frac{1}{2}$	57	46,258,606
1884	69,683,780	25.8	1,795,528,432	35.7	640,735,859	$34\frac{1}{2}$	$40\frac{1}{4}$	$44\frac{3}{4}$	49	52,876,456
1885	73,130,150	26.5	1,936,176,000	32.8	635,674,630	36	$42\frac{3}{4}$	$34\frac{1}{4}$	$36\frac{3}{4}$	64,829,617
1886	75,694,208	22.0	1,665,441,000	36.6	610,311,000	$35\frac{3}{4}$	38	$36\frac{7}{8}$	$39\frac{3}{8}$	41,368,584
1887	72,392,720	20.1	1,456,161,000	44.4	646,106,770	47	$51\frac{1}{8}$	54	60	25,360,869
1888	75,672,763	26.3	1,987,790,000	34.1	677,561,580	$33\frac{1}{2}$	$35\frac{7}{8}$	$33\frac{1}{8}$	$35\frac{3}{8}$	70,841,673
1889	78,319,651	27.0	2,112,892,000	28.3	597,918,829	$29\frac{1}{4}$	35	$32\frac{3}{4}$	35	103,418,709
1890	71,970,763	20.7	1,489,970,000	50.6	754,433,451	$47\frac{3}{4}$	53	55	$69\frac{1}{2}$	32,041,529
1891	76,204,515	27.0	2,060,154,000	40.6	836,439,228	$39\frac{3}{8}$	59	$40\frac{3}{4}$	a100	76,602,285
1892	70,626,658	23.1	1,628,464,000	39.4	642,146,630	40	$42\frac{7}{8}$	$39\frac{1}{2}$	$44\frac{1}{2}$	47,121,894
1893	72,036,465	22.5	1,619,496,131	36.5	591,625,627	$34\frac{1}{4}$	$36\frac{1}{2}$	$36\frac{3}{4}$	$38\frac{1}{2}$	66,489,529
1894	62,582,269	19.4	1,212,770,052	45.7	554,719,162	$44\frac{3}{4}$	$47\frac{1}{2}$	$47\frac{3}{4}$	$55\frac{1}{2}$	28,585,405
1895	82,075,830	26.2	2,151,138,580	25.3	544,985,534	25	$26\frac{3}{4}$	$27\frac{1}{2}$	$29\frac{1}{2}$	101,100,375
1896	81,027,156	28.2	2,283,875,165	21.5	491,006,967	$22\frac{1}{2}$	$23\frac{3}{4}$	23	$25\frac{1}{2}$	178,817,417
1897	80,095,051	23.8	1,902,967,933	26.3	501,072,952	25	$27\frac{1}{2}$	$32\frac{3}{8}$	37	212,055,543
1898	77,721,781	24.8	1,924,184,660	28.7	552,023,428	$33\frac{1}{8}$	38	$32\frac{1}{2}$	$34\frac{3}{8}$	177,255,046
1899	82,108,587	25.3	2,078,143,933	30.3	629,210,110	30	$31\frac{1}{2}$	36	$40\frac{1}{2}$	213,123,412
1900	83,320,872	25.3	2,105,102,516	35.7	751,220,034	$35\frac{1}{4}$	$40\frac{1}{8}$	$42\frac{5}{8}$	$58\frac{1}{2}$	181,405,473
1901	91,349,928	16.7	1,522,519,891	60.5	921,555,768	$62\frac{1}{2}$	$67\frac{1}{2}$	$59\frac{1}{8}$	$64\frac{3}{4}$	28,028,688
1902	94,043,613	26.8	2,523,648,312	40.3	1,017,017,349	$43\frac{3}{4}$	$57\frac{1}{4}$	44	46	76,639,261
1903	88,091,993	25.5	2,244,176,925	42.5	952,868,801	41	$43\frac{3}{4}$	$47\frac{1}{4}$	50	58,222,061
1904	92,231,581	26.8	2,467,480,934	44.1	1,087,461,440	$43\frac{1}{2}$	49	48	$64\frac{1}{2}$	90,293,483
1905	94,011,369	28.8	2,707,993,540	41.2	1,116,696,738	42	$50\frac{1}{4}$	......	......	......

a Coincident with "corner."

Acreage, production, value, and distribution of corn of the United States in 1905, by States.

State or Territory.	Crop of 1905.			Stock in farmers' hands March 1, 1906.		Shipped out of county where grown.
	Acreage.	Production.	Value.			
	Acres.	*Bushels.*	*Dollars.*	*Bushels.*	*Per cent.*	*Bushels.*
Maine	13,000	445,900	307,671	80,262	18	0
New Hampshire	27,045	1,000,665	690,459	210,140	21	0
Vermont	58,238	2,020,859	1,374,184	444,589	22	20,209
Massachusetts	44,799	1,679,962	1,175,973	470,389	28	16,800
Rhode Island	10,011	325,358	231,004	123,636	38	0
Connecticut	55,595	2,373,906	1,685,473	664,694	28	47,478
New York	613,103	19,312,744	11,789,774	5,407,568	28	579,382
New Jersey	277,749	9,943,414	5,468,878	4,076,800	41	1,392,078
Pennsylvania	1,441,797	56,085,903	30,286,388	20,751,784	37	3,365,154
Delaware	196,472	5,972,749	2,807,192	2,687,737	45	2,269,645
Maryland	628,795	23,202,536	11,137,217	10,673,167	46	6,960,761
Virginia	1,859,610	43,514,874	23,062,883	20,887,140	48	5,221,785
North Carolina	2,704,772	37,596,331	24,061,652	17,294,312	46	1,127,890
South Carolina	1,878,978	20,480,860	15,155,836	9,626,004	47	614,426
Georgia	4,295,924	47,255,164	33,078,615	24,100,134	51	1,417,655
Florida	645,416	6,518,702	4,302,343	2,933,416	45	65,187
Alabama	2,903,483	42,971,548	27,501,791	19,766,912	46	859,431
Mississippi	2,099,830	30,027,569	19,517,920	10,809,925	36	600,551
Louisiana	1,424,562	19,516,499	11,905,064	4,879,125	25	195,165
Texas	6,532,695	139,146,404	68,181,738	50,092,705	36	18,089,033
Arkansas	2,215,245	38,323,738	21,078,056	14,946,258	39	766,475
Tennessee	3,138,533	77,207,912	38,603,956	30,883,165	40	11,581,187
West Virginia	765,541	22,813,122	12,090,955	8,440,855	37	1,368,787
Kentucky	3,195,072	94,893,638	40,804,264	40,804,264	43	12,336,173
Ohio	2,973,529	112,399,396	48,331,740	41,587,777	37	31,471,831
Michigan	1,228,704	41,775,936	19,216,931	14,621,578	35	2,506,556
Indiana	4,597,804	187,130,623	71,109,637	74,852,249	40	65,495,718
Illinois	9,616,886	382,752,063	145,445,784	160,755,866	42	172,238,428
Wisconsin	1,473,613	55,407,849	23,271,297	19,392,747	35	3,324,471
Minnesota	1,507,614	48,997,455	16,169,160	19,109,007	39	7,349,618
Iowa	8,767,597	305,112,376	103,738,208	146,453,940	48	73,226,970
Missouri	6,014,639	203,294,798	75,219,075	81,317,919	40	26,428,324
Kansas	6,977,467	193,275,836	63,781,026	73,444,818	38	56,049,992
Nebraska	8,035,115	263,551,772	84,336,567	115,962,780	44	131,775,886
South Dakota	1,623,105	51,614,739	16,000,569	23,742,780	46	10,322,948
North Dakota	89,405	2,458,638	885,110	540,900	22	73,759
Montana	3,941	76,455	51,989	12,997	17	0
Wyoming	2,107	56,678	42,508	10,769	19	0
Colorado	116,659	2,776,484	1,304,947	666,356	24	249,884
New Mexico	39,423	997,402	688,207	229,402	23	19,948
Arizona	7,614	205,578	199,411	39,060	19	2,056
Utah	11,353	410,979	287,685	82,196	20	4,110
Idaho	5,506	149,763	98,844	17,972	12	0
Washington	10,796	261,263	156,758	41,802	16	13,063
Oregon	17,556	403,788	238,235	40,379	10	4,038
California	56,592	1,810,944	1,376,317	289,751	16	199,204
Oklahoma	1,902,948	48,144,584	15,406,267	15,406,267	32	14,443,375
Indian Territory	1,905,131	62,297,784	23,050,180	18,689,335	30	17,443,380
United States	94,011,369	2,707,993,540	1,116,696,738	1,108,363,628	40.9	681,538,811

Average yield per acre of corn in the United States, 1896–1905, by States.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	37.0	37.0	40.0	36.0	36.0	39.4	21.7	30.2	39.7	34.3
New Hampshire	42.0	34.0	41.0	39.0	37.0	38.5	23.3	21.0	27.3	37.0
Vermont	41.0	35.0	43.0	36.0	40.0	40.0	21.8	23.4	35.9	34.7
Massachusetts	43.0	32.5	40.0	36.0	38.0	40.5	31.3	24.0	36.0	37.5
Rhode Island	34.0	31.0	34.0	31.0	32.0	32.1	28.4	30.1	34.1	32.5
Connecticut	38.0	31.5	37.0	39.0	38.0	39.0	31.5	22.4	38.9	42.7
New York	34.0	31.0	33.0	31.0	32.0	33.0	25.0	25.0	27.3	31.5
New Jersey	33.0	31.5	37.0	39.0	33.0	36.9	34.5	24.0	38.0	35.8
Pennsylvania	40.0	36.0	37.0	32.0	25.0	35.0	36.1	31.2	34.0	38.9
Delaware	22.0	29.0	25.0	22.0	24.0	30.0	28.0	27.5	30.4	30.4
Maryland	32.0	33.0	31.0	32.0	26.0	34.2	32.4	28.7	33.4	36.9
Virginia	21.5	18.0	22.0	20.0	16.0	22.2	22.0	21.8	23.3	23.4
North Carolina	12.0	13.0	14.0	13.0	12.0	12.0	13.9	14.7	15.2	13.9
South Carolina	9.0	9.0	10.0	9.0	7.0	6.9	10.4	10.5	12.4	10.9
Georgia	11.0	11.0	9.0	10.0	10.0	10.0	9.0	11.7	11.9	11.0
Florida	10.0	8.0	9.0	10.0	8.0	9.0	8.6	9.9	10.7	10.1
Alabama	12.5	12.0	15.0	12.0	11.0	10.9	8.4	14.8	15.0	14.8
Mississippi	13.5	14.5	18.0	16.0	11.0	10.9	11.5	18.4	19.1	14.3
Louisiana	13.0	17.0	18.0	18.0	17.0	13.7	12.5	20.6	19.9	13.7
Texas	9.5	18.5	25.0	18.0	18.5	11.6	8.1	24.2	22.6	21.3
Arkansas	13.5	16.0	20.0	20.0	19.0	8.1	21.3	20.9	21.6	17.3
Tennessee	23.0	21.0	26.0	20.0	20.0	14.2	21.9	23.5	25.0	24.6
West Virginia	30.0	24.5	29.0	26.0	27.0	23.0	26.5	22.6	25.3	29.8
Kentucky	28.0	23.0	31.0	21.0	26.0	15.6	27.0	26.6	26.9	29.7
Ohio	41.0	32.5	37.0	36.0	37.0	26.1	38.0	29.6	32.5	37.8
Michigan	38.0	31.5	34.0	25.0	36.0	34.5	26.4	33.5	28.6	34.0
Indiana	35.0	30.0	36.0	38.0	38.0	19.8	37.9	33.2	31.5	40.7
Illinois	40.5	32.5	30.0	36.0	37.0	21.4	38.7	32.2	36.5	39.8
Wisconsin	37.0	33.0	35.0	35.0	40.0	27.4	28.2	29.3	29.7	37.6
Minnesota	30.5	26.0	32.0	33.0	33.0	26.3	22.8	28.3	26.9	32.5
Iowa	39.0	29.0	35.0	31.0	38.0	25.0	32.0	28.0	32.6	34.8
Missouri	27.0	26.0	26.0	26.0	28.0	10.1	39.0	32.4	26.2	33.8
Kansas	28.0	18.0	16.0	27.0	19.0	7.8	29.9	25.6	20.9	27.7
Nebraska	37.5	30.0	21.0	28.0	26.0	14.1	32.3	26.0	32.8	32.8
South Dakota	26.0	24.0	28.0	26.0	27.0	21.0	18.9	27.2	28.1	31.8
North Dakota	35.0	17.0	19.0	23.0	16.0	22.6	19.4	25.2	21.2	27.5
Montana	26.0	18.0	28.0	23.0	15.0	25.0	22.0	24.1	22.2	19.4
Wyoming	25.0	12.0	16.0	22.0	34.0	39.5	19.8	19.4	32.5	26.9
Colorado	16.0	19.0	18.0	17.0	19.0	17.1	16.5	19.8	20.5	23.8
New Mexico	16.0	27.0	21.0	20.0	22.0	31.6	22.0	24.0	22.7	25.3
Arizona	......	......	......	......	......	18.0	20.2	22.4	23.8	27.0
Utah	25.0	22.0	21.0	20.0	20.0	19.4	20.1	21.4	33.2	36.2
Idaho	......	......	......	......	......	23.0	24.7	34.5	29.3	27.2
Washington	14.0	18.0	12.0	23.0	20.0	17.5	23.0	23.1	24.7	24.2
Oregon	22.0	25.0	24.0	22.0	23.0	20.8	23.4	25.8	28.8	23.0
California	37.0	31.5	26.0	27.0	25.0	31.0	30.5	30.7	28.6	32.0
Oklahoma	......	......	......	19.0	26.0	7.3	25.8	23.3	28.1	25.3
Indian Territory	......	......	......	......	......	12.0	24.9	27.7	32.4	32.7
General average	28.2	23.8	24.8	25.3	25.3	16.7	26.8	25.5	26.8	28.8

Average value per acre of corn in the United States, based upon farm value December 1, 1896–1905, by States.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
Maine	$17.39	$17.39	$19.20	$18.00	$19.80	$29.94	$16.06	$19.93	$32.16	$23.67
New Hampshire	18.90	15.30	18.86	19.11	20.72	30.03	17.01	13.23	19.66	25.53
Vermont	15.58	15.05	18.92	16.92	20.00	29.20	14.82	14.51	26.21	23.60
Massachusetts	19.78	15.28	19.60	18.36	20.52	30.78	23.16	15.84	25.92	26.25
Rhode Island	16.66	16.74	21.76	16.43	21.44	24.40	22.15	24.38	28.64	23.08
Connecticut	15.96	15.43	19.24	19.50	20.90	29.25	23.31	15.01	28.40	30.32
New York	12.92	12.40	14.19	13.95	15.04	23.76	16.75	15.00	17.47	19.21
New Jersey	11.88	11.97	14.80	15.60	14.85	24.35	19.32	13.68	22.04	19.69
Pennsylvania	13.20	22.24	14.80	13.12	11.25	21.70	20.94	17.78	20.06	21.01
Delaware	5.50	8.70	7.75	7.48	9.12	17.10	13.72	13.48	14.90	14.29
Maryland	10.24	9.90	10.85	11.52	10.66	19.84	16.52	14.64	16.70	17.71
Virgina	6.88	6.84	7.70	7.60	7.84	13.10	11.44	11.55	13.75	12.40
North Carolina	4.44	5.59	6.02	6.11	6.84	8.76	8.34	8.97	9.42	8.90
South Carolina	4.14	4.41	4.60	4.50	4.48	5.80	7.18	7.11	8.68	8.07
Georgia	4.73	5.28	4.32	5.00	5.70	8.20	6.57	8.07	8.45	7.70
Florida	5.30	4.40	4.50	5.30	4.80	7.65	6.62	7.23	8.02	6.67
Alabama	5.63	5.52	6.15	5.64	6.38	8.39	5.63	8.44	9.00	9.47
Mississippi	5.94	6.53	7.02	7.36	6.38	8.07	7.02	9.94	10.70	9.30
Louisiana	5.85	7.65	7.38	7.92	8.50	10.27	8.25	11.95	11.34	8.36
Texas	3.90	7.58	8.50	6.48	8.46	9.28	5.35	11.62	11.75	10.44
Arkansas	4.99	6.40	5.80	7.60	8.17	6.56	10.44	10.66	11.45	9.51
Tennessee	6.44	7.56	7.54	7.80	9.80	9.23	10.29	11.52	12.50	12.30
West Virginia	10.20	9.80	10.73	11.70	13.50	14.95	14.31	14.46	16.19	15.79
Kentucky	7.00	8.05	8.37	7.77	10.40	9.52	11.34	14.90	13.18	12.77
Ohio	8.61	8.12	9.99	10.80	12.58	14.88	15.96	13.91	14.95	16.25
Michigan	9.12	8.50	11.56	9.00	13.32	17.94	13.73	15.41	14.87	15.64
Indiana	6.65	6.30	9.00	10.26	12.16	10.89	13.64	11.95	12.91	15.47
Illinois	7.29	6.83	7.50	9.36	11.84	12.20	13.93	11.59	14.23	15.12
Wisconsin	8.14	8.25	9.80	10.50	13.20	14.25	14.10	12.60	13.66	15.79
Minnesota	5.79	6.24	7.68	7.92	9.57	11.83	9.12	10.75	9.68	10.72
Iowa	5.46	4.93	8.05	7.13	10.26	13.00	10.56	10.64	10.76	11.83
Missouri	5.40	6.24	7.02	7.80	8.96	6.77	12.87	11.02	11.53	12.51
Kansas	5.04	3.96	4.16	6.75	6.08	4.91	10.17	9.22	8.57	9.14
Nebraska	4.88	5.10	4.62	6.44	8.06	7.61	9.69	7.28	10.82	10.50
South Dakota	4.68	5.04	6.44	6.76	7.83	9.45	7.75	9.52	10.12	9.86
North Dakota	8.75	5.44	6.84	7.59	6.72	10.40	8.73	10.58	8.48	9.90
Montana	15.60	11.70	18.48	11.96	8.85	22.50	15.84	14.94	15.10	13.19
Wyoming	19.50	6.00	8.80	9.46	20.40	28.44	11.68	11.25	18.52	20.17
Colorado	5.76	7.22	7.20	7.31	9.12	12.65	9.73	10.69	11.07	11.19
New Mexico	8.80	15.66	11.76	11.60	14.08	24.33	17.16	18.00	17.71	17.46
Arizona	......	......	......	......	......	16.20	20.40	20.16	21.66	26.19
Utah	12.75	12.10	12.60	11.80	12.60	17.46	13.47	14.98	23.90	25.34
Idaho	......	......	......	......	......	13.80	15.31	19.67	20.51	17.95
Washington	7.98	9.90	5.04	12.65	11.80	10.15	14.95	12.70	16.30	14.52
Oregon	12.32	13.25	14.40	14.08	13.11	11.86	15.44	17.29	17.57	13.57
California	19.61	17.64	16.12	16.20	15.25	21.08	23.49	22.72	22.31	24.32
Oklahoma	......	......	......	3.80	6.76	5.55	10.06	8.85	10.96	8.10
Indian Territory	......	......	......	......	......	9.12	10.71	10.80	12.96	12.10
General average	6.06	6.26	7.10	7.66	9.02	10.09	10.81	10.82	11.79	11.88

Average farm price of corn per bushel in the United States, December 1, 1896–1905, by States.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	47	47	48	50	55	76	74	66	81	69
New Hampshire	45	45	46	49	56	78	73	63	72	69
Vermont	38	43	44	47	50	73	68	62	73	68
Massachusetts	46	47	49	51	54	76	74	66	72	70
Rhode Island	49	54	64	53	67	76	78	81	84	71
Connecticut	42	49	52	50	55	75	74	67	73	71
New York	38	40	43	45	47	72	67	60	64	61
New Jersey	36	38	40	40	45	66	56	57	58	55
Pennsylvania	33	34	40	41	45	62	58	57	59	54
Delaware	25	30	31	34	38	57	49	49	49	47
Maryland	32	30	35	36	41	58	51	51	50	48
Virginia	32	38	35	38	49	59	52	53	59	53
North Carolina	37	43	43	47	57	73	60	61	62	64
South Carolina	46	49	46	50	64	84	69	69	70	74
Georgia	43	48	48	50	57	82	73	69	71	70
Florida	53	55	50	53	60	85	77	73	75	66
Alabama	45	46	41	47	58	77	67	57	60	64
Mississippi	44	45	39	46	58	74	61	54	56	65
Louisiana	45	45	41	44	50	75	66	58	57	61
Texas	41	41	34	36	47	80	66	48	52	49
Arkansas	37	40	29	38	43	81	49	51	53	55
Tennessee	28	36	29	39	49	65	47	49	50	50
West Virginia	34	40	37	45	50	65	54	64	64	53
Kentucky	25	35	27	37	40	61	42	56	49	43
Ohio	21	25	27	30	34	57	42	47	46	43
Michigan	24	27	34	36	37	52	52	46	52	46
Indiana	19	21	25	27	32	55	36	36	41	38
Illinois	18	21	25	26	32	57	36	36	39	38
Wisconsin	22	25	28	30	33	52	50	43	46	42
Minnesota	19	24	24	24	29	45	40	38	36	33
Iowa	14	17	23	23	27	52	33	38	33	34
Missouri	20	24	27	30	32	67	33	34	44	37
Kansas	18	22	26	25	32	63	34	36	41	33
Nebraska	13	17	22	23	31	54	30	28	33	32
South Dakota	18	21	23	26	29	45	41	35	36	31
North Dakota	25	32	36	33	42	46	45	42	40	36
Montana	60	65	66	52	59	90	72	62	68	68
Wyoming	78	50	55	43	60	72	59	58	57	75
Colorado	36	38	40	43	48	74	59	54	54	47
New Mexico	55	58	56	58	64	77	78	75	78	69
Arizona	......	......	......	......	......	90	101	90	91	97
Utah	51	55	60	59	63	90	67	70	72	70
Idaho	......	......	......	......	......	60	62	57	70	66
Washington	57	55	42	55	59	58	65	55	66	60
Oregon	56	53	60	64	57	57	66	67	61	59
California	53	56	62	60	61	68	77	74	78	76
Oklahoma	......	......	......	20	26	76	39	38	39	32
Indian Territory	......	......	......	......	......	76	43	39	40	37
General average	21.5	26.3	28.7	30.3	35.7	60.5	40.3	42.5	44.1	28.8

Wholesale prices of corn per bushel in leading cities of the United States, 1900–1905.

Date.	New York.		Baltimore.		Cincinnati.		Chicago.		Detroit.		St. Louis.		San Francisco.	
	No. 2.		Mixed.		No. 2.		No. 2.		No. 2.		No. 2.		No. 1, white (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1900.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*		
January	39⅞	42¼	36⅝	37¾	32¾	36	30½	31⅝	32¼	34	30½	31	$1.00	$1.00
February	39⅞	44⅛	36¾	40⅜	33¼	36	31½	34¼	33½	35½	30½	33½	1.00	1.00
March	40⅞	46	38	42⅞	36	40¾	33⅜	38¼	36	40¼	33⅛	37½	1.02½	1.10
April	45¾	49¾	42⅝	45½	41	43½	38¼	40⅞	40	43¼	37½	39¾	1.07½	1.10
May	41	47⅛	40⅝	45	40¼	44	36	40½	39¼	41	36⅜	40½	1.02½	1.07½
June	42¾	50⅝	41⅝	48	39¼	45	37⅜	43½	39¾	45	37	42	1.02½	1.17½
July	44	52⅛	42⅜	48	41¼	47	38⅜	44¾	40¾	45	37½	43	1.17½	1.17½
August	42⅞	47¾	41¾	45	41	43	37¼	41¼	42½	43¾	37½	40	1.22½	1.30
September	45	50⅜	44¼	47	42¼	44	38⅞	43¼	43½	44	38¾	40½	......	......
October	46	49¾	42	47	37	43	36½	41¾	41	43¼	34	39	1.25	1.27½
November	45¾	47½	42¼	44½	37	40	35	49½	38¾	41	34¼	35¾	1.20	1.25
December	44¾	48	41⅞	44¼	37¼	39½	35¼	40½	38	39¼	33¾	36	1.20	1.20
1901.														
January	45½	48½	41½	43¼	38	40	36	37¾	38	39¼	35	37	1.12½	1.15
February	47½	49	42¼	45	39¼	42¼	37¼	40	39¼	40¼	37½	40	1.10	1.20
March	48¼	50½	44¼	48¼	41¼	42¾	39	44	40	43	38¾	43	1.15	1.32½
April	48½	53¾	46⅛	49¾	44¼	47	41	48	43	45¼	41	46¼	1.15	1.35
May	49	56	46¾	50¼	43¼	46½	42⅝	58⅛	42¼	46	42	45⅝	1.20	1.35
June	46¼	49¾	44½	47¾	43¼	44½	41	44⅜	42	45	41¼	44	1.25	1.37½
July	50⅛	61¼	46¼	59	45	58	43½	58¼	44½	56¼	43¾	60½	1.50	1.75
August	60	64	56½	63½	57¼	64	53¾	59½	37	39¼	55¼	63	1.65	1.70
September	61½	66⅛	59¼	62	56¼	61½	54⅛	59¾	55¾	59¼	55¾	60	1.55	1.65
October	60⅞	64	58¼	61	60	60½	54⅝	58	57½	60	57	61	1.62½	1.70
November	63½	69½	60¾	67	63	66	57⅛	63⅞	60	66½	60½	66½	1.40	1.60
December	69¼	72⅞	65	68	66¼	71½	62⅛	67½	66½	70½	65½	70	1.30	1.40
1902.														
January	66	72¼	58½	69½	62	68½	56½	64½	57	67¾	59	69¼	1.30	1.45
February	66½	71¼	60¼	68⅛	61	64½	56⅝	61¼	59	62	58½	63	1.35	1.45
March	65	71½	63	68	62	64	56	61⅛	59	61¼	59	63	1.35	1.42½
April	65½	73	63½	69	60¼	67½	56¾	64½	59½	64¼	59¾	67	1.40	1.45
May	66⅞	73	66½	70	64	67¼	59⅛	64¾	63½	65¼	62½	66	1.55	1.60
June	68¾	71½	67½	72	63¼	66½	61	71½	63¼	66½	62	67	1.55	1.65
July	65¾	73	67	77	63¼	69	56	88	66	67	61	66	1.52½	1.60
August	63½	69½	59	67	58	64	54	60	66	67	54	61½	1.45	1.60
September	67½	72½	64	69	60	63½	57	62½	55¾	59½	56⅛	60½	1.45	1.65
October	67½	70½	65	69	60	62½	55	61½	57½	60	56	58½	1.45	1.60
November	61½	67	47	68	45	60	52¾	58	60	66¼	44½	49	1.42½	1.60
December	57	64	43½	55¼	44	50	43¾	57¼	66½	70½	40½	49½	1.47½	1.65
1903.														
January	55	68½	51½	60	43¼	48½	43¾	48⅛	47	49	40	44½	1.30	1.40
February	55¾	59	52½	55	46	48	42½	45	47	48	41	44¾	1.30	1.37½
March	50⅞	56¼	47¾	52¾	41¼	47	41⅜	45⅝	40½	47⅛	39	45	1.17½	1.35
April	51	53⅛	48½	52⅛	40	46	41¾	45¼	41⅛	45½	39½	42½	1.17½	1.27½
May	52¾	55	51	55½	45¼	47¾	44	46	46½	48	41½	47½	1.17½	1.27½
June	56	60⅝	54½	59	48¼	54	47¼	52	49½	55	48	55	1.20	1.30
July	56⅛	60	58½	61	50	53	49	53	51	55⅛	48	51¾	1.25	1.57½
August	58¼	60¼	58	60	52¼	54⅛	50½	53	54⅛	55½	48	51½	1.55	1.57½
September	53¼	59¾	56	60	48	53	45¼	52¾	51	56¼	45	50	1.47½	1.57½
October	51¼	54	53	55	45½	49	43½	46	47½	51½	41½	45	1.30	1.50
November	49¼	52⅜	46½	54½	45⅛	46	41⅜	44¾	46½	48½	41½	43¼	1.25	1.35
December	49½	53½	46¾	49¼	44¼	46	41	43¾	44	48½	41½	45	1.25	1.35
1904.									No. 3.					
January	51½	56	49¼	50⅝	45¼	46½	42¾	47⅛	42	44	43½	45½	1.27½	1.32½
February	53	63	49⅞	54⅛	45½	47½	46	54½	43½	46	44½	48½	1.25	1.35
March	54¼	57	50¼	52¾	46	51	49	56½	44½	46½	44	49¼	1.30	1.45
April	52¾	56	50⅛	52½	50¼	54	46½	56⅞	48½	51⅛	48	51½	1.37½	1.45
May	55½	60	51½	54	51¼	56⅛	47¼	50	51	52¼	48	54	1.42½	1.45
June	47⅛	50½	50½	53¾	48	51	53¼	59⅛	48½	52	47	50½	1.40	1.47½
July	53⅛	55⅜	50½	53¼	48	53½	47¼	50	49	51½	48½	52¾	1.40	1.55
August	55⅜	62⅛	53½	58½	52½	57½	51¼	55¾	51½	57½	51½	55	1.40	1.55
September	56½	60¼	56½	58¾	55	57	51	54¾	53½	54½	51	54	1.50	1.55
October	55⅝	62¼	......	......	55½	59	50	57¼	52	58½	51½	54⅛	1.40	1.55
November	54⅞	69	53	55	56½	58½	50	58⅛	47½	60	48½	57	1.37½	1.55
December	53	54¾	49¾	52½	45½	52	43½	49	44½	47¾	42½	49	1.25	1.55

Wholesale prices of corn per bushel in leading cities of the United States, 1900–1905—Continued.

Date.	New York.		Baltimore.		Cincinnati.		Chicago.		Detroit.		St. Louis.		San Francisco.	
	No. 2.		Mixed.		No. 2.		No. 2.		No. 2.		No. 2.		No. 1, white (per cwt).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*		
1905.														
January	51¼	52½	44¼	50⅛	45⅛	46	42	43¼	45	46¾	43¾	45	$1.25	$1.55
February	51	54⅜	44	50¾	46	48½	42¾	45½	45½	48½	44	47	1.32½	1.45
March	52	54¾	45½	54	48	52	45½	48½	48½	51½	46	49	1.32½	1.40
April	51	52¾	48	52½	47½	50½	46	49½	49½	50	46¼	49½	1.32½	1.40
May	52	58¼	48¼	56½	49	54⅛	48	64½	49½	54	48	53	1.32½	1.50
June	57¾	62½	50¾	64	54	57	51¾	56¾	54	57¼	50½	56	1.40	1.45
July	59¾	65½	58	65	57	59⅜	53¾	59	57¼	58	51	58½	1.40	1.42½
August	60	62¾	56	63½	54	57½	53	57	55⅛	57	51½	54½	1.40	1.42½
September	59	61	56	63	54½	56½	51¼	54⅛	54½	55½	51½	54½	1.32½	1.40
October	58¼	62½	51	63	53½	56½	50	54⅛	55⅛	59	50	53½	1.30	1.32½
November	52¼	62½	42	61	45½	53	45½	51½	44¾	55½	41½	51½	1.30	1.37½
December	50¾	53¼	42	51½	44½	47	42	50¼	44¾	45¾	41½	46½	1.32½	1.37½

WHEAT.

Wheat crop of countries named, 1901–1905.

Country.	1901.	1902.	1903.	1904.	1905.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	748,460,000	670,063,000	637,822,000	552,400,000	692,979,000
Ontario	22,118,000	26,904,000	22,583,000	13,030,000	22,195,000
Manitoba	52,094,000	54,750,000	41,381,000	40,397,000	57,518,000
Northwest Territories	13,212,000	14,397,000	16,619,000	17,407,000	29,309,000
Rest of Canada	4,000,000	4,000,000	4,000,000	4,000,000	4,000,000
Total Canada	91,424,000	100,051,000	84,583,000	74,834,000	113,022,000
Mexico	12,021,000	8,477,000	10,493,000	9,000,000	6,000,000
Total North America	851,905,000	778,591,000	732,898,000	636,234,000	812,001,000
Chile	9,000,000	10,641,000	10,014,000	17,948,000	14,700,000
Argentina	74,753,000	56,380,000	103,759,000	129,672,000	150,745,000
Uruguay	3,664,000	7,604,000	5,240,000	7,565,000	6,000,000
Total South America	87,417,000	74,625,000	119,013,000	155,185,000	171,445,000
Great Britain	54,111,000	58,463,000	49,144,000	38,043,000	60,759,000
Ireland	1,470,000	1,602,000	1,176,000	1,040,000	1,300,000
Total United Kingdom	55,581,000	60,065,000	50,320,000	39,083,000	62,059,000
Norway	300,000	265,000	307,000	212,000	300,000
Sweden	4,193,000	4,757,000	5,538,000	5,417,000	5,419,000
Denmark	942,000	4,528,000	4,461,000	4,302,000	4,500,000
Netherlands	4,231,000	5,105,000	4,258,000	4,423,000	4,400,000
Belgium	14,143,000	14,521,000	12,350,000	13,817,000	13,000,000
France	310,938,000	327,841,000	364,320,000	298,826,000	338,785,000
Spain	136,905,000	133,523,000	128,979,000	95,377,000	83,605,000
Portugal	10,000,000	10,400,000	8,000,000	6,500,000	5,000,000
Italy	164,587,000	136,210,000	184,451,000	150,664,000	160,000,000
Switzerland	4,400,000	4,200,000	4,000,000	4,000,000	4,000,000
Germany	91,817,000	143,315,000	130,626,000	139,803,000	135,947,000
Austria	44,027,000	49,655,000	46,198,000	53,734,000	54,466,000
Hungary	123,936,000	170,884,000	161,958,000	137,078,000	157,512,000
Croatia-Slavonia	10,693,000	12,017,000	14,664,000	9,841,000	12,668,000
Bosnia-Herzegovina	2,244,000	2,466,000	4,036,000	3,882,000	3,000,000
Total Austria-Hungary	180,900,000	235,022,000	226,856,000	204,535,000	227,646,000

Wheat crop of countries named, 1901–1905—Continued.

Country.	1901.	1902.	1903.	1904.	1905.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Roumania	72,386,000	76,220,000	73,700,000	53,738,000	100,000,000
Bulgaria	24,000,000	35,000,000	36,000,000	42,000,000	39,000,000
Servia	8,102,000	11,409,000	10,885,000	11,700,000	12,300,000
Montenegro	200,000	200,000	200,000	200,000	200,000
Turkey in Europe	22,000,000	25,000,000	26,000,000	23,000,000	20,000,000
Greece	6,400,000	7,000,000	8,000,000	6,000,000	6,000,000
Russia proper	319,991,000	463,258,000	454,596,000	519,964,000	451,327,000
Poland	14,409,000	20,349,000	19,255,000	21,241,000	20,238,000
Northern Caucasia	67,232,000	77,069,000	77,941,000	81,132,000	96,817,000
Finland	140,000	79,000	150,000	150,000	150,000
Total Russia in Europe	401,772,000	560,755,000	551,942,000	622,487,000	568,532,000
Total Europe	1,513,797,000	1,795,336,000	1,831,193,000	1,726,084,000	1,790,693,000
Siberia	16,504,000	30,796,000	48,670,000	31,590,000	42,412,000
Central Asia	9,645,000	15,897,000	20,995,000	12,822,000	25,491,000
Transcaucasia	35,000,000	38,025,000	40,437,000	42,000,000	40,000,000
Total Russia in Asia	61,149,000	84,718,000	110,102,000	86,412,000	107,903,000
Turkey in Asia	30,000,000	35,000,000	33,000,000	33,000,000	33,000,000
Cyprus	1,943,000	1,181,000	812,000	2,241,000	1,969,000
Persia	15,200,000	13,600,000	16,000,000	16,000,000	16,000,000
British India	264,825,000	227,380,000	297,601,000	359,936,000	281,263,000
Japan	22,457,000	20,243,000	9,600,000	21,000,000	16,000,000
Total Asia	395,574,000	382,122,000	467,115,000	518,589,000	456,135,000
Algeria	32,244,000	33,896,000	34,035,000	25,484,000	20,000,000
Tunis	4,428,000	4,127,000	7,523,000	10,519,000	7,500,000
Egypt	12,000,000	12,000,000	11,000,000	12,000,000	12,000,000
Cape Colony	2,000,000	2,000,000	1,755,000	2,000,000	2,000,000
Total Africa	50,672,000	52,023,000	54,313,000	50,003,000	41,500,000
West Australia	799,000	963,000	1,017,000	1,935,000	2,077,000
South Australia	11,608,000	8,265,000	6,555,000	13,626,000	12,454,000
Queensland	1,232,000	1,746,000	6,000	2,514,000	2,217,000
New South Wales	16,683,000	15,275,000	1,635,000	28,196,000	16,983,000
Victoria	18,410,000	12,510,000	2,650,000	29,425,000	21,666,000
Tasmania	1,145,000	994,000	905,000	792,000	818,000
Total Australia	49,877,000	39,753,000	12,768,000	76,488,000	56,215,000
New Zealand	6,733,000	4,174,000	7,693,000	8,140,000	9,411,000
Total Australasia	56,610,000	43,927,000	20,461,000	84,628,000	65,626,000

RECAPITULATION BY CONTINENTS.

North America	851,905,000	778,591,000	732,898,000	636,234,000	812,001,000
South America	87,417,000	74,625,000	119,013,000	155,185,000	171,445,000
Europe	1,513,797,000	1,795,336,000	1,831,193,000	1,726,084,000	1,790,693,000
Asia	395,574,000	382,122,000	467,115,000	518,589,000	456,135,000
Africa	50,672,000	52,023,000	54,313,000	50,003,000	41,500,000
Australasia	56,610,000	43,927,000	20,461,000	84,628,000	65,626,000
Total	2,955,975,000	3,126,624,000	3,224,993,000	3,170,723,000	3,337,400,000

World's international trade in wheat,[a] 1900–1905.

EXPORTS.

Country.	Year beginning—	1900.	1901.	1902.	1903	1904.
		Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Argentina	Jan. 1	73,495,142	36,858,239	25,672,366	65,421,536	90,115,115
Australia	Jan. 1	14,516,808	25,239,105	10,697,519	1,486,401	38,376,297
Belgium	Jan. 1	9,700,854	14,107,813	13,890,599	13,362,799	18,217,597
Bulgaria	Jan. 1	5,140,065	5,559,759	9,320,614	13,185,710	20,286,368
Canada	July 1	14,773,908	31,007,446	38,780,692	23,923,228	20,646,926
Chile	Jan. 1	422,465	75,164	1,013,883	2,270,726	3,146,413
Germany[b]	Jan. 1	12,463,765	4,875,717	4,044,662	7,956,750	8,640,465
India (British)	April 1	1,632,649	15,134,788	21,388,988	50,684,254	83,128,241
Netherlands	Jan. 1	28,487,704	37,789,666	37,349,804	40,218,462	41,268,227
Roumania	Jan. 1	27,664,693	22,104,492	34,715,889	31,860,939	26,719,065
Russia	Jan. 1	74,140,227	86,687,414	114,872,260	158,064,833	[c] 173,935,701
Servia	Jan. 1	3,641,128	2,226,733	1,875,580	2,016,358	3,098,326
United States	July 1	215,990,073	234,772,516	202,905,598	120,727,613	44,012,910
Other countries		15,658,000	15,868,000	15,370,000	9,734,000	10,268,000
Total		497,727,481	532,306,852	531,928,484	540,913,609	581,859,654

IMPORTS.

Country.	Year beginning—	1900.	1901.	1902.	1903	1904.
Belgium	Jan. 1	41,846,866	55,982,915	57,507,743	59,797,103	64,160,456
Brazil	Jan. 1	[d] 10,800,000	11,374,022	10,845,839	12,129,186	[d] 14,400,000
Denmark	Jan. 1	3,171,461	6,650,179	6,038,275	5,791,296	5,735,740
Finland	Jan. 1	3,463,811	2,586,776	3,026,986	3,342,444	3,413,760
France	Jan. 1	5,809,831	7,088,663	10,509,786	18,516,168	8,625,293
Germany[b]	Jan. 1	49,245,745	80,365,624	77,822,604	72,501,263	75,436,443
Greece	Jan. 1	6,873,282	7,427,560	7,483,833	7,088,606	5,878,684
Italy	Jan. 1	26,941,158	38,510,469	43,330,190	43,174,711	29,670,497
Japan	Jan. 1	3,056,847	2,103,314	2,382,118	9,164,674	6,701,969
Netherlands	Jan. 1	44,416,219	57,283,511	55,752,861	58,552,554	58,916,277
Portugal	Jan. 1	5,029,092	3,393,202	336,955	2,748,269	3,282,298
Spain	Jan. 1	8,502,071	5,425,853	2,620,395	3,363,238	8,253,950
Switzerland	Jan. 1	14,684,666	16,420,279	17,057,583	18,030,145	19,072,525
United Kingdom	Jan. 1	182,099,771	186,772,404	200,577,004	217,100,937	219,713,498
Other countries		33,075,000	38,894,000	43,186,000	57,229,000	37,063,000
Total		439,015,820	520,278,771	538,478,172	588,529,594	560,324,390

a Flour included, being converted into grain at the rate of 4½ bushels to the barrel.
b Not including free ports.
c Preliminary figures excluding the trade over the Asiatic frontier (excepting the Black Sea ports of the Caucasus).
d Estimated.

GENERAL NOTE.—It should not be expected that the world's export and import totals for any year will agree. Among sources of disagreement are these: (1) Different periods of time covered in the "year" of the various countries; (2) imports received in year subsequent to year of export; (3) want of uniformity in classification of goods among countries; (4) different practices and varying degrees of failure in recording countries of origin and ultimate destination; (5) different practices of recording reexported goods; (6) opposite methods of treating free ports; (7) clerical errors, which, it may be assumed, are not infrequent.

The exports given are domestic exports and the imports given are imports for consumption, as far as it is feasible and consistent so to express the facts, no statement is for net exports or net imports. While there are some inevitable omissions from such a table as this, on the other hand, there are some duplications because of reshipments that do not appear as such in official reports.

World's visible supply of wheat, first of each month, for ten years.[a]

Month.	1896–1897.	1897–1898.	1898–1899.	1899–1900.	1900–1901.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	137,451,000	88,378,000	86,773,000	140,299,000	149,839,000
August	124,292,000	77,590,000	70,101,000	134,525,000	150,193,000
September	126,485,000	87,075,000	66,511,000	142,595,000	164,629,000
October	151,271,000	119,162,000	83,090,000	162,877,000	188,200,000
November	190,559,000	139,321,000	106,886,000	191,189,000	200,892,000
December	202,329,000	156,016,000	135,846,000	203,477,000	203,237,000
January	184,616,000	157,008,000	147,197,000	200,388,000	200,534,000
February	173,496,000	151,717,000	146,458,000	190,535,000	197,851,000
March	155,533,000	140,571,000	151,124,000	181,527,000	192,749,000
April	139,049,000	132,037,000	144,950,000	184,141,000	187,817,000
May	121,491,000	111,233,000	139,521,000	175,776,000	171,753,000
June	106,912,000	109,845,000	136,952,000	159,405,000	152,518,000

a From Broomhall's Corn Trade News.

World's visible supply of wheat, first of each month, for ten years—Continued.

Month.	1901–1902.	1902–1903.	1903–1904.	1904–1905.	1905–1906.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	135,692,000	103,671,000	95,820,000	118,073,000	114,302,000
August	132,379,000	93,944,000	87,566,000	103,740,000	106,838,000
September	141,071,000	102,364,000	96,907,000	115,183,000	113,511,000
October	159,465,000	133,376,000	132,972,000	144,400,000	138,759,000
November	169,854,000	163,491,000	145,618,000	170,240,000	157,735,000
December	202,108,000	179,483,000	161,891,000	186,891,000	189,323,000
January	200,990,000	174,640,000	167,712,000	178,710,000	192,690,000
February	202,278,000	168,170,000	159,464,000	171,124,000	....
March	191,877,000	163,658,000	152,035,000	165,370,000	193,520,000
April	179,789,000	149,748,000	147,859,000	155,744,000	183,687,000
May	155,486,000	127,088,000	145,840,000	141,734,000	....
June	131,2[illegible],000	112,9[illegible],000	1[illegible],190,000	123,770,000	....

Visible supply of wheat in the United States and Canada, first of each month, for ten years.

EAST OF ROCKY MOUNTAINS.[a]

Month.	1896–1897.	1897–1898.	1898–1899.	1899–1900.	1900–1901.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	61,354,000	27,090,000	18,069,000	46,544,000	59,063,000
August	58,414,000	23,793,000	11,430,000	49,155,000	60,398,000
September	57,588,000	20,362,000	10,499,000	48,087,000	69,003,000
October	63,955,000	31,508,000	22,857,000	60,040,000	76,071,000
November	76,716,000	42,609,000	33,930,000	77,195,000	82,238,000
December	76,433,000	49,859,000	45,914,000	84,687,000	89,591,000
January	73,270,000	54,173,000	51,057,000	89,252,000	88,456,090
February	68,092,000	51,105,000	51,648,000	87,473,000	86,324,000
March	61,664,000	45,021,000	51,085,000	83,935,000	79,300,000
April	55,946,000	40,577,000	51,747,000	77,113,000	73,879,000
May	49,684,000	31,039,000	47,258,000	70,764,000	60,298 000
June	37,975,000	27,479,000	42,092,000	57,617,000	47,109,000

Month.	1901–1902.	1902–1903.	1903–1904.	1904–1905.	1905–1906.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	37,819,000	26,786,000	24,142,000	21,131,000	20,476,000
August	40,924,000	31,436,000	21,480,000	19,508,000	21,314,000
September	42,242,000	33,579,000	22,824,000	20,905,000	21,705,000
October	53,790,000	44,217,000	33,043,000	29,230,000	28,894,000
November	64,616,000	67,490,000	49,269,000	41,252,000	58,745,000
December	85,631,000	78,352,000	59,050,000	54,387,000	62,402,000
January	94,900,000	80,769,000	55,961,000	56,892,000	71,634,000
February	88,800,000	81,348,000	55,818,000	54,597,000	73,151,000
March	82,790,000	76,336,000	55,459,000	52,907,000	70,530,000
April	73,576,000	67,954,000	49,639,000	46,865,000	66,599,000
May	54,610,000	52,585,000	45,307,000	40,158,000	54,856,000
June	37,676,000	36,040,000	29,685,000	28,532,000	....

[a] The figures for stocks east of the Rocky Mountains represent 62 principal points of accumulation, including Manitoba elevators and stocks afloat on lakes and canals, as reported by Bradstreet's.

Visible supply of wheat in the United States and Canada, first of each month, for ten years—Continued.

PACIFIC COAST.

Month.	1896–1897.	1897–1898.	1898–1899.	1899–1900.	1900–1901.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	1,927,000	1,112,000	2,935,000	3,409,000	5,903,000
August	1,917,000	2,247,000	2,608,000	4,188,000	5,770,000
September	3,512,000	4,651,000	3,065,000	6,282,000	[illegible]
October	5,454,000	6,251,000	4,671,000	8,858,000	10,208,000
November	6,883,000	7,391,000	5,621,000	11,085,000	9,983,000
December	6,548,000	6,944,000	6,269,000	10,678,000	10,657,000
January	4,189,000	6,661,000	5,923,000	9,022,000	8,686,000
February	3,005,000	5,318,000	5,030,000	8,923,000	8,717,000
March	1,857,000	4,424,000	5,104,000	7,814,000	6,972,000
April	1,730,000	3,466,000	4,321,000	7,207,000	6,325,000
May	1,614,000	3,051,000	4,455,000	7,050,000	5,084,000
June	1,221,000	3,236,000	3,635,000	6,866,000	4,672,000

Month.	1901–1902.	1902–1903.	1903–1904.	1904–1905.	1905–1906.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	3,228,000	2,725,000	1,775,000	1,668,000	839,000
August	3,935,000	2,345,000	1,400,000	1,351,000	581,000
September	4,266,000	3,024,000	1,798,000	1,582,000	1,130,000
October	6,235,000	4,737,000	3,227,000	4,106,000	3,156,000
November	7,262,000	4,719,000	3,447,000	3,874,000	4,486,000
December	7,378,000	5,361,000	3,591,000	3,733,000	5,866,000
January	7,186,000	4,992,000	3,282,000	3,458,000	5,511,000
February	6,521,000	4,373,000	2,689,000	3,051,000	5,295,000
March	5,542,000	3,435,000	2,930,000	1,673,000	4,898,000
April	5,428,000	3,810,000	2,472,000	2,486,000	4,947,000
May	3,685,000	3,683,000	2,078,000	1,860,000	3,917,000
June	3,139,000	2,546,000	2,078,000	1,461,000	....

Statement showing the amount of wheat in farmers' hands, visible supply of the United States and Canada, and of the world, and price, on March 1, 1892–1906.

Year.	Stocks in farmers' hands in United States.	Visible supply of the United States and Canada.	Visible supply of the world.	Price at Chicago.
	Bushels.	*Bushels.*	*Bushels.*	*Cts. per bu.*
1892	171,070,881	68,007,000	181,400,000	87⅜
1893	135,205,430	110,693,000	229,300,000	72⅝
1894	114,059,560	105,863,000	222,400,000	58⅜
1895	74,999,790	110,546,000	212,400,000	52¼
1896	123,045,290	98,834,000	191,900,000	66½
1897	88,149,072	63,521,000	155,500,000	74½
1898	121,320,500	49,445,000	140,600,000	104½
1899	198,056,496	56,189,000	151,100,000	72⅞
1900	158,745,595	91,749,000	181,500,000	64⅛
1901	128,098,074	86,272,000	192,700,000	74
1902	173,702,583	88,332,000	191,900,000	76
1903	164,047,106	79,771,000	163,700,000	74½
1904	132,608,382	58,389,000	152,000,000	92
1905	111,054,959	54,580,000	165,400,000	116
1906	158,403,478	75,428,000	193,520,000	....

Condition of the wheat crop of the United States, monthly, 1888–1906.

Year.	December of previous year.	Winter wheat.					Spring wheat.			
		April.	May.	June.	July.	When harvested.	June.	July.	August.	When harvested.
	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
1888	95.9	82.0	73.1	73.3	75.6	77.4	92.8	95.9	87.3	77.2
1889	96.8	94.0	96.0	93.1	92.0	89.4	94.4	83.3	81.2	83.8
1890	95.3	81.0	80.0	78.1	76.2	73.5	91.3	94.4	83.2	79.8
1891	98.4	96.9	97.9	96.6	96.2	96.7	92.6	94.1	95.5	97.2
1892	85.3	81.2	84.0	88.3	89.6	87.6	92.3	90.9	87.3	81.2
1893	87.4	77.4	75.3	75.5	77.7	[a]74.0	86.4	74.1	67.0	....
1894	91.5	86.7	81.4	83.2	83.9	[a]83.7	88.0	68.4	67.1	....
1895	89.0	81.4	82.9	71.1	65.8	[a]75.4	97.8	102.2	95.9	....
1896	81.4	77.1	82.7	77.9	75.6	[a]74.6	99.9	93.3	78.9	....
1897	99.5	81.4	80.2	78.5	81.2	[a]85.7	89.6	91.2	86.7	....
1898	....	86.7	86.5	90.8	85.7	[a]86.7	100.9	95.0	96.5	....
1899	92.6	77.9	76.2	67.3	65.6	[a]70.9	91.4	91.7	83.6	....
1900	97.1	82.1	88.9	82.7	80.8	[a]69.6	87.3	55.2	56.4	....
1901	97.1	91.7	94.1	87.8	88.3	[a]82.8	92.0	95.6	80.3	....
1902	86.7	78.7	76.4	76.1	77.0	[a]80.0	95.4	92.4	89.7	....
1903	99.7	97.3	92.6	82.2	78.8	[a]74.7	95.9	82.5	77.1	....
1904	86.6	76.5	76.5	77.7	78.7	....	93.4	93.7	87.5	66.2
1905	82.9	91.6	92.5	85.5	82.7	....	93.7	91.0	89.2	87.3
1906	94.1	89.1	90.9	....	....	....	....	....	....	....

[a] Includes both winter and spring.

Acreage, production, value, prices, and exports of wheat of the United States, 1866–1905.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1.	Farm value, Dec. 1.	Chicago cash price per bushel.				Domestic exports, including flour, fiscal years beginning July 1.
						December.		May of following year.		
						Low.	High.	Low.	High.	
	Acres.	Bush.	Bushels.	Cents.	Dollars.	Cts.	Cts.	Cts.	Cts.	Bushels.
1866	15,424,496	9.9	151,999,906	152.7	232,109,630	129	145	185	211	12,646,941
1867	18,321,561	11.6	212,441,400	145.2	308,387,146	126	140	134	161	25,284,803
1868	18,460,132	12.1	224,036,600	108.5	243,032,746	80	88	87	96	29,717,201
1869	19,181,004	13.6	260,146,900	76.5	199,024,996	63	76	79	92	53,900,780
1870	18,992,591	12.4	235,884,700	94.4	222,766,969	91	98	113	120	52,580,111
1871	19,943,893	11.6	230,722,400	114.5	264,075,851	107	111	120	143	38,995,755
1872	20,858,359	11.9	249,997,100	111.4	278,522,068	97	108	112	122	52,014,715
1873	22,171,676	12.7	281,254,700	106.9	300,669,533	96	106	105	114	91,510,398
1874	24,967,027	12.3	308,102,700	86.3	265,881,167	78	83	78	94	72,912,817
1875	26,381,512	11.1	292,136,000	89.5	261,396,926	82	91	89	100	74,750,682
1876	27,627,021	10.5	289,356,500	96.3	278,697,238	104	117	130	172	57,043,936
1877	26,277,546	13.9	364,194,146	105.7	385,089,444	103	108	98	113	92,071,726
1878	32,108,560	13.1	420,122,400	77.6	325,814,119	81	84	91	102	150,502,506
1879	32,545,950	13.8	448,756,630	110.8	497,030,142	122	133½	112½	119	180,304,180
1880	37,986,717	13.1	498,549,868	95.1	474,201,850	93⅛	109¾	101	112⅝	186,321,514
1881	37,709,020	10.2	383,280,090	119.2	456,880,427	124¾	129	123	140	121,892,389
1882	37,067,194	13.6	504,185,470	88.4	445,602,125	91⅛	94¾	108	113⅜	147,811,316
1883	36,455,593	11.6	421,086,160	91.1	383,649,272	94⅝	99¼	85	94¾	111,534,182
1884	39,475,885	13.0	512,765,000	64.5	330,862,260	69½	76⅜	85⅜	90¾	132,570,366
1885	34,189,246	10.4	357,112,000	77.1	275,320,390	82⅞	89	72⅛	79	94,565,793
1886	36,806,184	12.4	457,218,000	68.7	314,226,020	75⅛	79½	80¾	88¾	153,804,969
1887	37,641,783	12.1	456,329,000	68.1	310,612,960	75⅛	79¼	81¼	89⅞	119,625,344
1888	37,336,138	11.1	415,868,000	92.6	385,248,030	96⅝	105½	77¼	95½	88,600,742
1889	38,123,859	12.9	490,560,000	69.8	342,491,707	76¾	80½	89¾	100	109,430,467
1890	36,087,154	11.1	399,262,000	83.8	334,773,678	87½	92¾	98⅞	108	106,181,316
1891	39,916,897	15.3	611,780,000	83.9	513,472,711	89⅜	93¼	80	85¾	225,665,812
1892	38,554,430	13.4	515,949,000	62.4	322,111,881	69½	73	68¼	76¼	191,912,635
1893	34,629,418	11.4	396,131,725	53.8	213,171,381	59⅛	64⅛	52⅛	60½	164,283,129
1894	34,882,436	13.2	460,267,416	49.1	225,902,025	52¾	63⅝	60¾	85⅜	144,812,718
1895	34,047,332	13.7	467,102,947	50.9	237,938,998	53¾	64¾	57⅛	67⅝	126,443,968
1896	34,618,646	12.4	427,684,346	72.6	310,602,539	74⅝	93⅛	68¾	97⅞	145,124,972
1897	39,465,066	13.4	530,149,168	80.8	428,547,121	92	109	117	185	217,306,005
1898	44,055,278	15.3	675,148,705	58.2	392,770,320	62¾	70	68⅜	79½	222,618,420
1899	44,592,516	12.3	547,303,846	58.4	319,545,259	64	69½	63⅝	67½	186,096,762
1900	42,495,385	12.3	522,229,505	61.9	323,515,177	69¼	74⅝	70	75⅛	215,990,073
1901	49,895,514	15.0	748,460,218	62.4	467,350,156	73	79½	72⅜	76¼	234,772,516
1902	46,202,424	14.5	670,063,008	63.0	422,224,117	71⅞	77¾	74¾	80⅝	202,905,598
1903	49,464,967	12.9	637,821,835	69.5	443,024,826	77¾	87	87¾	101½	120,727,613
1904	44,074,875	12.5	552,399,517	92.4	510,489,874	115	122	89½	113¾	44,112,910
1905	47,854,079	14.5	692,979,489	74.8	518,372,727	82½	90	......	......	....

Acreage, production, value, and distribution of wheat of the United States in 1905, by States.

State or Territory.	Crop of 1905. Acreage.	Crop of 1905. Production.	Crop of 1905. Value.	Stock in farmers' hands March 1, 1906.		Shipped out of county where grown.
	Acres.	*Bushels.*	*Dollars.*	*Bushels.*	*Per cent.*	*Bushels.*
Maine	7,880	181,240	192,114	57,997	32	0
Vermont	1,461	27,467	24,720	9,613	35	0
New York	490,521	10,300,941	8,858,809	2,472,226	24	1,442,132
New Jersey	110,075	1,805,230	1,588,602	397,151	22	361,046
Pennsylvania	1,629,279	27,860,671	24,238,784	10,029,842	36	2,786,067
Delaware	121,001	1,669,814	1,369,247	417,454	25	784,813
Maryland	809,619	13,196,790	10,821,368	2,903,294	22	8,050,042
Virginia	738,480	8,418,672	7,408,431	2,273,041	27	3,114,909
North Carolina	593,325	3,975,278	4,054,784	1,073,325	27	198,764
South Carolina	318,419	1,942,356	2,156,015	369,048	19	19,424
Georgia	305,298	2,106,556	2,254,015	484,508	23	63,197
Alabama	108,446	1,041,082	1,051,493	176,984	17	10,411
Mississippi	2,619	28,285	26,871	0	0	0
Texas	1,249,207	11,117,942	9,783,789	1,667,691	15	3,113,024
Arkansas	198,077	1,564,808	1,408,327	344,258	22	62,592
Tennessee	881,750	6,348,600	5,777,226	1,206,234	19	1,968,066
West Virginia	355,535	4,373,080	3,892,041	1,268,193	29	699,693
Kentucky	779,642	8,809,955	7,664,661	1,585,792	18	3,083,484
Ohio	1,882,907	32,197,710	26,402,122	9,015,359	28	16,420,832
Michigan	1,027,204	19,003,274	15,012,586	5,130,884	27	7,981,375
Indiana	1,931,774	35,351,464	28,988,200	8,130,837	23	16,615,188
Illinois	1,871,974	29,951,584	24,260,783	5,690,801	19	13,777,729
Wisconsin	474,233	7,893,381	5,998,969	2,841,617	36	947,206
Minnesota	5,446,183	72,434,234	51,428,306	20,281,586	28	54,325,676
Iowa	963,954	13,683,003	9,714,932	4,241,731	31	3,420,751
Missouri	2,259,866	28,022,338	22,137,647	5,324,244	19	12,610,052
Kansas	5,536,103	77,001,104	54,670,784	13,860,199	18	57,750,828
Nebraska	2,472,692	48,002,603	31,681,718	12,960,703	27	31,201,692
South Dakota	3,221,422	44,133,481	29,569,432	11,033,370	25	34,865,450
North Dakota	5,401,646	75,623,044	52,179,900	15,124,609	20	64,279,587
Montana	119,469	2,843,362	2,018,787	995,177	35	767,708
Wyoming	29,468	748,487	538,911	217,061	29	52,394
Colorado	254,355	6,358,875	4,451,212	1,526,130	24	3,815,325
New Mexico	42,691	947,740	852,966	227,458	24	28,432
Arizona	14,802	331,565	387,931	56,366	17	9,947
Utah	178,417	4,710,209	3,155,840	1,836,982	39	1,177,552
Nevada	26,800	723,600	557,172	115,776	16	14,472
Idaho	366,966	10,341,532	6,784,737	1,861,476	18	6,721,996
Washington	1,321,807	32,516,810	21,325,638	5,202,690	16	25,037,944
Oregon	717,565	13,382,585	9,100,157	2,408,865	18	7,226,596
California	1,886,238	17,542,013	14,384,451	1,403,361	8	10,876,048
Oklahoma	1,434,648	11,764,114	8,117,239	1,882,258	16	7,058,468
Indian Territory	270,261	2,702,610	2,081,010	297,287	11	1,351,305
United States	47,854,079	692,979,489	518,372,727	158,403,478	22.9	404,092,217

Acreage, production, and farm value on December 1 of winter and spring wheat in the United States in 1905.

State or Territory.	Winter wheat. Acreage.	Winter wheat. Average yield per acre.	Winter wheat. Production.	Winter wheat. Average farm price Dec. 1.	Winter wheat. Farm value Dec. 1.	Spring wheat. Acreage.	Spring wheat. Average yield per acre.	Spring wheat. Production.	Spring wheat. Average farm price Dec. 1.	Spring wheat. Farm value Dec. 1.
	Acres.	*Bu.*	*Bushels.*	*Cts.*	*Dollars.*	*Acres.*	*Bu.*	*Bushels.*	*Cts.*	*Dollars.*
Maine						7,880	23.0	181,240	106	192,114
Vermont						1,461	18.8	27,467	90	24,720
New York	490,521	21.0	10,300,941	86	8,858,809					
New Jersey	110,075	16.4	1,805,230	88	1,588,602					
Pennsylvania	1,629,279	17.1	27,860,671	87	24,238,784					
Delaware	121,001	13.8	1,669,814	82	1,369,247					
Maryland	809,619	16.3	13,196,790	82	10,821,368					
Virginia	738,480	11.4	8,418,672	88	7,408,431					
North Carolina	593,325	6.7	3,975,278	102	4,054,784					
South Carolina	318,419	6.1	1,942,356	111	2,156,015					
Georgia	305,298	6.9	2,106,556	107	2,254,015					
Alabama	108,446	9.6	1,041,082	101	1,051,493					
Mississippi	2,619	10.8	28,285	95	26,871					
Texas	1,249,207	8.9	11,117,942	88	9,783,789					
Arkansas	198,077	7.9	1,564,808	90	1,408,327					

Acreage, production, and farm value on December 1 of winter and spring wheat in the United States in 1905—Continued.

State or Territory.	Winter wheat.					Spring wheat.				
	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Farm value, Dec. 1.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Bu.*	*Bushels.*	*Cts.*	*Dollars.*	*Acres.*	*Bu.*	*Bushels.*	*Cts.*	*Dollars.*
Tennessee	881,750	7.2	6,348,600	91	5,777,226					
West Virginia	355,535	12.3	4,373,080	89	3,892,041					
Kentucky	779,642	11.3	8,809,955	87	7,664,661					
Ohio	1,882,907	17.1	32,197,710	82	26,402,122					
Michigan	1,027,204	18.5	19,003,274	79	15,012,586					
Indiana	1,931,774	18.3	35,351,464	82	28,988,200					
Illinois	1,871,974	16.0	29,951,584	81	24,260,783					
Wisconsin	117,794	19.2	2,261,645	76	1,718,850	356,439	15.8	5,631,736	76	4,280,119
Minnesota						5,446,183	13.3	72,434,234	71	51,428,306
Iowa	61,361	20.0	1,227,220	71	871,326	902,593	13.8	12,455,783	71	8,843,606
Missouri	2,259,866	12.4	28,022,338	79	22,137,647					
Kansas	5,289,740	13.9	73,527,386	71	52,204,444	246,363	14.1	3,473,718	71	2,466,340
Nebraska	2,091,393	20.4	42,664,417	66	28,158,515	381,299	14.0	5,338,186	66	3,523,203
South Dakota						3,221,422	13.7	44,133,481	67	29,569,432
North Dakota						5,401,646	14.0	75,623,044	69	52,179,900
Montana						119,469	23.8	2,843,362	71	2,018,787
Wyoming						29,468	25.4	748,487	72	538,911
Colorado						254,355	25.0	6,358,875	70	4,451,212
New Mexico						42,691	22.2	947,740	90	852,966
Arizona						14,802	22.4	331,565	117	387,931
Utah						178,417	26.4	4,710,209	67	3,155,840
Nevada						26,800	27.0	723,600	77	557,172
Idaho	196,066	32.0	6,274,112	66	4,140,914	170,900	23.8	4,067,420	65	2,643,823
Washington	478,647	28.3	13,545,710	65	8,804,712	843,160	22.5	18,971,100	66	12,520,926
Oregon	372,852	21.1	7,867,177	68	5,349,680	344,713	16.0	5,515,408	68	3,750,477
California	1,886,238	9.3	17,542,013	82	14,384,451					
Oklahoma	1,434,648	8.2	11,764,114	69	8,117,239					
Indian Territory	270,261	10.0	2,702,610	77	2,081,010					
United States	29,864,018	14.3	428,462,834	78.2	334,986,912	17,990,061	14.7	264,516,655	69.3	183,385,785

Average yield per acre of wheat in the United States, 1896–1905, by States.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	22.0	16.5	19.5	22.5	19.5	23.9	25.3	25.5	23.3	23.0
New Hampshire	21.0	16.0	19.0	17.2	16.3					
Vermont	24.5	17.0	22.5	22.0	23.5	18.7	18.8	20.9	25.1	18.8
Connecticut		20.0	20.0	18.3	20.8					
New York	16.0	21.4	21.2	18.5	17.7	13.1	16.8	17.8	11.3	21.0
New Jersey	15.3	18.5	17.4	14.5	19.1	16.8	16.0	14.0	13.3	16.4
Pennsylvania	14.0	19.7	17.5	13.6	13.5	17.1	15.8	15.6	14.1	17.1
Delaware	18.0	21.5	13.3	12.8	20.3	18.5	16.5	10.2	14.9	13.8
Maryland	17.0	19.2	15.3	14.1	19.5	17.2	14.7	12.5	13.4	16.3
Virginia	9.3	12.0	14.1	8.4	11.9	10.9	5.7	8.7	10.2	11.4
North Carolina	7.3	8.0	9.2	6.7	9.6	8.7	5.3	5.1	8.6	6.7
South Carolina	6.8	8.7	10.6	6.5	9.0	8.8	5.6	6.5	8.1	6.1
Georgia	8.0	9.4	10.0	6.8	9.1	8.2	6.0	6.2	8.8	6.9
Alabama	8.0	10.0	12.0	7.6	9.5	8.7	6.0	9.1	10.3	9.6
Mississippi	8.5	10.0	13.9	7.7	9.6	8.8	8.0	8.0	8.8	10.8
Texas	11.7	15.8	14.8	11.1	18.4	8.9	9.0	13.4	10.7	8.9
Arkansas	8.0	10.5	11.0	8.6	10.1	8.8	9.1	7.0	10.1	7.9
Tennessee	8.5	11.2	13.2	8.7	9.9	10.8	7.2	7.1	11.5	7.2
West Virginia	10.3	13.4	13.8	9.3	9.8	10.9	7.7	10.2	10.1	12.3
Kentucky	8.7	13.6	15.4	9.1	13.0	12.1	9.3	8.4	11.4	11.3
Ohio	9.0	16.9	16.9	14.2	6.0	15.3	17.1	13.7	11.5	17.1
Michigan	12.8	15.6	20.8	8.4	7.6	11.1	17.7	15.5	9.8	18.5
Indiana	9.0	13.0	15.6	9.8	5.3	15.8	16.0	10.0	9.2	18.3
Illinois	14.7	7.9	11.0	10.0	13.0	17.6	17.0	8.4	13.8	16.0
Wisconsin	13.3	12.5	18.0	15.5	15.5	16.1	18.1	15.6	15.5	16.6
Minnesota	14.2	13.0	15.8	13.4	10.5	12.9	13.9	13.1	12.8	13.3
Iowa	16.0	13.0	16.7	13.0	15.6	16.2	12.7	12.4	11.6	14.2
Missouri	11.7	9.0	9.8	9.9	12.5	15.9	19.9	8.7	17.7	12.4
Kansas	10.6	15.5	14.2	9.8	17.7	18.5	10.4	14.1	12.4	13.9
Nebraska	14.0	14.5	16.4	10.3	12.0	17.1	20.9	15.7	13.6	19.4
South Dakota	11.2	8.0	12.4	10.7	6.9	12.9	12.2	13.8	9.6	13.7
North Dakota	11.8	10.3	14.4	12.8	4.9	13.1	15.9	12.7	11.8	14.0
Montana	26.5	32.5	29.5	25.7	26.6	26.5	26.0	28.2	23.9	23.8

Average yield per acre of wheat in the United States, 1896–1905, by States—Continued.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Wyoming	24.5	25.0	23.7	18.8	17.6	24.5	23.5	20.9	22.1	25.4
Colorado	17.5	24.0	26.3	23.7	22.6	24.1	18.0	26.6	22.8	25.0
New Mexico	21.0	24.0	23.8	13.8	21.0	21.5	17.1	18.4	12.8	22.2
Arizona	23.0	18.0	31.7	15.3	14.6	21.8	18.7	25.3	25.5	24.4
Utah	26.5	21.0	28.0	20.7	20.9	20.5	21.2	22.6	26.6	26.4
Nevada	30.0	24.3	29.0	18.0	24.5	25.1	27.1	27.6	26.2	27.0
Idaho	24.5	22.0	31.0	24.2	20.8	21.2	22.1	21.1	22.9	28.2
Washington	18.0	23.5	24.2	22.7	23.5	29.1	22.2	20.3	22.2	24.6
Oregon	17.0	17.0	20.5	19.2	13.8	21.1	20.0	18.2	19.0	18.6
California	14.6	10.0	9.1	14.1	10.3	13.0	10.9	11.2	10.8	9.3
Oklahoma	13.0	19.0	14.9	13.3	19.0	16.4	11.1	14.9	11.7	8.2
Indian Territory	......	......	......	......	......	12.2	12.3	12.0	14.1	10.0
General average	12.4	13.4	15.3	12.3	12.3	15.0	14.5	12.9	12.5	14.5

Averge yield of wheat in certain countries, in bushels per acre, 1895–1904.

Year.	United States.	Russia.	Germany.	Austria.	Hungary.	France.	United Kingdom.
	(*a*)	(*b*)	(*b*)	(*b*)	(*b*)	(*a*)	(*a*)
1895	13.7	9.8	24.4	15.3	20.7	19.7	27.2
1896	12.4	9.0	26.4	15.9	19.4	20.0	34.7
1897	13.4	7.3	25.3	13.2	11.7	15.1	30.0
1898	15.3	9.8	27.2	18.0	17.1	21.1	35.8
1899	12.3	9.1	28.4	18.9	17.8	21.2	33.8
1900	12.3	8.1	27.9	15.5	16.9	19.2	29.5
1901	15.0	7.9	23.5	16.7	15.1	18.5	31.9
1902	14.5	11.1	30.3	19.0	20.7	20.2	33.9
1903	12.9	10.6	29.3	17.7	19.0	22.8	31.1
1904	12.5	11.5	29.4	19.5	16.3	18.5	27.8
Average	13.4	9.4	27.2	17.0	17.5	19.6	31.6

a Winchester bushels. *b* Bushels of 60 pounds.

Average value per acre of wheat in the United States, based upon farm value December 1, 1896–1905, by States.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
Maine	$18.48	$17.49	$17.36	$20.47	$17.55	$23.18	$23.28	$24.99	$24.23	$24.38
New Hampshire	21.00	17.60	17.48	16.34	15.00	......	......	......	......	......
Vermont	22.79	17.68	20.25	18.70	18.33	17.58	20.49	19.85	28.36	16.92
Connecticut	......	20.00	17.60	17.39	17.05	......	......	......	......	......
New York	14.08	19.26	15.26	14.80	13.63	10.74	13.27	14.42	12.32	18.06
New Jersey	13.62	17.20	12.70	10.88	14.13	12.10	12.16	11.48	14.63	14.43
Pennsylvania	11.62	17.93	11.90	8.98	9.72	12.31	11.53	12.32	15.23	14.88
Delaware	15.66	20.21	9.18	8.70	14.21	13.13	12.38	7.96	16.09	11.32
Maryland	14.96	17.86	10.71	9.59	13.84	12.21	10.58	9.88	14.20	13.37
Virginia	7.44	11.04	9.31	5.80	8.57	7.96	4.50	7.31	11.12	10.03
North Carolina	6.06	7.52	7.18	5.49	7.87	7.13	4.88	4.95	10.23	6.83
South Carolina	6.05	10.27	9.96	6.44	9.09	8.62	5.71	6.56	10.21	6.77
Georgia	7.12	9.68	9.80	6.66	8.64	7.71	5.88	5.95	11.09	7.38
Alabama	6.80	10.10	10.80	6.76	8.45	7.66	5.58	8.65	11.85	9.70
Mississippi	6.97	9.90	11.54	6.01	8.06	7.57	6.80	7.44	8.89	10.26
Texas	8.78	14.06	10.06	7.55	11.78	6.94	6.93	10.45	11.77	7.83
Arkansas	5.68	8.82	6.38	5.50	6.57	6.86	6.10	5.46	10.20	7.11
Tennessee	6.29	10.64	8.84	6.79	7.82	7.99	5.47	5.96	12.77	6.55
West Virginia	8.03	11.93	9.80	6.60	7.55	8.39	6.31	8.67	11.01	10.95
Kentucky	6.61	12.10	9.55	6.01	8.97	8.71	6.88	6.80	12.43	9.83
Ohio	7.02	14.87	11.15	9.09	4.26	10.86	12.14	10.96	12.65	14.02
Michigan	10.75	13.57	13.31	5.46	5.24	7.88	12.21	11.94	10.58	14.61
Indiana	7.20	11.57	9.83	6.27	3.71	11.06	10.88	7.80	9.75	15.01
Illinois	10.88	7.03	6.60	6.30	8.32	12.14	10.56	6.30	13.94	12.96
Wisconsin	9.31	10.50	10.62	9.46	9.92	10.48	11.61	11.22	15.18	12.65
Minnesota	9.66	10.01	8.53	7.37	6.62	7.74	8.48	9.04	11.14	9.44
Iowa	9.92	9.75	8.68	7.15	9.20	9.75	6.96	7.69	10.48	10.08
Missouri	8.19	7.65	5.78	6.14	7.88	10.97	11.54	6.18	11.23	9.80
Kansas	6.68	11.47	7.10	5.10	9.73	10.92	5.73	8.33	11.06	9.88
Nebraska	8.12	10.00	7.71	5.05	6.36	9.23	10.23	8.47	11.83	12.81
South Dakota	6.94	5.52	6.20	5.35	4.00	6.84	6.95	8.56	7.58	9.18

Average value per acre of wheat in the United States, based upon farm value December 1, 1896–1905, by States—Continued.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
North Dakota	$7.55	$7.62	$7.34	$6.53	$2.84	$7.07	$9.22	$8.00	$9.56	$9.66
Montana	17.49	22.10	17.11	15.68	16.23	17.76	16.12	18.61	21.28	16.90
Wyoming	15.19	17.50	16.35	12.60	13.38	16.91	19.04	15.47	19.89	18.29
Colorado	10.67	16.80	14.73	13.51	13.33	16.15	13.50	17.56	22.75	17.50
New Mexico	13.86	18.00	14.76	8.42	14.28	15.48	14.71	13.80	13.57	19.98
Arizona	18.40	13.32	29.16	9.79	11.53	18.53	19.64	23.53	28.82	26.21
Utah	18.02	14.28	15.12	10.97	11.49	14.35	16.11	18.08	22.88	17.69
Nevada	20.70	21.87	27.55	13.68	17.15	22.09	25.56	27.32	24.10	20.79
Idaho	15.93	15.40	15.81	12.10	9.57	12.93	15.44	15.86	18.34	18.49
Washington	13.32	15.98	13.07	11.58	11.99	13.67	14.44	14.04	17.77	16.13
Oregon	12.24	12.24	12.71	10.18	7.59	11.37	13.37	13.98	15.37	12.68
California	12.12	8.30	6.55	8.74	5.97	7.80	8.72	9.74	9.50	7.63
Oklahoma	8.84	14.44	7.75	7.05	10.07	10.33	6.44	9.39	10.88	5.66
Indian Territory	......	......	......	......	......	8.42	7.50	8.28	13.82	7.70
General average	8.97	10.86	8.92	7.17	7.61	9.37	9.14	8.96	11.58	10.83

Average farm price of wheat per bushel in the United States, December 1, 1896–1905, by States.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
Maine	$0.84	$1.06	$0.89	$0.91	$0.90	$0.97	$0.92	$0.98	$1.04	$1.06
New Hampshire	1.00	1.10	.92	.95	.92	......	......	......	......	......
Vermont	.93	1.04	.90	.85	.78	.94	1.09	.95	1.13	.90
Connecticut	......	1.00	.88	.95	.82	......	......	......	......	......
New York	.88	.90	.72	.80	.77	.82	.79	.81	1.09	.86
New Jersey	.89	.93	.73	.75	.74	.72	.76	.82	1.10	.88
Pennsylvania	.83	.91	.68	.66	.72	.72	.73	.79	1.08	.87
Delaware	.87	.94	.69	.68	.70	.71	.75	.78	1.08	.82
Maryland	.88	.93	.70	.68	.71	.71	.72	.79	1.06	.82
Virginia	.80	.92	.66	.69	.72	.73	.79	.84	1.09	.88
North Carolina	.83	.94	.78	.82	.82	.82	.92	.97	1.19	1.02
South Carolina	.89	1.18	.94	.99	1.01	.98	1.02	1.01	1.26	1.11
Georgia	.89	1.03	.98	.98	.95	.94	.98	.96	1.26	1.07
Alabama	.85	1.01	.90	.89	.89	.88	.93	.95	1.15	1.01
Mississippi	.82	.99	.83	.78	.84	.86	.85	.93	1.01	.95
Texas	.75	.89	.68	.68	.64	.78	.77	.78	1.10	.88
Arkansas	.71	.84	.58	.64	.65	.78	.67	.78	1.01	.90
Tennessee	.74	.95	.67	.78	.79	.74	.76	.84	1.11	.91
West Virginia	.78	.89	.71	.71	.77	.77	.82	.85	1.09	.89
Kentucky	.76	.89	.62	.66	.69	.72	.74	.81	1.09	.87
Ohio	.78	.88	.66	.64	.71	.71	.71	.80	1.10	.82
Michigan	.84	.87	.64	.65	.69	.71	.69	.77	1.08	.79
Indiana	.80	.89	.63	.64	.70	.70	.68	.78	1.06	.82
Illinois	.74	.89	.60	.63	.64	.69	.59	.75	1.01	.81
Wisconsin	.70	.84	.59	.61	.64	.65	.64	.72	.98	.76
Minnesota	.68	.77	.54	.55	.63	.60	.61	.69	.87	.71
Iowa	.62	.75	.52	.55	.59	.60	.55	.62	.90	.71
Missouri	.70	.85	.59	.62	.63	.69	.58	.71	.96	.79
Kansas	.63	.74	.50	.52	.55	.59	.55	.59	.89	.71
Nebraska	.58	.69	.47	.49	.53	.54	.49	.54	.87	.66
South Dakota	.62	.69	.50	.50	.58	.53	.57	.62	.79	.67
North Dakota	.64	.74	.51	.51	.58	.54	.58	.63	.81	.69
Montana	.66	.68	.58	.61	.61	.67	.62	.66	.89	.71
Wyoming	.62	.70	.69	.67	.76	.69	.81	.74	.90	.72
Colorado	.61	.70	.56	.57	.59	.67	.75	.66	.91	.70
New Mexico	.66	.75	.62	.61	.68	.72	.86	.75	1.06	.90
Arizona	.80	.74	.92	.64	.79	.85	1.05	.93	1.13	1.17
Utah	.68	.68	.54	.53	.55	.70	.76	.80	.86	.67
Nevada	.69	.90	.95	.76	.70	.88	.98	.99	.92	.77
Idaho	.65	.70	.51	.50	.46	.61	.70	.75	.80	.65
Washington	.74	.68	.54	.51	.51	.47	.65	.69	.80	.66
Oregon	.72	.72	.62	.53	.55	.54	.67	.77	.81	.68
California	.83	.83	.72	.62	.58	.60	.80	.87	.88	.82
Oklahoma	.68	.76	.52	.53	.53	.63	.58	.63	.93	.69
Indian Territory	......	......	......	......	......	.69	.61	.69	.98	.77
General average	.726	.808	.582	.584	.619	.624	.630	.695	.924	.748

Wholesale prices of wheat per bushel in leading cities of the United States, 1900–1905.

Date.	New York.		Baltimore.		Chicago.		Detroit.		St. Louis.		Minneapolis.		San Francisco.	
	No. 2, red winter.		Southern, No. 2, red.		Low.	High.	No. 2, red.		No. 2, red winter.		No. 1, northern.		No. 1, California (per cwt.).	
	Low.	High.	Low.	High.			Low.	High.	Low.	High.	Low.	High.	Low.	High.
1900.														
January	$0.72¼	$0.78⅜	$0.70	$0.73	$0.61⅛	$0.67⅛	$0.66¾	$0.72	$0.66¼	$0.72	$0.62	$0.66¼	$0.95	$1.00
February	.74¼	.79⅞	.73	.76	.63⅞	.67½	.70¾	.73¼	.69	.71¾	.63	.65⅞	.96¼	1.00
March	.74¼	.81⅜	.71½	.75½	.64	.67	.70¼	.72½	.69	.72¼	.63⅛	.66	.95	.97½
April	.78	.81¼	.71½	.76	.64¾	.67⅞	.71	.72¾	.70	.72¾	.64½	.66⅛	.95	.97½
May	.78	.82¾	.72	.73½	.63⅜	.67½	.71⅜	.74	.70¼	.71¼	.64½	.66⅛	.90	.95
June	.80	.96¼	.72	.90	.65¼	.87½	.73¼	.91½	.68¼	.86½	.64⅞	.88¼	.90	1.12½
July	.81	.90¼	.73	.81½	.74	.81½	.77½	.84½	.71¼	.80¼	.74¾	.82¼	1.03¼	1.08¾
August	.78¼	.83⅜	.71	.76	.71¾	.76¼	.74	.78¾	.68¼	.73	.72¼	.76	1.02½	1.06¼
September	.79¼	.85	.71¾	.77	.72½	.79⅜	.75¼	.80⅞	.71	.77½	.73½	.81¼	1.03½	1.07½
October	.76¼	.82⅞	.71¼	.77	.71⅜	.77⅜	.75	.79½	.69	.75½	.73⅞	.80¼	.95	1.02½
November	.77½	.81¼	.71¾	.73¾	.69⅝	.74¼	.74¼	.77½	.69½	.72¾	.72¾	.76⅝	.97½	1.00
December	.77⅞	.83⅜	.71½	.75½	.69¼	.74⅛	.74½	.81	.69¾	.71¼	.71⅞	.75¼	.96¼	.98¾
1901.														
January	.79⅛	.83⅜	.73¾	.78	.71⅜	.76⅜	.78	.82½	.72	.77	.73	.77½	.97½	1.01¼
February	.79¼	.81¼	.76	.78¾	.72⅛	.74¾	.78½	.80¼	.73½	.75¾	.73	.74⅝	.95	.98¾
March	.80½	.82¼	.77¾	.81	.73¼	.76¼	.78½	.80	.74	.75¾	.73	.74¾	.95	1.02½
April	.78⅛	.84¼	.76½	.81½	.69½	.74⅛	.74	.78	.71	.76¼	.70¼	.74½	1.00	1.05
May	.81¾	.84⅞	.78¾	.80½	.70	.75⅛	.74½	.77¼	.73½	.76	.70⅞	.74¼	.97½	1.01¼
June	.75½	.85¼	.72	.79½	.65½	.77¼	.67¾	.77¼	.63¼	.75½	.62⅞	.74¼	.96¼	1.00
July	.72¼	.79¾	.69¼	.75½	.63⅛	.71¾	.66½	.74	.61¼	.70¼	.60½	.69¾	.95	1.00
August	.76	.80½	.72	.78	.66⅝	.77	.68¼	.76½	.66¼	.73½	.66	.71½	.97½	.98¾
September	.75⅜	.77⅝	.78½	.75½	.68⅛	.71	.70½	.73½	.70⅞	.72½	.66¾	.69⅛	.96¼	.97½
October	.74⅝	.80⅝	.70½	.75	.66¾	.71½	.70	.74	.70½	.73½	.66	.68⅞	.95	.98¾
November	.80½	.83½	.74¼	.78	.70	.73¾	.73	.79½	.72¼	.80	.68⅛	.71½	.98¾	1.01¼
December	.84¼	.89⅞	.78½	.85¾	.73	.79½	.79	.90½	.81	.88½	.71¾	.77	1.01¼	1.06¼
1902.														
January	.85¾	.94¼	.81⅜	.87½	.74	.80½	.86	.93½	.86½	.92½	.73⅝	.79½	1.05	1.08¾
February	.85⅞	.93¼	.80	.85⅝	.72⅞	.76½	.84¼	.87½	.83¼	.89	.72¼	.75⅛	1.07½	1.12½
March	.82	.90¾	.76	.85	.69¾	.76	.77½	.85¾	.76½	.86¾	.70½	.75½	1.10	1.12½
April	.82	.92½	.75	.85½	.70	.76¾	.77½	.87¼	.77¼	.83½	.70⅝	.77⅞	1.10	1.13¾
May	.88¼	.93¾	.81	.87½	.72⅜	.76¼	.80	.88	.76½	.84½	.74	.78	1.11½	1.16¼
June	.87⅛	.93⅜	.76	.83	.71¼	.75⅜	.79	.81½	.76	.80	.73⅛	.77½	1.11¼	1.13¾
July	.76⅛	.92¼	.70¾	.81¾	.71½	.79	.72	.82	.65½	.78	.76⅜	.80⅞	1.13¼	1.16¼
August	.74⅞	.78⅜	.66¼	.74¼	.68¼	.76	.68½	.73	.63	.68¼	.74¼	.79¾	1.12½	1.15
September	.73½	.77	.68	.72¾	.70	.95	.70¾	.74	.66	.68½	.66½	.71¼	1.12½	1.20
October	.73⅞	.79	.69	.75½	.67½	.75½	.72	.76¾	.67¾	.72	.68	.73⅞	1.18¾	1.35
November	.76	.79⅞	.71¼	.77½	.69⅞	.77⅜	.75½	.80¾	.69	.71	.71⅞	.74½	1.32½	1.45
December	.76⅛	.80⅛	.71¼	.77	.71⅞	.77¾	.77½	.83	.69	.74½	.72¼	.74⅞	1.37½	1.43¾
1903.														
January	.78¼	.84⅝	.77½	.83	.70¾	.79¼	.77¾	.83½	.73½	.76½	.73½	.78⅛	1.36¼	1.50
February	.81⅛	.84	.80	.81	.73¾	.80½	.79	.81	.73½	.77½	.75⅞	.78	1.43¼	1.55
March	.78½	.83⅛	.77¾	.81	.70¼	.75⅞	.74¼	.79	.70	.75½	.74⅜	.77⅞	1.35	1.52½
April	.79	.86½	.78¼	.83	.71⅝	.79	.75¼	.77¾	.69½	.73⅝	.74⅛	.77⅛	1.35	1.38¼
May	.81¾	.89⅛	.79	.82½	.74¾	.80⅝	.76	.79½	.72	.76½	.76	.80⅛	1.32½	1.40
June	.85	.87	.78¼	.82	.74¼	.85⅛	.77¾	.82	.76	.83¼	.79½	.88⅛	1.32½	1.40
July	.80¼	.89⅞	.76½	.81	.75	.84	.76½	.80	.77½	.82	.83¼	.89¼	1.32½	1.50
August	.83¾	.89⅞	.79	.83½	.77¼	.90¼	.78½	.84	.79¼	.85	.83⅜	1.00	1.45	1.50
September	.81¼	.89½	.78¼	.83¼	.79½	.93	.79	.84¼	.81	.88	.82	.91¾	1.37½	1.47½
October	.82¼	.91⅝	.80½	.86	.76¾	.88	.82¾	.87½	.85	.89	.78¼	.86	1.36¼	1.41¼
November	.83¼	.92⅞	.82½	.87	.75¾	.86¼	.84	.90	.85½	.90¼	.77⅞	.82⅛	1.38¼	1.41¼
December	.89⅛	.99⅞	.85¾	.88¾	.77¾	.87	.89½	.94	.90	.94	.80½	.83⅞	1.33¼	1.40
1904.														
January	.92¼	1.01	.88¾	.94	.81¼	.93¼	.92	.95½	.89½	.97	.84¾	.91¼	1.35	1.40
February	.94	1.15	.94	1.12	.86	1.10	.94¼	1.12	.94	1.12	.90	1.05	1.35	1.43¾
March	1.01	1.11	.99	1.05¼	.88¼	.98⅛	.97½	1.04½	.98	1.08¼	.94½	1.01½	1.36¼	1.43¾
April	1.04	1.10¼	.98¼	1.05	.85½	.96½	.98	1.05	.97	1.08	.90⅜	.98¾	1.27½	1.40
May	1.06	1.20	.99¼	1.08	.87¾	1.01½	1.02½	1.12½	.98	1.10	.93½	.98⅝	1.26¼	1.30
June	1.04	1.15½	.82	1.03¼	.92	1.00	1.01	1.13	1.00	1.10¼	.93½	.97½	1.23¼	1.30
July	1.09	1.16	.82	.89	.94½	1.06½	.97	1.07	.91	1.12	.94⅜	1.02	1.23¼	1.37½
August	1.09	1.20¾	.88⅝	1.09¼	1.02	1.20	.98	1.16	.91	1.14¼	1.03½	1.24⅜	1.37½	1.46¼
September	1.08	1.25¼	1.03¼	1.14	1.16	1.22	1.11½	1.23	1.08½	1.21	1.12	1.24¼	1.40	1.48¾
October	1.13½	1.26¼	1.13	1.18½	1.15	1.22	1.16	1.21	1.13½	1.21	1.11⅝	1.22	1.45	1.50
November	1.17¼	1.25¾	1.08½	1.15¼	1.15	1.20	1.16	1.22	1.12½	1.18	1.06⅜	1.19⅝	1.45	1.50
December	1.16	1.21¼	1.08¾	1.15	1.15	1.22	1.15	1.20	1.13	1.18½	1.06⅛	1.14⅛	1.45	1.50

Wholesale prices of wheat per bushel in leading cities of the United States, 1900–1905—Continued.

Date.	New York.		Baltimore.		Chicago.		Detroit.		St. Louis.		Minneapolis.		San Francisco.	
	No. 2, red winter.		Southern, No. 2, red.		No. 1, northern spring.		No. 2, red.		No. 2, red winter.		No. 1, northern.		No. 1, California (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1905.														
January	$1.18¾	$1.25¾	$1.01¾	$1.19½	$1.18	$1.21	$1.19	$1.23½	$1.14	$1.20	$1.08¼	$1.13½	$1.45	$1.62½
February	1.20¼	1.25¼	1.01½	1.17¼	1.15	1.24	1.17½	1.24	1.16½	1.19½	1.07¾	1.12¾	1.50	1.55
March	1.14¼	1.21¼	.98	1.14½	1.12	1.18¾	1.07½	1.21	1.11¼	1.17	1.05	1.11⅞	1.50	1.55
April	.91½	1.15	.83	1.09½	.88½	1.18	.96	1.07½	.98	1.12	.91⅝	1.08⅛	1.45	1.55
May	.91½	1.11½	.83½	1.07½	.89½	1.13¾	.97	1.08	.95	1.13½	.95⅝	1.24½	1.45	1.55
June	1.03⅜	1.14¼	.73	1.03½	1.07⅜	1.20	1.00	1.09	.92	1.06	1.04	1.09¼	1.50	1.55
July	.90	1.09¼	.75	.92	1.12	1.20	.86	1.05	.83½	.95½	1.01¼	1.09¼	1.50	1.55
August	.84⅜	.91⅛	.76	.84½	1.03	1.15	.81	.84	.82½	.88	.83½	1.11	1.45	1.55
September	.85⅝	.91⅜	.75¾	.84½	.88	.95	.82¼	.85¾	.82	.90	.75¼	.80	1.40	1.55
October	.88¼	.99	.76⅛	.86½	.86	.92¼	.80	.90½	.88	.95	.78⅜	.87⅛	1.40	1.45
November	.90	.98¼	.76	.85¼	.85	.92	.87¼	.90½	.89	.95	.79	.84½	1.40	1.45
December	.92¼	1.01	.78	.87	.82½	.90	.86	.89	.92¾	1.01	.77¾	.81¾	1.35	1.45

OATS.

Oat crop of countries named, 1901–1905.

Country.	1901.	1902.	1903.	1904.	1905.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	736,809,000	987,843,000	784,094,000	894,596,000	953,216,000
Ontario	80,803,000	109,786,000	113,337,000	105,393,000	108,890,000
Manitoba	28,673,000	35,565,000	34,077,000	37,434,000	46,917,000
Northwest Territories	11,463,000	10,997,000	14,627,000	16,850,000	29,633,000
Rest of Canada	50,000,000	50,000,000	50,000,000	50,000,000	50,000,000
Total Canada	170,939,000	206,348,000	212,041,000	209,677,000	235,440,000
Total North America	907,748,000	1,194,191,000	996,135,000	1,104,273,000	1,188,656,000
Great Britain	113,576,000	134,493,000	128,611,000	131,423,000	120,106,000
Ireland	62,240,000	65,570,000	58,816,000	60,142,000	61,600,000
Total United Kingdom	175,816,000	200,063,000	187,427,000	191,565,000	181,706,000
Sweden	55,342,000	57,323,000	59,641,000	50,117,000	61,363,000
Denmark	37,409,000	40,822,000	41,176,000	38,183,000	37,000,000
Netherlands	18,485,000	19,241,000	20,112,000	18,592,000	16,000,000
Belgium	36,820,000	45,588,000	48,345,000	37,499,000	37,000,000
France	225,283,000	276,948,000	300,366,000	257,811,000	282,642,000
Spain	22,788,000	23,349,000	22,942,000	18,500,000	16,500,000
Italy	15,000,000	13,000,000	16,000,000	14,000,000	16,000,000
Germany	485,716,000	514,452,000	542,432,000	477,852,000	451,017,000
Austria	118,191,000	125,473,000	128,330,000	109,611,000	123,886,000
Hungary	68,083,000	82,807,000	87,334,000	62,775,000	78,009,000
Croatia-Slavonia	5,814,000	6,301,000	7,330,000	4,907,000	6,456,000
Total Austria-Hungary	192,088,000	214,581,000	222,994,000	177,293,000	208,351,000
Roumania	16,540,000	21,905,000	33,108,000	12,608,000	18,973,000
Bulgaria	8,000,000	10,000,000	11,000,000	8,000,000	10,000,000
Russia proper	527,576,000	807,888,000	650,405,000	1,006,102,000	767,544,000
Poland	56,150,000	63,167,000	58,745,000	44,393,000	61,933,000
Northern Caucasia	11,932,000	16,112,000	18,939,000	14,593,000	22,229,000
Total Russia in Europe	595,658,000	887,167,000	728,089,000	1,065,088,000	851,706,000
Total Europe	1,884,945,000	2,324,439,000	2,233,632,000	2,367,108,000	2,188,258,000
Siberia	21,569,000	34,078,000	60,352,000	51,101,000	70,671,000
Central Asia	6,870,000	9,433,000	11,342,000	8,014,000	14,278,000
Total Russia in Asia	28,439,000	43,511,000	71,694,000	59,175,000	84,949,000
Total Asia	28,439,000	43,511,000	71,694,000	59,175,000	84,949,000

Oat crop of countries named, 1901–1905—Continued.

Country.	1901.	1902.	1903.	1904.	1905.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Algeria	7,623,000	8,732,000	7,976,000	6,631,000	6,000,000
Cape Colony	1,750,000	1,750,000	2,503,000	2,000,000	2,000,000
Total Africa	9,373,000	10,482,000	10,479,000	8,631,000	8,000,000
West Australia	90,000	164,000	173,000	267,000	233,000
South Australia	378,000	484,000	610,000	931,000	573,000
Queensland	8,000	44,000	1,000	73,000	16,000
New South Wales	612,000	709,000	363,000	1,292,000	673,000
Victoria	9,884,000	6,937,000	4,542,000	13,858,000	6,353,000
Tasmania	1,451,000	1,756,000	1,808,000	1,673,000	1,216,000
Total Australia	12,423,000	10,094,000	7,527,000	18,094,000	9,064,000
New Zealand	19,687,000	15,519,000	22,452,000	15,583,000	15,012,000
Total Australasia	32,110,000	25,613,000	29,979,000	33,677,000	24,076,000

RECAPITULATION BY CONTINENTS.

North America	907,748,000	1,194,191,000	996,135,000	1,104,273,000	1,188,656,000
Europe	1,884,945,000	2,324,439,000	2,233,632,000	2,367,108,000	2,188,258,000
Asia	28,439,000	43,511,000	71,694,000	59,175,000	84,949,000
Africa	9,373,000	10,482,000	10,479,000	8,631,000	8,000,000
Australasia	32,110,000	25,613,000	29,979,000	33,677,000	24,076,000
Total	2,862,615,000	3,598,236,000	3,341,919,000	3,572,864,000	3,493,939,000

Visible supply of oats in the United States and Canada, first of each month, for ten years.[a]

Month.	1896–1897.	1897–1898.	1898–1899.	1899–1900.	1900–1901.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	14,120,000	12,912,000	8,716,000	10,262,000	12,716,000
August	10,384,000	9,604,000	4,971,000	6,885,000	9,364,000
September	11,410,000	13,784,000	7,360,000	10,973,000	13,853,000
October	13,821,000	15,573,000	9,286,000	13,127,000	17,140,000
November	17,217,000	20,096,000	11,352,000	13,254,000	20,528,000
December	17,995,000	19,768,000	9,460,000	11,789,000	18,136,000
January	19,538,000	16,148,000	10,893,000	12,004,000	15,861,000
February	19,978,000	20,245,000	13,231,000	11,876,000	16,175,000
March	20,832,000	17,925,000	14,782,000	12,449,000	16,800,000
April	20,672,000	15,609,000	15,725,000	14,176,000	15,823,000
May	16,138,000	14,402,000	13,971,000	13,845,000	16,824,000
June	12,878,000	10,421,000	13,661,000	12,301,000	14,989,000

Month.	1901–1902.	1902–1903.	1903–1904.	1904–1905.	1905–1906.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	15,275,000	2,120,000	6,686,000	6,766,000	11,174,000
August	7,808,000	2,988,000	8,623,000	4,044,000	8,007,000
September	10,603,000	5,159,000	11,714,000	19,607,000	20,597,000
October	14,445,000	11,241,000	10,876,000	31,553,000	28,018,000
November	12,899,000	10,661,000	13,332,000	33,693,000	37,526,000
December	10,109,000	10,401,000	13,995,000	34,103,000	40,206,000
January	8,680,000	8,794,000	13,785,000	31,343,000	39,301,000
February	8,537,000	8,727,000	14,774,000	26,095,000	35,791,000
March	8,207,000	12,437,000	15,241,000	22,570,000	31,726,000
April	6,606,000	12,432,000	15,377,000	22,667,000	28,006,000
May	5,010,000	9,992,000	12,955,000	19,395,000	22,033,000
June	4,571,000	7,160,000	8,296,000	11,325,000	....

[a] These figures represent stocks available at 62 of the principal points of accumulation east of the Rocky Mountains, stocks in Manitoba elevators, and stocks afloat on lakes and canals, as reported by Bradstreet's.

Condition of the oat crop of the United States, monthly, 1888–1905.

Year.	June.	July.	August.	September.	Year.	June.	July.	August.	September.	Year.	June.	July.	August.	September.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*		*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*		*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
1888	95.4	95.2	91.7	87.2	1894 ...	87.0	77.7	76.5	77.8	1900 ...	91.7	85.5	85.0	82.9
1889	93.8	94.1	92.3	90.0	1895 ...	84.3	83.2	84.5	86.0	1901 ...	85.3	83.7	73.6	72.1
1890	89.8	81.6	70.1	64.4	1896 ...	98.8	96.3	77.3	74.0	1902 ...	90.6	92.1	89.4	87.2
1891	85.1	87.6	89.[illegible]	90.7	1897 ...	89.0	87.5	86.0	84.6	1903 ...	85.5	84.3	79.5	75.7
1892	88.5	87.2	86.2	78.9	1898 ...	98.0	92.8	84.2	79.0	1904 ...	89.2	89.8	86.6	85.6
1893	88.9	88.8	78.3	74.9	1899 ...	88.7	90.0	90.8	87.2	1905 ...	92.9	92.1	90.8	90.3

Acreage, production, value, prices, exports, etc., of oats of the United States, 1866–1905.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1	Farm value, Dec. 1.	Chicago cash price per bushel, No. 2.				Domestic exports, including oatmeal, fiscal years beginning July 1.[a]	Imports during fiscal years beginning July 1.[a]
						December.		May of following year.			
						Low.	High.	Low.	High.		
	Acres.	*Bush.*	*Bushels.*	*Cts.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*	*Bushels.*
1866.....	8,864,219	30.2	268,141,077	35.1	94,057,945	36	43	59	78	825,895	778,198
1867.....	10,746,416	25.9	278,698,000	44.5	123,902,556	52	57¼	......	......	122,554	780,798
1868.....	9,665,736	26.4	254,960,800	41.7	106,355,976	43	49½	56¾	62½	481,871	326,659
1869.....	9,461,441	30.5	288,334,000	38.0	109,521,734	40	44¾	46½	53½	121,517	2,266,785
1870.....	8,792,395	28.1	247,277,400	39.0	96,443,637	37¾	41	47¼	51	147,572	599,514
1871.....	8,365,809	30.6	255,743,000	36.2	92,591,359	30¾	33	34¾	42½	262,975	535,250
1872.....	9,000,769	30.2	271,747,000	29.9	81,303,518	23½	25¾	30	34	714,072	225,555
1873.....	9,751,700	27.7	270,340,000	34.6	93,474,161	34	40⅝	44	48½	812,873	191,802
1874.....	10,897,412	22.1	240,369,000	47.1	113,133,934	51¾	54½	57¼	64½	504,770	1,500,040
1875.....	11,915,075	29.7	354,317,500	32.0	113,441,491	29½	30½	28⅝	31½	1,466,228	121,547
1876.....	13,358,908	24.0	320,884,000	32.4	103,844,896	31¾	34½	37¼	45¾	2,854,128	41,597
1877.....	12,826,148	31.7	406,394,000	28.4	115,546,194	24⅛	27	23	27	3,715,479	21,391
1878.....	13,176,500	31.4	413,578,560	24.6	101,752,468	19⅝	20⅜	24⅜	30½	5,452,136	13,395
1879.....	12,683,500	28.7	363,761,320	33.1	120,533,294	32¾	36¾	29½	34⅞	766,366	489,576
1880.....	16,187,977	25.8	417,885,380	36.0	150,243,565	29⅛	33⅛	36¼	39½	402,904	64,412
1881.....	16,831,600	24.7	416,481,000	46.4	193,198,970	43½	46¾	48¾	56⅜	625,690	1,850,983
1882.....	18,494,691	26.4	488,250,610	37.5	182,978,022	34¾	41½	33¾	42¾	461,496	815,017
1883.....	20,324,962	28.1	571,302,400	32.7	187,040,264	29⅜	36⅛	30¾	34¼	3,274,622	121,069
1884.....	21,300,917	27.4	583,628,000	27.7	161,528,470	22½	25¼	34½	37	6,203,104	94,310
1885.....	22,783,630	27.6	629,409,000	28.5	179,631,860	27	29	26½	29⅝	7,311,306	149,480
1886.....	23,658,474	26.4	624,134,000	29.8	186,137,930	25¾	27¼	25⅛	27½	1,374,635	139,575
1887.....	25,920,906	25.4	659,618,000	30.4	200,699,790	28⅝	30⅞	32½	38	573,080	123,817
1888.....	26,998,282	26.0	701,735,000	27.8	195,424,240	25	26⅞	21⅝	23⅝	1,191,471	131,501
1889.....	27,462,316	27.4	751,515,000	22.9	171,781,008	20	21	24¾	30	15,107,238	153,232
1890.....	26,431,369	19.8	523,621,000	42.4	222,048,486	39⅞	43⅞	45½	54	1,382,836	41,848
1891.....	25,581,861	28.9	738,394,000	31.5	232,312,267	31⅛	33⅝	28½	33½	10,586,644	47,782
1892.....	27,063,835	24.4	661,035,000	31.7	209,253,611	25⅝	31¼	28¾	32¼	2,700,793	49,433
1893.....	27,273,033	23.4	638,854,850	29.4	187,576,092	27½	29⅛	32½	36	6,290,229	31,759
1894.....	27,023,553	24.5	662,036,928	32.4	214,816,920	28¾	29⅜	27½	30¾	1,708,824	330,318
1895.....	27,878,406	29.6	824,443,537	19.9	163,655,068	16⅝	17½	18	19⅜	15,156,618	66,602
1896.....	27,565,985	25.7	707,346,440	18.7	132,485,033	16½	18¾	16⅞	18¾	37,725,083	131,204
1897.....	25,730,375	27.2	698,767,809	21.2	147,974,719	21	23⅞	26	32	73,880,307	25,093
1898.....	25,777,110	28.4	730,906,643	25.5	186,405,364	26	27¾	24	27¾	33,534,362	28,098
1899.....	26,341,380	30.2	796,177,713	24.9	198,167,975	22¼	23	21¼	23¾	45,048,857	54,576
1900.....	27,364,795	29.6	809,125,989	25.8	208,669,233	21¾	22¾	27⅞	31	42,268,931	32,107
1901.....	28,541,476	25.8	736,808,724	39.9	293,658,777	42	48¼	41	49½	13,277,612	38,978
1902.....	28,653,144	34.5	987,842,712	30.7	303,584,852	29¼	32	33⅜	38¼	8,381,805	150,065
1903.....	27,638,126	28.4	784,094,199	34.1	267,661,665	34¼	38	39⅝	44¾	1,960,740	183,983
1904.....	27,842,669	32.1	894,595,552	31.3	279,900,013	28¼	32	28⅝	32	8,394,692	55,699
1905.....	28,046,746	34.0	953,216,197	29.1	277,047,537	29½	32¾	......	......	....	....

[a] In years 1866 to 1882, inclusive, oatmeal is not included.

Acreage, production, value, and distribution of oats of the United States in 1905, by States.

State or Territory.	Crop of 1905.			Stock in farmers' hands March 1, 1906.		Shipped out of county wheregrown.
	Acreage.	Production.	Value.			
	Acres.	*Bushels.*	*Dollars.*	*Bushels.*	*Per cent.*	*Bushels.*
Maine	112,817	4,343,454	1,867,685	1,476,774	34	43,435
New Hampshire	12,174	399,307	171,702	135,764	34	3,993
Vermont	78,526	3,093,924	1,237,570	1,175,691	38	61,878
Massachusetts	6,372	203,901	87,679	69,327	34	2,039
Rhode Island	1,601	47,158	19,806	17,920	38	472
Connecticut	10,077	347,656	146,016	83,437	24	3,477
New York	1,258,210	43,030,782	15,921,389	19,363,852	45	3,442,463
New Jersey	62,512	2,000,384	740,142	880,169	44	260,050
Pennsylvania	1,161,186	39,480,324	14,212,917	16,186,933	41	1,974,016
Delaware	4,124	128,669	51,468	39,887	31	11,580
Maryland	33,160	918,532	330,672	266,374	29	91,853
Virginia	176,459	3,140,970	1,224,978	1,067,930	34	157,048
North Carolina	203,815	3,118,370	1,465,634	686,041	22	62,367
South Carolina	187,509	3,056,397	1,681,018	458,460	15	61,128
Georgia	233,250	3,522,075	1,866,700	563,532	16	70,441
Florida	29,957	359,484	186,932	71,897	20	10,785
Alabama	191,853	3,165,574	1,614,443	474,836	15	94,967
Mississippi	90,374	1,671,919	835,960	183,911	11	0
Louisiana	27,715	443,440	199,548	53,213	12	0
Texas	914,440	28,713,416	11,485,366	6,029,817	21	8,901,159
Arkansas	192,261	3,902,898	1,639,217	1,053,782	27	39,029
Tennessee	151,106	3,052,341	1,190,413	854,655	28	457,851
West Virginia	82,182	1,980,586	772,429	732,817	37	99,029
Kentucky	223,982	5,487,559	1,920,646	2,085,272	38	384,129
Ohio	1,061,260	37,993,108	11,777,863	14,817,312	39	12,917,657
Michigan	1,009,802	35,948,951	10,784,685	14,020,091	39	8,627,748
Indiana	1,343,706	47,432,822	12,806,862	14,229,847	30	23,716,411
Illinois	3,740,275	132,779,762	37,178,333	45,145,119	34	66,389,881
Wisconsin	2,527,692	98,579,988	26,616,597	44,360,995	45	17,744,398
Minnesota	2,151,192	80,669,700	19,360,728	37,108,062	46	27,427,698
Iowa	3,746,148	131,115,180	31,467,643	57,690,679	44	41,956,858
Missouri	723,709	19,684,885	5,905,466	6,889,710	35	2,952,733
Kansas	857,868	23,248,223	6,509,502	8,369,360	36	3,952,198
Nebraska	1,886,270	58,474,370	14,033,849	25,728,723	44	25,728,723
South Dakota	720,603	28,103,517	6,463,809	14,613,829	52	6,463,809
North Dakota	1,197,799	46,594,381	10,716,708	25,626,910	55	8,386,989
Montana	178,911	7,389,024	3,177,280	3,103,390	42	1,921,146
Wyoming	45,548	1,817,365	745,120	636,078	35	290,778
Colorado	137,929	4,827,515	1,979,281	1,786,181	37	1,351,704
New Mexico	11,912	351,404	203,814	98,393	28	7,028
Arizona	879	27,425	17,552	6,582	24	823
Utah	44,067	1,753,867	771,701	561,237	32	175,387
Nevada	6,267	233,132	121,229	46,626	20	4,663
Idaho	98,058	3,863,485	1,62[illegible],664	927,236	24	1,120,411
Washington	164,540	8,227,000	3,37[illegible],070	2,139,020	26	3,043,990
Oregon	281,842	6,792,392	2,92[illegible],729	2,105,642	31	1,562,250
California	168,755	4,725,140	2,409,821	519,765	11	1,275,788
Oklahoma	294,442	9,716,586	2,817,810	3,[illegible]12,142	31	2,429,146
Indian Territory	201,607	7,257,852	2,395,091	2,[illegible]49,934	31	1,451,570
United States	28,046,746	953,216,197	277,04[illegible],537	37[illegible],8[illegible]5,154	39.8	277,132,976

Average yield per acre of oats in the United States, 1896–1905, by States.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	40.0	31.0	36.0	35.0	37.5	35.0	39.0	39.5	36.6	38.5
New Hampshire	38.0	35.0	33.0	35.0	32.6	29.5	35.0	31.1	33.2	32.8
Vermont	40.5	33.0	38.0	37.0	34.9	33.0	40.0	38.2	37.9	39.4
Massachusetts	36.0	32.0	32.0	33.0	36.8	31.0	32.2	31.7	34.0	32.0
Rhode Island	30.0	32.0	27.0	26.0	30.9	29.4	36.2	28.1	25.4	29.4
Connecticut	29.0	29.0	28.2	28.0	31.0	28.7	34.5	31.2	33.5	34.5
New York	33.0	31.0	27.5	31.0	27.9	21.6	40.0	34.0	34.1	34.2
New Jersey	34.0	25.0	19.6	24.0	29.6	16.0	32.2	25.4	32.5	32.0
Pennsylvania	31.0	28.2	23.3	33.0	31.1	18.9	36.5	28.6	33.9	34.0
Delaware	29.0	22.0	22.0	20.0	21.0	18.5	22.6	22.2	28.2	31.2
Maryland	24.0	24.0	19.5	23.0	24.0	18.8	26.7	20.6	29.7	27.7
Virginia	18.5	12.0	16.1	14.0	14.8	14.9	17.5	13.8	21.1	17.8
North Carolina	12.0	13.0	14.3	12.0	13.9	14.4	12.7	11.4	15.8	15.3
South Carolina	11.0	15.5	17.2	12.0	15.5	15.8	13.1	14.0	17.1	16.3
Georgia	12.0	14.0	16.6	9.0	15.0	14.8	11.1	13.6	14.8	15.1
Florida	12.0	9.0	15.4	9.0	11.3	13.1	13.6	13.2	12.9	12.0
Alabama	14.0	13.0	16.8	10.0	14.4	14.5	10.9	15.8	14.9	16.5
Mississippi	13.0	14.0	18.5	10.0	14.0	15.2	15.4	15.0	19.2	18.5
Louisiana	10.0	18.0	18.1	18.0	18.0	13.4	15.2	15.9	18.4	16.0

Average yield per acre of oats in the United States, 1896–1905, by States—Continued.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Texas	20.0	25.0	29.7	25.0	38.0	16.3	23.2	35.5	32.0	31.4
Arkansas	16.0	17.0	22.8	19.0	22.2	12.3	20.0	18.6	22.7	20.3
Tennessee	16.5	10.0	18.7	14.0	16.6	17.5	17.3	18.5	21.1	20.2
West Virginia	24.0	20.0	19.5	23.0	21.0	18.7	28.6	21.7	26.4	24.1
Kentucky	21.0	18.0	22.4	18.0	21.3	19.7	22.2	20.1	24.0	24.5
Ohio	31.0	32.0	30.9	36.0	38.0	31.5	41.1	30.6	40.9	35.8
Michigan	30.0	26.0	32.8	34.0	36.7	29.0	39.9	30.5	32.5	35.6
Indiana	29.0	30.2	29.2	32.0	32.7	28.6	35.4	24.4	33.1	35.3
Illinois	28.0	32.0	29.0	38.0	38.0	28.2	37.7	26.6	32.0	35.5
Wisconsin	33.4	34.0	36.1	36.0	32.0	29.1	39.9	32.8	35.0	39.0
Minnesota	33.0	26.0	36.3	32.0	25.2	32.1	39.0	32.3	39.2	37.5
Iowa	27.5	30.0	34.0	33.0	34.0	29.8	30.7	24.0	32.0	35.0
Missouri	18.0	22.0	17.0	25.0	27.4	11.2	32.5	22.1	22.7	27.2
Kansas	13.0	24.0	18.0	29.0	31.6	18.6	33.5	26.2	17.8	27.1
Nebraska	19.0	31.0	32.1	30.0	21.8	19.8	34.6	29.5	30.7	31.0
South Dakota	27.5	22.0	26.8	26.0	21.5	28.8	34.8	38.6	39.0	39.0
North Dakota	22.0	23.0	30.7	30.0	10.3	32.6	38.4	27.4	37.4	38.9
Montana	47.0	42.0	40.6	38.0	39.0	42.0	41.9	46.4	37.7	41.3
Wyoming	32.0	35.0	31.2	30.0	34.2	41.0	36.0	29.4	30.2	39.9
Colorado	28.0	34.0	35.8	27.0	32.8	33.8	26.8	33.3	35.4	35.0
New Mexico	27.0	35.5	38.8	24.0	30.1	31.6	19.1	22.6	19.6	29.5
Arizona	......	......	......	......	......	35.0	31.7	35.5	30.1	31.2
Utah	38.0	35.0	39.7	34.0	35.9	33.0	35.5	36.4	37.6	39.8
Nevada	......	......	......	......	......	43.0	34.8	28.6	37.0	37.2
Idaho	42.0	36.3	43.6	34.0	36.6	38.3	42.1	41.5	39.3	39.4
Washington	36.0	48.0	41.9	37.0	34.4	47.5	46.2	47.9	44.9	50.0
Oregon	21.0	32.0	27.0	30.0	18.5	31.5	28.7	33.8	23.1	24.1
California	31.0	18.0	33.0	31.0	24.6	30.4	30.5	34.8	34.1	28.0
Oklahoma	......	......	......	......	......	20.7	47.8	26.4	21.2	33.0
Indian Territory	......	......	......	......	......	25.0	32.6	30.0	32.2	36.0
General average	25.7	27.2	28.4	30.2	29.6	25.8	34.5	28.4	32.1	34.0

Average yield of oats in certain countries, in bushels per acre, 1895–1904.

Year.	United States.	Russia.	Germany.	Austria.	Hungary.	France.	United Kingdom.
	(*a*)	(*b*)	(*b*)	(*b*)	(*b*)	(*a*)	(*a*)
1895	29.6	19.9	43.2	26.2	29.6	27.5	39.5
1896	25.7	19.2	41.8	23.1	31.4	27.0	39.2
1897	27.2	15.7	39.9	21.5	24.3	23.1	40.1
1898	28.4	16.5	47.1	27.3	30.2	29.0	43.6
1899	30.2	23.6	48.0	30.2	33.3	27.8	41.8
1900	29.6	19.5	48.0	25.2	28.1	25.7	41.2
1901	25.8	14.0	44.5	25.6	28.1	23.5	40.6
1902	34.5	21.8	50.2	27.6	34.0	29.2	45.9
1903	28.4	17.7	51.3	28.4	34.5	31.6	44.2
1904	32.1	25.7	46.3	24.3	25.5	27.2	42.1
Average	29.2	19.4	46.0	25.9	29.9	27.2	41.8

[a] Winchester bushels. [b] Bushels of 32 pounds.

Average value per acre of oats in the United States, based upon farm value December 1, 1896–1905, by States.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
Maine	$12.40	$9.92	$12.24	$13.30	$14.25	$17.50	$17.55	$17.77	$16.47	$16.55
New Hampshire	13.30	13.30	12.54	13.65	12.39	15.34	15.40	14.93	15.60	14.10
Vermont	12.56	10.56	13.30	13.69	12.56	16.50	17.20	16.81	16.68	15.76
Massachusetts	12.60	10.56	11.84	12.54	13.98	17.05	14.49	15.53	15.30	13.76
Rhode Island	9.30	10.88	9.99	9.62	11.74	15.88	15.57	12.65	11.94	12.35
Connecticut	8.99	9.86	10.15	10.36	10.85	15.50	14.14	14.04	14.74	14.49
New York	8.58	8.37	8.53	10.23	8.93	10.37	14.40	13.94	12.96	12.65
New Jersey	9.52	7.50	6.08	7.92	9.18	7.52	12.56	10.92	13.00	11.84
Pennsylvania	7.43	7.61	6.99	9.57	9.33	8.50	12.41	10.58	12.88	12.24
Delaware	6.09	5.06	6.60	5.00	6.30	8.33	9.49	8.88	11.56	12.48
Maryland	5.52	6.24	5.65	6.90	7.44	7.71	10.15	8.24	10.69	9.97
Virginia	4.81	3.48	4.67	4.62	5.48	6.26	7.35	5.93	9.07	6.94
North Carolina	4.20	4.81	5.29	4.92	6.26	7.34	6.48	5.93	8.22	7.19
South Carolina	5.28	6.98	7.74	5.64	7.44	9.80	7.73	8.26	10.26	8.96

Average value per acre of oats in the United States, based upon farm value December 1, 1896–1905, by States—Continued.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
Georgia	$4.92	$5.88	$7.97	$4.82	$7.35	$9.92	$5.88	$7.48	$8.14	$8.00
Florida	6.36	4.77	8.32	4.50	5.65	9.43	8.30	7.92	7.74	6.24
Alabama	5.74	5.59	6.89	4.30	6.34	9.28	6.00	8.53	8.05	8.42
Mississippi	5.72	6.16	7.77	5.00	6.44	9.58	7.85	7.65	9.98	9.25
Louisiana	3.40	6.84	6.88	7.20	7.20	8.04	7.60	7.31	8.28	7.20
Texas	6.80	6.75	8.32	7.50	11.40	9.78	11.37	15.62	14.08	12.56
Arkansas	4.96	5.61	6.61	6.46	7.77	7.01	8.20	8.18	9.76	8.53
Tennessee	4.29	2.80	5.24	4.48	5.81	7.87	7.27	7.77	7.80	7.88
West Virginia	6.72	6.00	5.85	8.05	7.14	8.04	11.73	9.98	11.62	9.40
Kentucky	5.04	4.86	6.05	5.76	6.60	8.08	7.99	8.24	9.60	8.58
Ohio	5.27	6.40	7.42	9.00	9.88	12.28	13.15	11.02	13.09	11.10
Michigan	5.70	5.98	8.86	9.52	9.54	11.89	13.17	10.98	10.72	10.68
Indiana	4.64	5.74	6.72	7.36	7.52	10.87	9.91	7.81	9.93	9.53
Illinois	4.20	5.76	6.67	8.36	8.74	11.28	10.56	8.51	9.60	9.94
Wisconsin	5.95	6.46	8.66	8.28	7.36	11.35	11.97	11.15	9.80	10.53
Minnesota	4.95	4.94	7.62	7.04	6.05	10.91	10.53	9.69	10.19	9.00
Iowa	3.30	4.80	8.16	6.27	6.80	10.73	7.67	6.96	8.00	8.40
Missouri	3.06	4.18	3.91	6.00	6.30	4.82	9.10	7.07	7.72	8.16
Kansas	2.08	5.32	3.96	6.38	7.27	8.00	10.05	7.86	5.87	7.59
Nebraska	2.09	4.65	6.42	6.60	5.23	7.33	8.65	7.97	7.67	7.44
South Dakota	3.58	3.96	5.63	5.98	5.16	9.79	10.09	11.19	9.75	8.97
North Dakota	3.96	5.98	7.98	8.10	3.30	10.76	10.37	8.49	8.98	8.95
Montana	14.57	13.86	14.21	14.82	16.38	15.12	15.08	16.24	17.34	17.76
Wyoming	16.96	12.25	12.48	12.00	16.07	19.68	18.00	14.70	11.78	16.36
Colorado	8.40	10.88	14.68	11.34	14.10	16.90	13.67	13.65	16.28	14.35
New Mexico	10.80	14.56	15.91	10.56	14.45	18.96	12.99	14.01	11.17	17.11
Arizona	......	......	......	......	......	21.00	23.78	21.65	22.27	19.97
Utah	14.82	11.55	15.09	13.60	15.80	16.83	16.68	17.84	17.67	17.51
Nevada	......	......	......	......	......	30.10	24.36	19.45	23.31	19.34
Idaho	12.60	11.62	15.70	12.92	14.64	16.85	20.21	18.68	19.65	16.55
Washington	14.40	16.80	16.76	14.06	13.76	16.63	22.64	18.20	19.31	20.50
Oregon	6.93	11.20	10.80	12.30	7.59	10.71	11.77	14.87	10.86	10.36
California	13.64	8.82	16.50	14.57	11.32	13.38	15.55	18.79	19.44	14.28
Oklahoma	......	......	......	......	......	10.35	16.25	8.98	7.63	9.57
Indian Territory	......	......	......	......	......	11.50	12.06	10.50	12.24	11.88
General average	4.81	5.75	7.23	7.52	7.63	10.29	10.60	9.68	10.05	9.88

Average farm price of oats per bushel in the United States December 1, 1896–1905, by States.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	31	32	34	38	38	50	45	45	45	43
New Hampshire	35	38	38	39	38	52	44	48	47	43
Vermont	31	32	35	37	36	50	43	44	44	40
Massachusetts	35	33	37	38	38	55	45	49	45	43
Rhode Island	31	34	37	37	38	54	43	45	47	42
Connecticut	31	34	36	37	35	54	41	45	44	42
New York	26	27	31	33	32	48	36	41	38	37
New Jersey	28	30	31	33	31	47	39	43	40	37
Pennsylvania	24	27	30	29	30	45	34	37	38	36
Delaware	21	23	30	25	30	45	42	40	41	40
Maryland	23	26	29	30	31	41	38	40	36	36
Virginia	26	29	29	33	37	42	42	43	43	39
North Carolina	35	37	37	41	45	51	51	52	52	47
South Carolina	48	45	45	47	48	62	59	59	60	55
Georgia	41	42	48	48	49	67	53	55	55	53
Florida	53	53	54	50	50	72	61	60	60	52
Alabama	41	43	41	43	44	64	55	54	54	51
Mississippi	44	44	42	50	46	63	51	51	52	50
Louisiana	34	38	38	40	40	60	50	46	45	45
Texas	34	27	28	30	30	60	49	44	44	40
Arkansas	31	33	29	34	35	57	41	44	43	42
Tennessee	26	28	28	32	35	45	42	42	37	39
West Virginia	28	30	30	35	34	43	41	46	44	39
Kentucky	24	27	27	32	31	41	36	41	40	35
Ohio	17	20	24	25	26	39	32	36	32	31
Michigan	19	23	27	28	26	41	33	36	33	30
Indiana	16	19	23	23	23	38	28	32	30	27
Illinois	15	18	23	22	23	40	28	32	30	28
Wisconsin	17	19	24	23	23	39	30	34	28	27
Minnesota	15	19	21	22	24	34	27	30	26	24
Iowa	12	16	24	19	20	36	25	29	25	24
Missouri	17	19	23	24	23	43	28	32	34	30
Kansas	16	18	22	22	23	43	30	30	33	28
Nebraska	11	15	20	22	24	37	25	27	25	24

Average farm price of oats per bushel in the United States December 1, 1896-1905, by States—Continued.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
South Dakota	13	18	21	23	24	34	29	29	25	23
North Dakota	18	26	26	27	32	33	27	31	24	23
Montana	31	33	35	39	42	36	36	35	46	43
Wyoming	53	35	40	40	47	48	50	50	39	41
Colorado	30	32	41	42	43	50	51	41	46	41
New Mexico	40	41	41	44	48	60	68	62	57	58
Arizona	......	......	......	......	......	60	75	61	74	64
Utah	39	33	38	40	44	51	47	49	47	44
Nevada	......	......	......	......	......	70	70	68	63	52
Idaho	30	32	36	38	40	44	48	45	50	42
Washington	40	35	40	38	40	35	49	38	43	41
Oregon	33	35	40	41	41	34	41	44	47	43
California	44	49	50	47	46	44	51	54	57	51
Oklahoma	......	......	......	......	......	50	34	34	36	29
Indian Territory	......	......	......	......	......	46	37	35	38	33
General average	18.7	21.2	25.5	24.9	25.8	39.9	30.7	34.1	31.3	29.1

Wholesale prices of oats per bushel in leading cities of the United States, 1900-1905.

Date.	New York.		Baltimore.		Cincinnati.		Chicago.		Milwaukee.		Duluth.		Detroit.		San Francisco.	
	No. 2, mixed.		No. 2, mixed.		No. 2, mixed.		No. 2.		No. 2, white.		No. 2.		No. 2, white.		No. 1, white (per cwt.).	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
1900.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*		
Jan	29	29¾	28	29½	25¼	26½	22½	23	25	26	23	24	26¼	28½	$1.25	$1.30
Feb	29	29½	28¾	29½	25¼	26	22½	23¾	25	26	24	24	27¼	28½	1.25	1.25
Mar	28¼	29¼	28	29¼	25¼	26¼	23	24¼	25	27	24	24	27¼	28¼	1.25	1.26¼
Apr	27½	29½	27¾	29¼	26	28	23	25¼	26½	29	24	24½	28¼	29	1.25	1.26¼
May	26	28	26½	28¼	24½	26⅛	21¼	23¾	24	27½	23	24½	27	28½	1.22½	1.25
June	26	29¾	26	29	24	27	21¾	26¼	24¼	28½	23	28	26	29¼	1.22½	1.25
July	26½	29	27	28½	25	28	21½	24¾	24¾	28½	23¾	28	28	28½	1.25	1.30
Aug	25½	26½	24	27	21	25	21	22⅝	24½	27¼	23¼	24½	24½	28	1.27½	1.30
Sept	24¾	25½	24⅛	25¾	22¼	23½	21⅛	22¼	24¾	26	22½	23¾	24¾	26	1.27½	1.27½
Oct	25	26	24¼	25¼	23	24	21¼	22¼	24¼	26	23¼	24	25¼	26	1.30	1.32½
Nov	25½	26¾	24¾	26	23	25	21¾	22½	24¾	26¼	23¼	23¼	24	26½	1.35	1.35
Dec	26½	28½	26	29	24	25½	21¾	22¾	25⅛	26¼	23⅛	24¾	27	28	1.35	1.40
1901.																
Jan	28¼	31	28	29	25	27½	23¼	24¼	25½	27	25¼	26¼	28	28½	1.17½	1.45
Feb	30	31	28	30	26¾	28	24⅛	25½	27	28¼	26¼	26¾	28½	30	1.20	1.42½
Mar	30½	31½	29¾	31	27½	28	24¾	26½	27½	28¾	25¼	27¼	29	29¾	1.20	1.45
Apr	30¾	32	30½	32	28	29	25½	27½	27¾	30½	27	27¼	30	31	1.25	1.50
May	32¼	34	31	32	30	32	27⅞	31	29	30½	27¼	29¼	30½	32¼	1.30	1.45
June	32	33	31½	32½	29½	30½	27	28¾	28¾	29¾	27¼	28¼	30	31½	1.40	1.55
July	33⅛	41½	31½	42	31½	42	27½	39	30¾	41½	27¼	36¼	31½	40½	1.15	1.40
Aug	38	40½	37¼	42½	37	38	33½	37½	36¾	39½	34⅞	37½	54½	60½	1.10	1.35
Sept	38	39½	37½	38½	36	38	33⅝	36¾	36¼	38¾	35⅛	37½	36¼	39½	1.10	1.30
Oct	38	42	38	41½	38	39	34½	37¾	36	40½	35¼	37⅛	38⅛	40½	1.02½	1.30
Nov	42½	49	41	49	40	46	37⅛	44⅛	41	46	36⅞	43¼	41½	48½	1.10	1.30
Dec	49	52	48½	53	47	50¾	42	48¼	45¾	48¾	42¾	46⅞	48½	51	1.20	1.42½
1902.																
Jan	46½	53	48	52	46	50	38⅛	46¼	44¼	49	40⅜	47⅛	45	50½	1.25	1.40
Feb	48	50	47	49½	46	48	40¾	44¼	42¾	47	38⅝	43¼	46	47½	1.27½	1.42½
Mar	46¾	52	47½	49	45½	47	40¼	45½	44	47	40	43	46	48¼	1.25	1.40
Apr	46½	49½	47½	49	44	46½	41	44½	43¾	47¼	40	46⅛	46	48½	1.27½	1.45
May	45½	48	47½	48½	44	46	41	49½	44¼	46	42⅛	45⅝	46	48½	1.35	1.50
June	44½	55	47½	55	43	52	39	48½	43	54	28¾	34	46½	57	1.35	1.50
July	55	64¾	54	60	32½	57	30	56	51½	58	30½	34½	57	61	1.20	1.35
Aug	34½	65	31	59	27	31	25	31	33¼	58	27½	30	34¾	60	1.15	1.30
Sept	32	35	29	32	28½	31½	26⅛	27¼	31½	35	29	31½	36¼	39½	1.17½	1.30
Oct	33	34½	29½	33½	30	32	27¼	30	32	34	29⅛	32	38½	41¼	1.15	1.32½
Nov	34	36	32½	35½	29¾	34	27¾	29½	30½	34	28⅛	32	41¼	48	1.20	1.35
Dec	36	38¼	35½	40	33	39	29¼	32	32⅛	34	31	32	48⅛	51	1.25	1.40
1903.																
Jan	38½	44	39½	42½	35	39	31¾	34½	33½	36¾	32½	34½	36	38	1.22½	1.35
Feb	42½	43¾	39½	41	37½	39½	33⅛	36	36	36¾	34	35⅛	38	40	1.22½	1.37½
Mar	42	44½	40	41½	37	39	31¼	34⅜	36	36	31	34½	38	39	1.22½	1.32½
Apr	38	42	38	41½	33½	37	32⅛	35¾	36	36¾	32½	33½	36½	38½	1.20	1.32½
May	38	39½	37½	39	33	37½	33⅜	38¼	36	38	33½	35½	37	39	1.20	1.30
June	39¾	43¾	38½	44	36	43½	35⅛	43¼	36⅛	40½	35	40	39	45	1.17½	1.27½

Wholesale prices of oats per bushel in leading cities of the United States, 1900–1905—Continued.

Date.	New York.		Baltimore.		Cincinnati.		Chicago.		Milwaukee.		Duluth.		Detroit.		San Francisco.	
	No. 2, mixed.		No. 2, mixed.		No. 2, mixed.		No. 2.		No. 2, white.		No. 2.		No. 2, white.		No. 1, white (per cwt.).	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
1903.	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*		
July	40	43	36½	44	31¼	41½	33¼	45	36½	41	32½	37½	36	41½	$1.17½	$1.30
Aug	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	37	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.17½	[illegible]
Sept	38	42	39	41⅛	35	39	35⅛	38	37	40	35¾	38⅞	37½	40	1.17½	1.32½
Oct	40½	42	40	41	36⅛	39	34⅛	38⅛	37⅛	39	35	37⅛	38¼	39¾	1.20	1.32½
Nov	40	42	38½	40¼	35⅛	37½	33⅛	38¼	36¼	38¾	32⅝	35¼	36¼	38½	1.25	1.32½
Dec	40½	42½	39	40⅛	37	39	34¼	38	37⅛	38	34¼	35⅞	37⅛	39	1.25	1.32½
1904.											No. 3.		No. 3, white			
Jan	42⅛	45⅛	41	43⅛	38	42⅛	36⅛	41⅛	35	41	35½	39⅜	39	42⅛	1.25	1.37½
Feb	46	55⅛	43	48	41⅛	44½	39⅜	46	40	44½	38⅞	42⅞	42¼	48¼	1.25	1.37½
Mar	46	55¼	45½	47⅛	41	44½	38	42¾	39	44	38¼	40⅞	44	46¼	1.27½	1.37½
Apr	40¼	47	[illegible]	46¼	40	43	36⅛	41⅝	37	43⅝	37¼	41	42¼	45¼	1.27½	[illegible]
May	45⅛	47	43⅛	45⅛	41⅛	42⅛	39⅜	44¾	41	45	40	43	45	45⅜	1.32½	1.50
June	44¾	46	43⅛	45¼	41	44	39¾	42¼	38	44	40	42⅛	42¼	46⅛	1.40	1.50
July	41	45	43⅛	45⅛	40	41⅛	38⅛	45	37	41	36	38	41¼	44	1.30	1.50
Aug	35⅛	46	34⅛	45	32⅛	40⅛	31⅛	40	31¾	42	32¼	38	33	43½	1.30	1.50
Sept	34⅛	36	33	35	33	34⅛	29⅝	33⅛	29⅛	33½	30	32⅜	32	33½	1.40	1.52½
Oct	34⅛	36	33	34	31⅛	33⅛	28¼	31½	28⅛	33	27¾	30⅝	31⅞	34	1.40	1.55
Nov	35	35	33	35¾	31	33⅛	29	32¼	29⅛	32	29	29⅜	32	32½	1.45	1.60
Dec	34⅛	36½	35⅛	36	32¾	33¾	28¼	32	29	32	28¼	29⅜	32½	33⅛	1.45	1.60
1905.											a					
Jan	35⅛	37½	36¼	37	32¾	33½	29⅜	31	31⅛	32½	28¾	29¾	33⅛	34¼	1.45	1.60
Feb	36	37	35	[illegible]	32¾	[illegible]	29¼	32¼	32	[illegible]	[illegible]	30¼	[illegible]	34¼	1.45	1.60
Mar	35¾	37½	35	36¾	31¾	34½	29¼	33¼	32	34½	28⅛	31¼	33¼	34¼	1.45	1.60
Apr	34¼	36	33½	35⅛	30⅛	32½	28⅜	32	32	33⅛	28¼	29¾	33	34¼	1.45	1.60
May	34⅛	35⅛	33⅛	34⅛	30⅛	32¾	28⅝	32	31¾	34	28⅜	31⅛	33	34¾	1.45	1.67½
June	34⅛	36	33¾	36½	32½	33⅛	30¼	33¼	33	34½	30¼	32⅛	33¾	34½	1.65	1.80
July	33⅛	36½	33	36½	28	34	27	34¼	33	35½	27⅛	32¼	35	37	......	......
Aug	29	33	27⅛	32⅛	25	32	25¼	29½	27½	34	25⅛	28⅜	27	35½	......	......
Sept	29	33⅛	28	32½	26	30	25	30	28	30	25¼	28⅛	26¼	30½	1.37½	1.47½
Oct	32⅛	35¾	32	35	29	32	27½	30¾	29	32	26¼	29⅛	29¾	32¾	1.37½	1.45
Nov	[illegible]	[illegible]	[illegible]	[illegible]	31½	[illegible]	29	31½	31	[illegible]	[illegible]	30	[illegible]	[illegible]	1.47½	[illegible]
Dec	36	37	34	36½	33	35½	29½	32¾	31⅛	33½	29	30½	32¾	35	1.45	1.55

a No grade of oats in Duluth for 1905.

BARLEY.

Barley crop of countries named, 1901–1905.

Country.	1901.	1902.	1903.	1904.	1905.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	109,933,000	134,954,000	131,861,000	139,749,000	136,651,000
Ontario	17,289,000	22,580,000	25,147,000	25,342,000	25,030,000
Manitoba	6,742,000	12,222,000	8,982,000	11,530,000	14,507,000
Northwest Territories	[illegible]	[illegible]	[illegible]	[illegible]	2,751,000
Rest of Canada	4,000,000	4,000,000	4,000,000	4,000,000	4,000,000
Total Canada	28,851,000	[illegible]	[illegible]	[illegible]	46,288,000
Mexico	[illegible]	[illegible]	[illegible]	[illegible]	7,500,000
Total North America	[illegible]	180,699,000	180,847,000	190,896,000	190,439,000
Great Britain	[illegible]	[illegible]	61,348,000	58,996,000	59,941,000
Ireland	[illegible]	[illegible]	6,076,000	5,478,000	6,000,000
Total United Kingdom	[illegible]	[illegible]	[illegible]	64,474,000	[illegible]
Sweden	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Denmark	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Netherlands	[illegible]	[illegible]	[illegible]	[illegible]	4,100,000
Belgium	[illegible]	4,974,000	[illegible]	[illegible]	[illegible]
France	[illegible]	41,948,000	[illegible]	[illegible]	[illegible]
Spain	[illegible]	81,279,000	[illegible]	[illegible]	[illegible]
Italy	8,000,000	[illegible]	8,000,000	7,000,000	8,000,000
Germany	[illegible]	142,392,000	[illegible]	[illegible]	[illegible]

Barley crop of countries named, 1901-1905—Continued.

Country.	1901.	1902.	1903.	1904.	1905.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Austria	67,091,000	73,788,000	73,873,000	66,815,000	70,441,000
Hungary	50,071,000	62,350,000	64,577,000	49,915,000	62,452,000
Croatia-Slavonia	3,051,000	3,259,000	3,839,000	2,285,000	3,258,000
Total Austria-Hungary	120,213,000	139,397,000	142,289,000	119,015,000	136,151,000
Roumania	24,222,000	24,586,000	29,716,000	11,567,000	26,400,000
Bulgaria	9,500,000	11,000,000	13,000,000	12,000,000	11,000,000
Russia proper	189,435,000	274,899,000	289,699,000	290,766,000	272,694,000
Poland	20,640,000	22,185,000	20,819,000	17,705,000	22,731,000
Northern Caucasia	25,685,000	35,530,000	39,980,000	31,254,000	43,429,000
Total Russia in Europe	235,760,000	332,614,000	350,498,000	339,725,000	338,854,000
Total Europe	782,326,000	901,275,000	915,940,000	826,801,000	857,284,000
Siberia	2,003,000	2,628,000	4,213,000	4,268,000	4,965,000
Central Asia	2,154,000	3,008,000	2,759,000	2,262,000	3,144,000
Total Russia in Asia	4,157,000	5,636,000	6,972,000	6,530,000	8,109,000
Japan	83,352,000	74,078,000	59,737,000	80,000,000	70,000,000
Total Asia	87,509,000	79,714,000	66,709,000	86,530,000	78,109,000
Algeria	48,770,000	47,912,000	38,496,000	36,125,000	35,000,000
Tunis	3,449,000	3,201,000	11,322,000	14,815,000	9,000,000
Cape Colony	700,000	800,000	949,000	850,000	850,000
Total Africa	52,919,000	51,913,000	50,767,000	51,790,000	44,850,000
West Australia	30,000	37,000	48,000	55,000	39,000
South Australia	218,000	251,000	327,000	503,000	358,000
Queensland	131,000	286,000	4,000	527,000	342,000
New South Wales	117,000	107,000	19,000	180,000	275,000
Victoria	1,254,000	716,000	579,000	1,256,000	902,000
Tasmania	120,000	173,000	207,000	219,000	200,000
Total Australia	1,870,000	1,570,000	1,184,000	2,740,000	2,116,000
New Zealand	1,060,000	1,883,000	1,172,000	1,197,000	1,164,000
Total Australasia	2,930,000	2,453,000	2,356,000	3,937,000	3,280,000
Grand total	1,072,195,000	1,216,054,000	1,216,619,000	1,159,957,000	1,173,962,000

Visible supply of barley in the United States and Canada, first of each month, for ten years.[a]

Month.	1896-1897.	1897-1898.	1898-1899.	1899-1900.	1900-1901.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	805,000	1,574,000	587,000	1,059,000	1,038,000
August	771,000	1,051,000	581,000	694,000	702,000
September	790,000	1,578,000	548,000	1,055,000	1,158,000
October	2,292,000	2,630,000	2,125,000	1,739,000	2,779,000
November	6,032,000	4,267,000	3,777,000	3,925,000	5,396,000
December	5,500,000	6,318,000	4,406,000	4,695,000	6,053,000
January	4,501,000	5,115,000	4,372,000	3,122,000	5,395,000
February	4,183,000	3,455,000	4,017,000	2,303,000	4,331,000
March	4,124,000	2,571,000	3,067,000	2,138,000	3,903,000
April	3,514,000	1,492,000	2,626,000	1,712,000	2,879,000
May	2,816,000	1,159,000	1,913,000	1,720,000	1,761,000
June	1,819,000	815,000	1,555,000	1,267,000	1,351,000

[a] These figures represent stocks available at 62 of the principal points of accumulation east of the Rocky Mountains, stocks in Manitoba elevators, and stocks afloat on lakes and canals as reported by Bradstreet's.

Visible supply of barley in the United States and Canada, first of each month, for ten years—Continued.

Month.	1901-1902.	1902-1903.	1903-1904.	1904-1905.	1905-1906.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	528,000	847,000	602,000	2,046,000	2,557,000
August	335,000	217,000	471,000	1,656,000	1,031,000
September	956,000	419,000	1,024,000	1,694,000	1,358,000
October	3,610,000	2,460,000	5,047,000	6,551,000	5,524,000
November	4,813,000	5,064,000	7,313,000	9,329,000	8,509,000
December	5,416,000	5,680,000	7,975,000	9,620,000	10,217,000
January	4,580,000	4,389,000	6,907,000	10,403,000	10,657,000
February	5,244,000	3,843,000	6,338,000	8,801,000	8,526,000
March	5,065,000	3,107,000	5,441,000	6,952,000	7,686,000
April	4,075,000	2,426,000	4,975,000	4,674,000	6,567,000
May	2,146,000	1,493,000	3,969,000	3,354,000	4,251,000
June	1,836,000	1,133,000	3,105,000	2,231,000	....

Condition of the barley crop of the United States, monthly, 1890–1905.

Year.	June.	July.	August.	September.	Year.	June.	July.	August.	September.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*		*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
1890	86.4	88.3	82.8	78.6	1898	78.8	85.7	79.3	79.2
1891	90.3	90.9	93.8	94.3	1899	91.4	92.0	93.6	86.7
1892	92.1	92.0	91.1	87.4	1900	86.2	76.3	71.6	70.7
1893	88.3	88.8	84.6	83.8	1901	98.8	91.3	86.9	85.8
1894	82.2	76.8	69.8	71.5	1902	93.6	93.7	90.2	89.7
1895	90.3	91.9	87.2	87.6	1903	91.5	86.8	83.4	82.1
1896	98.0	88.1	82.9	83.1	1904	90.5	88.5	88.1	87.4
1897	87.4	88.5	87.5	86.4	1905	93.7	91.5	89.5	87.8

Acreage, production, value, prices, exports, etc., of barley of the United States, 1866–1905.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1.	Farm value, Dec. 1.	Chicago cash price per bushel, No. 2.[a] December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports, fiscal years beginning July 1.	Imports, fiscal years beginning July 1.
	Acres.	*Bush.*	*Bushels.*	*Cts.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*	*Bushels.*
1866	492,532	22.9	11,283,807	70.2	7,916,342	59	70	85	100	....	3,247,250
1867	1,131,217	22.7	25,727,000	70.1	18,027,746	150	180	227	250	9,810	3,783,966
1868	937,498	24.4	22,896,100	109.0	24,948,127	140	170	149	175	59,077	5,069,880
1869	1,025,795	27.9	28,652,200	70.8	20,298,164	74	85	50	62	255,490	6,727,597
1870	1,108,924	23.7	26,295,400	79.1	20,792,213	68	80	72	95	340,093	4,866,700
1871	1,113,735	24.0	26,718,500	75.8	20,264,015	55½	64	55	71	86,891	5,565,591
1872	1,397,082	19.2	26,846,400	68.6	18,415,839	60	70	71	85	482,410	4,244,751
1873	1,387,106	23.1	32,044,491	86.7	27,794,229	132	158	130	155	320,399	4,891,189
1874	1,580,626	20.6	32,552,500	86.0	27,997,824	120	129½	115	137	91,118	6,255,063
1875	1,789,902	20.6	36,908,600	74.1	27,367,522	81	88	62½	72½	317,781	10,285,957
1876	1,766,511	21.9	38,710,500	63.0	24,402,691	63¾	68½	80	85	1,186,129	6,702,965
1877	1,614,654	21.3	34,441,400	62.8	21,629,130	56¼	64	46½	52½	3,921,501	6,764,228
1878	1,790,400	23.6	42,245,630	57.9	24,454,301	91	100	64	73	715,536	5,720,979
1879	1,680,700	24.0	40,283,100	58.9	23,714,444	86	92	75	80	1,128,923	7,135,258
1880	1,843,329	24.5	45,165,346	66.6	30,090,742	100	120	95	105	885,246	9,528,616
1881	1,967,510	20.9	41,161,330	82.3	33,862,513	101	107	100	100	205,930	12,182,722
1882	2,272,103	21.5	48,953,926	62.9	30,768,015	79	82	80	80	433,005	10,050,687
1883	2,379,009	21.1	50,136,097	58.7	29,420,423	62	67	65	74	724,955	8,596,122
1884	2,608,818	23.5	61,203,000	48.7	29,779,170	53	58	65	65	629,130	9,986,507
1885	2,729,359	21.4	58,360,000	56.3	32,867,696	62	65	58	60	252,183	10,197,115
1886	2,652,957	22.4	59,428,000	53.6	31,840,510	51	54	57	57	1,305,300	10,355,594
1887	2,901,953	19.6	56,812,000	51.9	29,464,390	80	80	69	77	550,884	10,831,461
1888	2,996,382	21.3	63,884,000	59.0	37,672,032	......	......	......	......	1,440,321	11,368,414
1889	3,220,834	24.3	78,332,976	41.6	32,614,271	58	58	......	......	1,408,311	11,332,545
1890	3,135,302	21.4	67,168,344	62.7	42,140,502	......	......	......	......	973,062	5,078,733
1891	3,352,579	25.9	86,839,153	52.4	45,470,342	......	......	......	......	2,800,075	3,146,328
1892	3,400,361	23.6	80,096,762	47.5	38,026,062	65	67	65	65	3,035,267	1,970,129
1893	3,220,371	21.7	69,869,495	41.1	28,729,386	52	54	55	60	5,219,405	791,061
1894	3,170 602	19.4	61,400,465	44.2	27,134,127	53½	55½	51	52	1,563,754	2,116,816

Acreage, production, value, prices, exports, etc., of barley of the United States, 1866–1905—Continued.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel Dec. 1.	Farm value, Dec. 1.	Chicago cash price per bushel, No. 2.[a] December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports, fiscal years beginning July 1.	Imports, fiscal years beginning July 1.
	Acres.	*Bush.*	*Bushels.*	*Cts.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*	*Bushels.*
1895	3,299,973	26.4	87,072,744	33.7	29,312,413	33	40	25	36	7,680,331	837,384
1896	2,950,539	23.6	69,695,223	32.3	22,491,241	22	37	24½	35	20,030,301	1,271,787
1897	2,719,116	24.5	66,685,127	37.7	25,142,139	25½	42	36	53	11,237,077	124,804
1898	2,583,125	21.6	55,792,257	41.3	23,064,359	40	50½	36	42	2,267,403	110,475
1899	2,878,229	25.5	73,381,563	40.3	29,594,254	35	45	36	44	23,661,662	189,757
1900	2,894,282	20.4	58,925,833	40.8	24,075,271	37	61	37	57	6,293,207	171,004
1901	4,295,744	25.6	109,932,924	45.2	49,705,163	56	63	64	72	8,714,268	57,406
1902	4,661,063	29.0	134,954,023	45.9	61,898,634	36	70	48	56	8,429,141	56,462
1903	4,993,137	26.4	131,861,391	45.6	60,166,313	42	61½	38	59	10,881,627	90,708
1904	5,145,878	27.2	139,748,958	42.0	58,651,807	38	52	40	50	10,661,655	81,020
1905	5,095,528	26.8	136,651,020	40.3	55,047,166	37	53				

[a] Prices from 1895 are for No. 3 grade.

Acreage, production, and value of barley in the United States in 1905, by States.

State or Territory.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*
Maine	7,817	29.0	226,693	68	154,151
New Hampshire	1,522	20.8	31,658	73	23,110
Vermont	12,939	31.5	507,578	54	274,092
New York	90,729	25.7	2,331,735	54	1,259,137
Pennsylvania	8,692	25.0	217,300	55	119,515
Maryland	1,436	31.0	44,516	48	21,368
Virginia	2,472	28.0	69,216	55	38,069
Texas	4,843	24.0	116,232	66	76,713
Tennessee	1,161	21.6	25,078	57	14,294
Kentucky	748	24.0	17,952	44	7,899
Ohio	23,165	26.2	606,923	45	273,115
Michigan	33,499	27.0	904,473	47	425,102
Indiana	9,429	28.0	264,012	45	118,805
Illinois	24,093	30.0	722,790	42	303,572
Wisconsin	493,063	29.9	14,742,584	41	6,044,459
Minnesota	1,074,538	27.0	29,012,526	32	9,284,008
Iowa	448,515	26.0	11,661,390	30	3,498,417
Missouri	1,852	23.0	42,596	44	18,742
Kansas	152,929	22.0	3,364,438	32	1,076,620
Nebraska	66,498	27.5	1,828,695	31	566,895
South Dakota	332,080	30.0	9,962,400	29	2,889,096
North Dakota	690,223	28.0	19,326,244	30	5,797,873
Montana	15,227	33.0	502,491	56	281,395
Wyoming	1,188	31.7	37,660	59	22,219
Colorado	18,909	33.0	623,997	53	330,718
New Mexico	604	21.0	12,684	69	8,752
Arizona	14,893	44.0	655,292	81	530,787
Utah	7,799	37.0	288,563	53	152,938
Nevada	6,883	34.0	234,022	70	163,815
Idaho	66,153	40.0	2,646,120	48	1,270,138
Washington	169,314	40.0	6,772,560	47	3,183,103
Oregon	59,862	31.0	1,855,722	52	964,975
California	1,237,533	21.5	26,606,960	59	15,698,106
Oklahoma	14,920	26.0	387,920	40	155,168
United States	5,095,528	26.8	136,651,020	40.3	55,047,166

Average yield per acre of barley in the United States, 1896–1905, by States.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	30.6	25.0	27.0	29.0	27.4	27.5	29.4	29.9	32.7	29.0
New Hampshire	29.3	22.5	23.5	25.0	22.7	21.5	21.2	19.8	20.7	20.8
Vermont	33.0	28.5	30.0	31.0	29.1	29.6	29.7	29.2	33.1	31.5
Massachusetts	30.0	34.5	24.5	30.0	25.8	......	......	......	......	......
Rhode Island	29.0	28.0	28.0	29.0	28.0	......	......	......	......	......
New York	23.2	25.0	25.2	24.0	22.0	14.0	28.5	26.6	26.8	25.7
Pennsylvania	17.2	21.5	19.4	21.0	19.0	17.2	21.0	21.3	22.6	25.0
Maryland	......	......	......	......	......	18.0	27.0	25.9	21.8	31.0
Virginia	......	......	......	......	......	24.9	18.3	24.4	24.7	28.0
Texas	12.0	25.0	20.0	18.0	24.6	13.5	21.3	24.4	31.0	24.0
Tennessee	14.0	18.0	18.0	11.0	14.7	16.8	16.0	20.6	22.0	21.6
Kentucky	14.8	20.0	16.0	21.0	28.6	19.4	25.9	21.4	20.6	24.0
Ohio	20.2	28.5	28.7	28.0	27.0	24.9	32.3	23.3	27.5	26.2
Michigan	22.3	21.5	25.2	24.0	23.9	22.8	28.6	25.2	24.1	27.0
Indiana	20.3	19.0	23.4	25.0	24.6	25.4	28.0	22.8	29.2	28.0
Illinois	23.7	25.0	27.3	29.0	25.6	24.5	28.6	28.2	27.1	30.0
Wisconsin	27.4	28.0	29.1	30.0	25.5	27.2	33.8	27.7	30.0	29.9
Minnesota	27.2	25.5	28.4	25.0	22.4	25.8	28.6	25.3	28.4	27.0
Iowa	26.3	24.0	26.0	26.0	26.4	23.6	26.3	23.4	27.8	26.0
Missouri	17.5	19.0	20.0	18.0	20.8	16.5	25.0	18.3	20.3	23.0
Kansas	4.6	17.5	28.0	17.0	21.5	15.9	16.0	31.9	21.6	22.0
Nebraska	19.9	22.0	27.1	26.0	17.6	16.0	31.1	26.6	27.4	27.5
South Dakota	28.5	20.0	23.0	23.0	14.3	22.4	29.2	31.4	28.0	30.0
North Dakota	16.1	22.5	26.4	24.0	8.2	28.2	31.6	21.6	28.1	28.0
Montana	25.0	38.0	36.0	35.0	38.8	39.0	37.0	40.2	29.9	33.0
Wyoming	......	......	......	......	......	32.5	24.4	21.3	30.1	31.7
Colorado	20.0	28.0	30.5	28.0	24.8	28.7	26.3	38.3	37.1	33.0
New Mexico	19.0	32.5	33.8	32.0	29.0	31.7	16.1	23.1	23.6	21.0
Arizona	......	......	......	......	......	28.7	25.2	32.8	33.6	44.0
Utah	27.1	31.0	37.0	33.0	36.5	35.0	32.1	37.5	38.3	37.0
Nevada	......	......	......	......	......	33.0	34.3	34.6	35.9	34.0
Idaho	15.3	35.0	35.0	35.0	32.8	40.2	46.3	34.4	37.4	40.0
Washington	26.0	45.0	39.8	35.0	33.4	43.5	43.7	37.9	34.8	40.0
Oregon	21.8	32.5	29.1	28.0	28.9	30.6	31.9	33.2	28.7	31.0
California	21.6	23.0	10.5	26.0	16.7	26.0	26.0	25.7	22.7	21.5
Oklahoma	......	......	......	......	......	22.0	36.0	26.9	30.1	26.0
General average	23.6	24.5	21.6	25.5	20.4	25.6	29.0	26.4	27.2	26.8

Average yield of barley in certain countries, in bushels per acre, 1895–1904.

Year.	United States.	Russia.	Germany.	Austria.	Hungary.	France.	United Kingdom.
	(*a*)	(*b*)	(*b*)	(*b*)	(*b*)	(*a*)	(*a*)
1895	26.4	13.7	31.2	20.9	21.4	21.9	33.1
1896	23.6	12.8	30.7	19.3	24.0	21.8	35.2
1897	24.5	11.8	29.0	17.6	17.6	19.4	33.9
1898	21.6	14.9	32.2	22.0	23.6	23.3	37.4
1899	25.5	11.1	33.8	24.9	24.0	22.7	35.7
1900	20.4	11.4	33.4	20.2	20.9	21.8	32.7
1901	25.6	11.2	33.3	22.5	20.0	21.1	32.7
1902	29.0	15.6	35.1	24.5	24.7	24.5	36.9
1903	26.4	15.5	36.2	24.7	25.1	25.2	33.4
1904	27.2	14.4	33.6	22.9	19.8	22.0	32.2
Average	25.0	13.2	32.8	22.0	22.1	22.4	34.3

a Winchester bushels. *b* Bushels of 48 pounds.

Average value per acre of barley in the United States, based upon farm value December 1, 1896–1905, by States.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
Maine	$13.16	$13.75	$15.12	$17.11	$16.99	$18.43	$19.99	$21.23	$23.22	$19.72
New Hampshire	15.53	13.50	13.63	16.25	15.21	17.20	15.90	16.63	15.53	15.18
Vermont	13.53	13.11	14.10	16.12	15.13	19.54	18.12	17.52	21.85	21.18
Massachusetts	17.40	22.77	16.17	20.40	17.80	......	......	......	......	......
Rhode Island	17.40	15.12	17.08	20.30	21.56	......	......	......	......	......
New York	9.05	10.50	12.10	12.00	11.22	7.84	15.68	14.63	15.28	13.88
Pennsylvania	6.88	9.55	8.54	10.29	9.50	10.15	11.34	11.93	12.66	13.75
Maryland	......	......	......	......	......	9.36	13.23	12.95	13.95	14.88
Virginia	......	......	......	......	......	11.70	9.88	13.91	15.07	15.40

Average value per acre of barley in the United States, based upon farm value December 1, 1896–1905, by States—Continued.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
Texas	$6.00	$10.75	$10.00	$11.88	$17.71	$11.88	$16.34	$17.08	$22.63	$15.84
Tennessee	6.30	10.62	10.08	7.04	9.11	11.76	9.76	13.39	14.08	12.31
Kentucky	5.92	8.00	6.40	9.03	15.73	13.77	14.50	13.48	13.59	10.66
Ohio	7.68	11.69	12.63	12.60	11.61	12.70	15.83	11.65	14.30	11.79
Michigan	9.37	8.60	11.09	11.62	11.23	12.31	14.87	13.10	13.25	12.69
Indiana	6.70	8.36	10.30	11.25	11.56	12.95	12.88	11.40	14.02	12.60
Illinois	7.35	9.50	10.65	13.63	12.03	12.99	12.58	12.41	11.65	12.60
Wisconsin	7.40	8.96	11.64	12.00	11.22	13.87	15.55	13.30	12.90	12.26
Minnesota	5.44	6.12	9.37	7.75	8.51	11.61	10.58	9.36	9.09	8.64
Iowa	5.52	5.76	8.84	8.06	9.77	11.09	9.47	8.42	10.01	7.80
Missouri	4.38	7.60	7.20	7.56	9.36	9.08	13.75	9.88	12.59	10.12
Kansas	1.01	4.38	7.56	4.59	7.10	7.15	6.08	10.85	7.99	7.04
Nebraska	3.78	5.28	6.78	7.80	5.81	6.56	10.26	8.78	8.49	8.52
South Dakota	5.42	4.40	6.21	6.67	4.43	9.41	11.10	10.36	8.96	8.70
North Dakota	3.38	6.07	7.66	7.92	2.87	11.28	11.38	7.78	7.87	8.40
Montana	13.75	19.00	20.52	17.85	18.62	22.23	18.87	23.32	18.54	18.48
Wyoming	......	......	......	......	......	21.12	18.30	15.34	17.16	18.70
Colorado	9.20	14.28	14.03	15.40	12.40	18.08	15.78	23.36	21.15	17.49
New Mexico	12.35	17.88	18.59	19.52	17.98	20.61	11.43	14.78	21.24	14.49
Arizona	......	......	......	......	......	19.52	22.93	23.62	31.25	35.64
Utah	11.38	13.95	17.39	17.16	20.07	18.55	18.94	22.13	21.83	19.61
Nevada	......	......	......	......	......	23.10	27.44	29.41	25.85	23.80
Idaho	3.37	14.70	16.80	16.10	16.40	21.31	24.54	17.89	23.56	19.20
Washington	10.40	19.35	17.91	15.40	13.03	17.83	20.10	18.95	17.05	18.80
Oregon	9.81	14.63	14.26	14.00	12.14	14.99	16.59	19.59	16.93	16.12
California	10.37	12.42	6.82	13.00	7.18	10.66	16.38	15.68	13.62	12.68
Oklahoma	......	......	......	......	......	10.78	15.12	11.84	12.04	10.40
General average	7.62	9.25	8.93	10.28	8.32	11.57	13.28	12.05	11.40	10.80

Average farm price of barley per bushel in the United States December 1, 1896–1905, by States.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	43	55	56	59	62	67	68	71	71	68
New Hampshire	53	60	58	65	67	80	75	84	75	73
Vermont	41	46	47	52	52	66	61	60	66	54
Massachusetts	58	66	66	68	69	......	......	......	......	......
Rhode Island	60	54	61	70	77	......	......	......	......	......
New York	39	42	48	50	51	56	55	55	57	54
Pennsylvania	40	39	44	49	50	59	54	56	56	55
Maryland	......	......	......	......	......	52	49	50	64	48
Virginia	......	......	......	......	......	47	54	57	61	55
Texas	50	43	50	66	72	88	72	70	73	66
Tennessee	45	59	56	64	62	70	61	65	64	57
Kentucky	40	40	40	43	55	71	56	63	65	44
Ohio	38	41	44	45	43	51	49	50	52	45
Michigan	42	40	44	48	47	54	52	52	55	47
Indiana	33	44	44	45	47	51	46	50	48	45
Illinois	31	38	39	47	47	53	44	44	43	42
Wisconsin	27	32	40	40	44	51	46	48	43	41
Minnesota	20	24	33	31	38	45	37	37	32	32
Iowa	21	24	34	31	37	47	36	36	36	30
Missouri	25	40	36	42	45	55	55	54	62	44
Kansas	22	25	27	27	33	45	38	34	37	32
Nebraska	19	24	25	30	33	41	33	33	31	31
South Dakota	19	22	27	29	31	42	38	33	32	29
North Dakota	21	27	29	33	35	40	36	36	28	30
Montana	55	50	57	51	48	52	51	58	62	56
Wyoming	......	......	......	......	......	65	75	72	57	59
Colorado	46	51	46	55	50	63	60	61	57	53
New Mexico	65	55	55	61	62	65	71	64	90	69
Arizona	......	......	......	......	......	68	91	72	93	81
Utah	42	45	47	52	55	53	59	59	57	53
Nevada	......	......	......	......	......	70	80	85	72	70
Idaho	22	42	48	46	50	53	53	52	63	48
Washington	40	43	45	44	39	41	46	50	49	47
Oregon	45	45	49	50	42	49	52	59	59	52
California	48	54	65	50	43	41	63	61	60	59
Oklahoma	......	......	......	......	......	49	42	44	40	40
General average	32.3	37.7	41.3	40.3	40.8	45.2	45.9	45.6	42.0	40.3

Wholesale prices of barley, per bushel, in leading cities of the United States, 1901–1905.

Date.	Cincinnati. Extra No. 3 spring.		Chicago. No. 3.		St. Louis. Malting, medium to choice.		Minneapolis.		San Francisco. No. 1, brewing (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1901.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*		
January	62	70	36	63	50	67	35	53	$0.75	$0.80
February	62	70	37	61	55	64	40	53	.73¾	.81¼
March	62	66	37	59	52	64	40	53	.75	.82½
April	60	66	38	58	55	63	35	41	.78¾	.85
May	60	64	37	57	......	......	34	40	.77½	.81¼
June	59	62	40	54	......	......	35	45	.75	.80
July	......	......	40	65	......	......	30	55	.77½	.82½
August	58	60	48	65	......	......	45	61	.80	.83¾
September	65	67	50	62	55	66	45	57	.80	.82½
October	62	67	51	60	55	63	46	56½	.77½	.82½
November	62	66	51	63	55	64	46	58	.76¾	.82½
December	68	69	56	63	60	67	50	61	.78¾	.85
1902.										
January	67	70	57	65½	59	67	54	62	.80	.95
February	67	69	58	64	59	66	51	63	.90	1.02½
March	67	70	58	67	56	67	51	64	.92½	1.02½
April	68	74	61	70	57	68	52	66	.93¾	1.02½
May	67	69	64	72	60	70	56	70	.95	1.07½
June	67	69	64	71	......	......	50	67	.92½	1.01¼
July	......	......	48	73	......	......	41	52	.92½	1.00
August	......	......	41	65	......	......	35	63	.93¾	1.01¼
September	55	65	38	63	52	67	35	62	.96¼	1.15
October	55	65	35	60	50	62	32	69	1.12½	1.25
November	55	65	35	58	48	61	30	60	1.18¾	1.30
December	55	65	36	70	48	61	30	60	1.22½	1.32½
1903.									No. 1 feed.	
January	55	65	45	58	50	61	35	62	1.15	1.21¼
February	56	65	47	56	50	61	42	60	1.15	1.22½
March	56	65	46	55	50	61	40	58	1.11¼	1.20
April	55	62	46	55	48	57	40	52	1.05	1.16¼
May	55	62	48	56	48	57	40	52	1.05	1.12¼
June	55	62	49	54	......	......	40	52	.90	1.12½
July	......	......	47	53	......	......	34	57	.97½	1.10
August	......	......	47	57	......	......	34	55	1.02½	1.13¾
September	62	71	51	63	55	67	40	57	1.08¾	1.16¼
October	61	69	46	62	54	65	35	55	1.08¾	1.16¼
November	62	69	43	61½	50	64	33	57	1.11¼	1.15
December	60	69	42	61½	49	63	30	55	1.07½	1.15
1904.										
January	60	69	37	61	48	65	32	57	1.10	1.13¾
February	62	69	40	61	50	65	36	55	1.07½	1.15
March	62	69	40	54	48	64	34	54	1.06¼	1.15
April	62	69	38	60	49	62	33	52	1.07½	1.15
May	62	69	38	59	......	......	33	52	1.03¾	1.10
June	62	69	35	59	......	......	32	52	.95	1.06¼
July	......	......	36	55	......	......	28	50	.95	1.03¾
August	......	......	38	55	42	48	30	53	1.03¾	1.10
September	......	......	38	55	50	59	33	56	1.05	1.12½
October	55	62	37	54	45	59	32	47	1.07½	1.12½
November	55	60	38	53	45	54	32	46	1.07½	1.13¾
December	55	60	38	52	44	54	33	48	1.10	1.15
1905.										
January	52	58	38	50	44	53	33	45	1.16¼	1.23¾
February	52	58	37	48	45	53	36	45	1.22½	1.25
March	52	58	40	48	45	51	37	44	1.22½	1.30
April	52	58	40	49½	47	48	36	44	1.22½	1.30
May	54	58	40	50	......	......	37	46	1.22½	1.35
June	54	58	43	50	......	......	39	46	1.27½	1.35
July	54	58	40	52	......	......	35	48	1.10	1.30
August	54	58	37½	50	......	......	30	48	1.02½	1.10
September	54	58	37½	52	48	55	32	47	1.05	1.13¾
October	54	58	36½	53	43	55	32	48	1.10	1.30
November	54	58	37½	55	43	56	34	48	1.22½	1.27½
December	54	58	37	53	45	54	34	48	1.22½	1.27½

RYE.

Rye crop of countries named, 1901–1905.

Country.	1901.	1902.	1903.	1904.	1905.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	30,345,000	33,631,000	29,363,000	27,242,000	28,486,000
Ontario	2,625,000	3,620,000	3,064,000	2,065,000	1,769,000
Manitoba	64,000	51,000	51,000	130,000	64,000
Rest of Canada	800,000	800,000	800,000	800,000	800,000
Total Canada	3,489,000	4,471,000	3,915,000	2,995,000	2,633,000
Total North America	33,834,000	38,102,000	33,278,000	30,237,000	31,119,000
United Kingdom	2,000,000	2,000,000	2,000,000	2,000,000	2,000,000
Sweden	21,771,000	22,293,000	23,360,000	20,960,000	25,203,000
Denmark	16,605,000	18,779,000	19,305,000	16,516,000	17,000,000
Netherlands	14,180,000	13,971,000	13,973,000	13,517,000	13,500,000
Belgium	25,045,000	22,374,000	21,756,000	21,988,000	21,000,000
France	58,198,000	47,051,000	57,951,000	52,141,000	60,267,000
Spain	28,370,000	26,187,000	22,511,000	14,200,000	13,500,000
Italy	4,000,000	3,200,000	4,000,000	3,000,000	4,000,000
Germany	321,350,000	373,768,000	389,923,000	396,075,000	378,204,000
Austria	75,514,000	82,482,000	81,130,000	91,685,000	98,192,000
Hungary	40,883,000	49,458,000	47,355,000	43,880,000	54,089,000
Croatia-Slavonia	2,774,000	3,049,000	3,386,000	2,038,000	2,838,000
Total Austria-Hungary	119,171,000	134,989,000	131,871,000	137,603,000	155,119,000
Roumania	9,573,000	6,958,000	7,145,000	2,201,000	7,300,000
Bulgaria	7,000,000	8,000,000	8,000,000	11,000,000	10,000,000
Russia proper	680,205,000	810,537,000	803,296,000	893,205,000	629,670,000
Poland	50,781,000	75,257,000	69,100,000	76,606,000	69,087,000
Northern Caucasia	7,937,000	8,654,000	7,498,000	8,179,000	9,950,000
Total Russia in Europe	738,923,000	894,448,000	879,894,000	977,990,000	708,707,000
Total Europe	1,366,186,000	1,574,018,000	1,581,689,000	1,669,221,000	1,415,800,000
Siberia	15,620,000	23,080,000	30,982,000	29,360,000	28,044,000
Central Asia	382,000	1,489,000	1,066,000	1,088,000	689,000
Total Russia in Asia	16,002,000	24,569,000	32,048,000	30,448,000	28,733,000
Grand total	1,416,022,000	1,636,689,000	1,647,015,000	1,729,906,000	1,475,652,000

Visible supply of rye in the United States and Canada, first of each month, for ten years.[a]

Month.	1896–1897.	1897–1898.	1898–1899.	1899–1900.	1900–1901.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	1,575,000	2,464,000	988,000	904,000	806,000
August	1,630,000	1,946,000	365,000	638,000	725,000
September	2,328,000	2,499,000	721,000	647,000	1,056,000
October	2,010,000	3,064,000	894,000	962,000	1,216,000
November	2,596,000	3,832,000	1,260,000	1,906,000	1,513,000
December	2,695,000	3,932,000	1,212,000	1,892,000	1,754,000
January	3,276,000	4,436,000	1,573,000	1,806,000	1,651,000
February	4,266,000	4,291,000	1,576,000	1,734,000	1,530,000
March	4,104,000	4,099,000	1,724,000	1,951,000	1,532,000
April	4,128,000	3,682,000	1,658,000	1,566,000	1,333,000
May	3,607,000	3,039,000	1,335,000	1,441,000	1,112,000
June	2,798,000	1,526,000	975,000	1,206,000	938,000

[a] These figures represent stocks available at 62 of the principal points of accumulation east of the Rocky Mountains, stocks in Manitoba elevators, and stocks afloat on lakes and canals, as reported by Bradstreet's.

Visible supply of rye in the United States and Canada, first of each month, for ten years—Continued.

Month.	1901-1902.	1902-1903.	1903-1904.	1904-1905.	1905-1906.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
July	747,000	442,000	926,000	938,000	920,000
August	753,000	328,000	867,000	968,000	823,000
September	1,864,000	903,000	866,000	1,233,000	1,081,000
October	2,440,000	1,362,000	1,259,000	1,686,000	1,627,000
November	2,863,000	1,828,000	1,509,000	2,055,000	2,251,000
December	3,463,000	2,159,000	1,744,000	2,525,000	2,703,000
January	3,257,000	2,454,000	1,833,000	2,504,000	2,990,000
February	3,270,000	2,354,000	1,746,000	2,259,000	2,857,000
March	2,972,000	2,273,000	1,717,000	1,961,000	2,723,000
April	2,639,000	1,688,000	1,483,000	1,554,000	2,452,000
May	1,910,000	1,879,000	1,554,000	1,336,000	1,954,000
June	950,000	2,027,000	1,186,000	1,064,000	....

Acreage, production, value, prices, and exports of rye of the United States, 1866–1905.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1.	Farm value, Dec. 1.	Chicago cash price per bushel, No. 2. December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports, including rye flour, fiscal years beginning July 1.
	Acres.	*Bush.*	*Bushels.*	*Cents.*	*Dollars.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Bushels.*
1866	1,548,023	13.5	20,864,944	82.2	17,149,716	......	......	142	150	234,971
1867	1,689,175	13.7	23,184,000	100.4	23,280,584	132	157	173	185	564,901
1868	1,651,321	13.6	22,504,800	94.9	21,349,190	106½	118	100	115½	92,869
1869	1,657,584	13.6	22,527,900	77.0	17,341,861	66	77½	78	[illegible]	199,450
1870	1,176,137	13.2	15,473,600	73.2	11,326,967	67	74	[illegible]	91	87,174
1871	1,069,531	14.4	15,365,500	71.1	10,927,623	62	63¾	75	93	832,689
1872	1,048,654	14.2	14,888,600	67.6	10,071,061	57½	70	68½	70	611,749
1873	1,150,355	13.2	15,142,000	70.3	10,638,258	70	81	91	102	1,923,404
1874	1,116,716	13.4	14,990,900	77.4	11,610,339	93	99½	103	107½	267,058
1875	1,359,788	13.0	17,722,100	67.1	11,894,223	67	68¾	61½	70½	589,159
1876	1,468,374	13.9	20,374,800	61.4	12,504,970	65½	73	70	92½	2,234,856
1877	1,412,902	15.0	21,170,100	57.6	12,201,759	55½	56½	54	60	4,249,684
1878	1,622,700	15.9	25,842,790	52.5	13,566,002	44	44½	47	52	4,877,821
1879	1,625,450	14.5	23,639,460	65.6	15,507,431	73½	81	73½	85	2,943,894
1880	1,767,619	13.9	24,540,829	75.6	18,564,560	82	91½	115	118	1,955,155
1881	1,789,100	11.6	20,704,950	93.3	19,327,415	96½	98	77	83	1,003,609
1882	2,227,894	13.4	29,960,037	61.5	18,439,194	57	58½	62	67	2,206,212
1883	2,314,754	12.1	28,058,582	58.1	16,300,503	56½	60	60⅛	62½	6,247,590
1884	2,343,963	12.2	28,640,000	51.9	14,857,040	51	52	68	73	2,974,390
1885	2,129,301	10.2	21,756,000	57.9	12,594,820	58½	61	58	61	216,699
1886	2,129,918	11.5	24,489,000	53.8	13,181,330	53	54½	54½	56½	377,302
1887	2,053,447	10.1	20,693,000	54.5	11,283,140	55½	61½	63	68	94,827
1888	2,364,805	12.0	28,415,000	58.8	16,721,869	50	52	39	41½	309,266
1889	2,171,493	13.1	28,420,299	42.3	12,009,752	44	45½	49½	54	2,280,975
1890	2,141,853	12.0	25,807,472	62.9	16,229,992	64½	68½	83	92	358,263
1891	2,176,466	14.6	31,751,868	77.4	24,589,217	86	92	70¼	79	12,068,628
1892	2,163,657	12.9	27,978,824	54.2	15,160,056	46	51	50½	62	1,493,924
1893	2,038,485	13.0	26,555,446	51.3	13,612,222	45	47½	44½	48	249,152
1894	1,944,780	13.7	26,727,615	50.1	13,395,476	47½	49	62½	67	32,045
1895	1,890,345	14.4	27,210,070	44.0	11,964,826	32	35¾	33	36½	1,011,128
1896	1,831,201	13.3	24,369,047	40.9	9,960,769	37	42½	32¾	35½	8,575,667
1897	1,703,561	16.1	27,363,324	44.7	12,239,647	45¾	47	48	75	15,562,035
1898	1,643,207	15.6	25,657,522	46.3	11,875,350	52½	55½	56½	62	10,169,822
1899	1,659,308	14.4	23,961,741	51.0	12,214,118	49	52	53	56¼	2,382,012
1900	1,591,362	15.1	23,995,927	51.2	12,295,417	45¾	49¾	51½	54	2,345,512
1901	1,987,505	15.3	30,344,830	55.7	16,909,742	59	65¾	54½	58	2,712,077
1902	1,978,548	17.0	33,630,592	50.8	17,080,793	48	49¾	48	50½	5,445,273
1903	1,906,894	15.4	29,363,416	54.5	15,993,871	50½	52½	69¾	78	784,068
1904	1,792,673	15.2	27,241,515	68.8	18,748,323	73	75	70	84	29,749
1905	1,730,159	16.5	28,485,952	61.1	17,414,138	64	68	......	......	....

Acreage, production, and value of rye in the United States in 1905, by States.

State or Territory.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*
Vermont	1,772	15.0	26,580	65	17,277
Massachusetts	3,938	15.5	61,039	79	48,221
Connecticut	10,464	18.0	188,352	74	139,380
New York	135,374	16.0	2,165,984	67	1,451,209
New Jersey	78,363	18.0	1,410,534	66	930,952
Pennsylvania	346,265	17.0	5,886,505	65	3,826,228
Delaware	1,069	10.0	10,690	66	7,055
Maryland	20,741	14.5	300,744	65	195,484
Virginia	17,642	11.8	208,176	71	147,805
North Carolina	17,334	9.5	164,673	86	141,619
South Carolina	4,226	8.1	34,231	119	40,735
Georgia	14,206	7.7	109,386	109	119,231
Alabama	1,743	11.7	20,393	114	23,248
Texas	4,635	14.0	64,890	85	55,156
Arkansas	2,075	12.0	24,900	93	23,157
Tennessee	10,346	12.1	125,187	77	96,394
West Virginia	11,808	11.8	139,334	70	97,534
Kentucky	11,861	15.0	177,915	71	126,320
Ohio	11,686	18.0	210,348	62	130,416
Michigan	134,100	16.0	2,145,600	59	1,265,904
Indiana	27,535	15.4	424,039	60	254,423
Illinois	71,471	18.0	1,286,478	60	771,887
Wisconsin	290,682	16.5	4,796,253	59	2,829,789
Minnesota	87,572	18.2	1,593,810	53	844,719
Iowa	56,678	17.5	991,865	53	525,688
Missouri	17,481	15.5	270,956	62	167,993
Kansas	66,815	15.7	1,048,996	54	566,458
Nebraska	125,611	18.0	2,260,998	48	1,085,279
South Dakota	31,812	19.0	604,428	49	296,170
North Dakota	21,284	19.5	415,038	50	207,519
Montana	1,871	20.0	37,420	65	24,323
Wyoming	428	23.0	9,844	62	6,103
Colorado	2,368	19.0	44,992	56	25,196
Utah	3,701	18.0	66,618	65	43,302
Idaho	1,500	25.0	37,500	56	21,000
Washington	2,625	18.5	48,562	70	33,993
Oregon	10,690	15.0	160,350	81	129,884
California	67,402	13.0	876,226	77	674,694
Oklahoma	2,985	12.1	35,118	62	22,393
United States	1,730,159	16.5	28,485,952	61.1	17,414,138

Condition of the rye crop of the United States, monthly, 1888–1906.

Year.	December of previous year.	April.	May.	June.	July.	August.	When harvested.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1888	96.0	93.5	92.9	93.9	95.1	91.4	92.8
1889	97.2	93.9	96.5	95.2	96.7	95.4	91.6
1890	96.4	92.8	93.5	92.3	92.0	86.8	85.4
1891	99.0	95.4	97.2	95.4	93.9	89.6	95.1
1892	88.8	87.0	88.9	91.0	92.8	89.8	88.5
1893	89.4	85.7	82.7	84.6	85.3	78.5	82.0
1894	94.6	94.4	90.7	93.2	87.0	79.8	86.9
1895	96.2	87.0	88.7	85.7	80.7	84.0	83.7
1896	94.9	82.9	87.7	85.2	83.8	88.0	82.0
1897	99.8	88.9	88.0	89.9	93.4	89.8	90.1
1898	....	92.1	94.5	97.1	94.6	93.7	89.4
1899	98.9	84.9	85.2	84.5	84.9	89.0	82.0
1900	98.2	84.8	88.5	87.6	84.0	76.0	84.2
1901	99.1	93.1	94.1	93.9	93.5	83.6	84.9
1902	89.9	85.4	83.4	88.1	90.3	90.5	90.2
1903	98.1	97.9	93.3	90.6	89.3	87.2	84.1
1904	92.7	82.3	81.2	86.3	89.1	91.8	86.9
1905	90.5	92.1	93.5	95.3	92.9	92.6	90.8
1906	95.4	90.9	93.0	....	....	....	....

Average yield per acre of rye in the United States, 1896–1905, by States.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	18.0	13.5	18.0	15.0	17.2	......	......	......	......	......
New Hampshire	19.6	18.0	17.5	15.0	17.1	......	......	......	......	......
Vermont	18.6	16.0	19.1	17.0	16.5	18.3	16.9	19.4	16.9	15.9
Massachusetts	22.0	19.5	16.7	16.0	16.9	15.9	15.2	13.7	17.0	15.5
Connecticut	15.4	19.0	18.0	18.0	17.0	18.0	17.4	17.0	16.9	18.0
New York	14.3	18.5	17.5	16.0	15.1	14.9	17.5	15.2	14.8	16.0
New Jersey	13.8	17.0	15.5	15.0	15.9	15.0	16.4	13.8	17.5	18.0
Pennsylvania	16.0	19.0	16.1	15.0	15.3	15.9	16.0	15.6	15.5	17.0
Delaware	......	......	......	......	......	15.3	13.5	14.8	11.8	10.0
Maryland	9.2	17.0	14.5	14.0	16.5	14.4	14.0	13.7	14.8	14.5
Virginia	10.0	11.0	11.2	9.0	10.5	11.1	9.6	12.2	15.7	11.8
North Carolina	7.5	8.8	9.1	7.0	8.9	8.5	8.2	8.8	9.9	9.5
South Carolina	4.8	6.6	8.5	5.0	7.5	7.7	7.6	7.6	7.5	8.1
Georgia	7.1	7.4	8.0	6.0	7.0	7.6	6.3	7.9	8.3	7.7
Alabama	8.0	9.6	11.1	8.0	7.8	8.0	10.0	10.6	10.4	11.7
Texas	7.0	12.0	12.0	10.0	16.5	11.1	9.9	14.2	13.1	14.0
Arkansas	10.0	11.0	11.4	11.0	11.5	8.7	12.3	9.7	11.1	12.0
Tennessee	9.0	10.0	10.5	9.0	11.0	11.3	11.0	13.4	11.7	12.1
West Virginia	10.6	11.5	11.2	10.0	10.5	12.0	8.1	11.5	12.5	11.8
Kentucky	11.0	13.0	13.0	10.0	13.1	14.0	13.4	11.6	13.7	15.0
Ohio	9.6	18.0	17.4	16.0	16.6	16.9	17.5	15.3	16.1	18.0
Michigan	9.2	15.0	15.3	14.0	14.6	14.0	17.9	15.5	13.2	16.0
Indiana	10.6	13.0	15.5	13.0	15.1	14.5	14.5	12.6	14.6	15.4
Illinois	15.3	15.5	14.8	15.0	17.2	17.0	19.1	16.5	17.6	18.0
Wisconsin	14.5	16.0	15.3	15.0	15.8	15.9	18.9	16.6	16.2	16.5
Minnesota	15.6	17.2	20.5	18.0	19.5	19.3	22.3	18.4	17.7	18.2
Iowa	17.5	16.0	19.0	18.0	18.0	18.4	17.4	16.9	17.2	17.5
Missouri	12.2	12.0	13.1	13.0	14.0	14.2	18.2	12.8	14.4	15.5
Kansas	7.0	14.0	15.6	11.0	15.2	14.3	12.0	16.2	13.2	15.7
Nebraska	16.9	17.0	18.8	16.0	14.2	15.0	20.3	14.2	15.8	18.0
South Dakota	11.6	16.5	16.6	15.0	10.6	14.4	18.8	20.2	16.5	19.0
North Dakota	12.0	14.5	15.0	15.0	5.2	13.8	20.2	15.7	18.5	19.5
Montana	......	......	......	......	......	26.7	25.0	24.6	19.9	20.0
Wyoming	......	......	......	......	......	24.0	18.0	18.0	19.5	23.0
Colorado	23.5	15.0	18.0	14.0	16.8	16.1	15.9	18.3	19.1	19.0
Utah	20.0	12.0	19.5	17.0	17.5	14.2	12.4	16.1	16.0	18.0
Idaho	......	......	......	......	......	15.0	20.2	18.5	19.7	25.0
Washington	15.0	19.5	18.0	16.0	16.3	17.5	17.8	21.0	19.0	18.5
Oregon	12.7	15.0	14.4	11.0	16.1	15.7	13.4	14.2	14.4	15.0
California	14.3	12.2	9.0	15.0	13.0	12.8	12.0	12.3	7.6	13.0
Oklahoma	......	......	......	......	......	14.8	16.0	17.9	9.4	12.1
General average	13.3	16.1	15.6	14.4	15.1	15.3	17.0	15.4	15.2	16.5

Average yield of rye in certain countries, in bushels per acre, 1895–1904.

Year.	United States.	Russia.	Germany.	Austria.	Hungary.	France.	Ireland.
	(*a*)	(*b*)	(*b*)	(*b*)	(*b*)	(*a*)	(*b*)
1895	14.4	11.6	20.9	14.5	16.7	18.8	26.8
1896	13.3	10.9	22.7	16.3	18.2	18.7	25.4
1897	16.1	9.3	21.8	13.9	13.5	13.4	21.6
1898	15.6	10.5	24.2	17.7	16.9	18.3	25.8
1899	14.4	12.8	23.6	18.7	17.7	18.2	25.8
1900	15.1	12.5	22.9	13.0	15.1	16.9	25.6
1901	15.3	14.0	22.4	16.9	15.8	16.7	27.4
1902	17.0	12.5	24.5	18.2	19.1	14.3	28.0
1903	15.4	12.2	26.3	18.2	18.2	18.1	26.9
1904	15.2	13.7	26.3	19.3	17.1	16.6	26.0
Average	15.2	12.0	23.6	16.7	16.8	17.0	25.9

a Winchester bushels. *b* Bushels of 56 pounds.

Average value per acre of rye in the United States, based upon farm value December 1, 1896–1905, by States.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
Maine	$12.06	$11.07	$15.12	$12.60	$14.10	......	......	......	......	......
New Hampshire	14.11	15.12	13.12	12.15	14.02	......	......	......	......	......
Vermont	12.09	9.60	11.08	10.54	10.13	$14.64	$13.01	$12.61	$12.51	$9.75
Massachusetts	15.40	11.90	10.52	12.64	12.68	12.56	12.16	10.00	13.94	12.25
Connecticut	8.78	11.21	10.80	11.52	11.05	12.96	13.05	12.07	13.35	13.32
New York	6.29	8.88	8.75	8.96	8.46	9.24	10.15	9.27	10.80	10.72
New Jersey	6.49	8.50	7.75	8.25	8.74	8.85	10.00	8.83	12.25	11.88
Pennsylvania	7.52	8.17	7.57	7.65	8.11	9.54	8.48	9.67	11.01	11.05
Delaware	......	......	......	......	......	8.87	8.37	9.03	8.61	6.60
Maryland	4.42	7.82	7.83	7.98	8.58	8.06	8.12	8.08	11.25	9.43
Virginia	4.80	5.50	5.15	4.77	6.09	6.77	6.34	8.05	11.62	8.38
North Carolina	5.32	5.28	5.82	5.25	6.76	6.63	6.97	7.39	8.61	8.17
South Carolina	4.18	5.68	8.67	5.45	7.87	8.55	8.59	8.13	9.45	9.64
Georgia	7.17	6.81	7.84	6.72	7.21	8.06	6.93	9.01	8.47	8.39
Alabama	7.04	11.33	11.65	8.32	8.03	8.32	10.50	11.45	12.48	13.34
Texas	4.69	8.64	8.52	8.20	11.05	10.32	7.52	10.51	11.27	11.90
Arkansas	7.00	9.46	7.41	8.14	8.28	7.74	8.98	8.15	9.77	11.16
Tennessee	5.40	5.80	5.56	6.03	7.48	8.36	8.03	9.92	9.24	9.32
West Virginia	5.94	5.87	5.82	6.20	6.72	7.80	5.51	8.17	9.63	8.26
Kentucky	5.94	6.89	7.15	7.00	8.25	9.38	8.31	8.00	10.96	10.65
Ohio	3.74	7.92	7.83	8.80	9.13	9.30	9.27	8.87	11.91	11.16
Michigan	2.94	6.30	6.58	7.28	7.01	7.28	8.77	7.90	9.50	9.44
Indiana	3.82	5.46	6.67	6.24	7.55	7.68	6.67	6.68	10.07	9.24
Illinois	5.20	6.82	6.51	7.05	8.08	9.69	9.55	8.58	12.32	10.80
Wisconsin	4.82	6.56	6.58	7.20	7.74	8.27	9.45	8.30	11.18	9.73
Minnesota	4.68	6.36	7.79	7.56	8.19	9.46	9.59	8.28	11.33	9.65
Iowa	5.08	5.76	7.60	7.20	7.38	9.20	7.31	7.44	10.32	9.27
Missouri	5.73	5.28	6.16	6.50	7.14	9.51	8.74	7.04	9.22	9.61
Kansas	2.45	5.60	5.77	4.62	6.54	7.87	5.40	7.13	8.58	8.48
Nebraska	3.72	5.44	6.39	6.08	5.68	6.90	7.31	5.25	8.69	8.64
South Dakota	3.13	5.78	5.64	5.55	4.13	6.19	7.71	8.08	9.41	9.31
North Dakota	2.64	5.22	5.40	5.55	2.13	5.93	8.69	6.75	11.10	9.75
Montana	......	......	......	......	......	16.02	16.00	15.50	15.32	13.00
Wyoming	......	......	......	......	......	19.20	9.00	12.42	7.80	14.26
Colorado	14.57	7.80	9.00	6.72	9.07	9.98	8.90	11.16	12.41	10.64
Utah	8.00	7.20	8.97	8.16	9.10	9.23	7.56	10.46	10.72	11.70
Idaho	......	......	......	......	......	10.05	12.12	12.02	14.77	14.00
Washington	7.50	12.09	10.44	9.60	9.45	10.85	11.39	15.12	15.01	12.95
Oregon	7.62	8.85	10.37	7.70	9.82	10.36	9.78	13.77	12.82	12.15
California	8.70	7.93	6.30	11.70	7.54	7.30	9.00	9.47	5.93	10.01
Oklahoma	......	......	......	......	......	10.36	7.52	8.95	5.83	7.50
General average	5.44	7.18	7.23	7.36	7.73	8.51	8.63	8.39	10.46	10.07

Average farm price of rye per bushel in the United States December 1, 1896–1905, by States.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	67	82	84	84	82	......	......	......	......	......
New Hampshire	72	84	75	81	82	......	......	......	......	......
Vermont	65	60	58	62	61	80	70	65	74	65
Massachusetts	70	61	63	79	75	79	80	73	82	79
Connecticut	57	59	60	64	65	72	75	71	79	74
New York	44	48	50	56	56	62	58	61	73	67
New Jersey	47	50	50	55	55	59	61	64	70	66
Pennsylvania	47	43	47	51	53	60	53	62	71	65
Delaware	......	......	......	......	......	58	62	61	73	66
Maryland	48	46	54	57	52	56	58	59	76	65
Virginia	48	50	46	53	58	61	66	66	74	71
North Carolina	71	60	64	75	76	78	85	84	87	86
South Carolina	87	86	102	109	105	111	113	107	126	119
Georgia	101	92	98	112	103	106	110	114	102	109
Alabama	88	118	105	104	103	104	105	108	120	114
Texas	67	72	71	82	67	93	76	74	86	85
Arkansas	70	86	65	74	72	89	73	84	88	93
Tennessee	60	58	53	67	68	74	73	74	79	77
West Virginia	56	51	52	62	64	65	68	71	77	70
Kentucky	54	53	55	70	63	67	62	69	80	71
Ohio	39	44	45	55	55	55	53	58	74	62
Michigan	32	42	43	52	48	52	49	51	72	59
Indiana	36	42	43	48	50	53	46	53	69	60
Illinois	34	44	44	47	47	57	50	52	70	60
Wisconsin	33	41	43	48	49	52	50	50	69	59
Minnesota	30	37	38	42	42	49	43	45	64	53
Iowa	29	36	40	40	41	50	42	44	60	53

Average farm price of rye per bushel in the United States December 1, 1896–1905, by States—Continued.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Missouri	47	44	47	50	51	67	48	55	64	62
Kansas	35	40	37	42	43	55	45	44	65	54
Nebraska	22	32	34	38	40	46	36	37	55	48
South Dakota	27	35	34	37	39	43	41	40	57	49
North Dakota	22	36	36	37	41	43	43	43	60	50
Montana	......	......	......	......	......	60	64	63	77	65
Wyoming	......	......	......	......	......	80	50	69	40	62
Colorado	62	52	50	48	51	62	56	61	65	56
Utah	40	60	46	48	52	65	61	65	67	65
Idaho	......	......	......	......	......	67	60	65	75	56
Washington	50	62	58	60	58	62	64	72	79	70
Oregon	60	59	72	70	61	66	73	97	89	81
California	60	65	70	78	58	57	75	77	78	77
Oklahoma	......	......	......	......	......	70	47	50	62	62
General average	40.9	44.7	46.3	51.0	51.2	55.7	50.8	54.5	68.8	61.1

Wholesale prices of rye per bushel in leading cities of the United States, 1901–1905.

Date.	Philadelphia.		Cincinnati.		Chicago.		Duluth.		San Francisco (per cwt.).	
			No. 2.		No. 2.					
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1901.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	60	62¾	53	58½	47½	49¾	48	50	85	87½
February	63	65½	56	59	48½	50¼	49¼	50½	80	87½
March	59	62¾	55	59	49½	51½	50¼	51¼	80	82½
April	58½	62½	54	58½	48¾	53	49¾	53	80	82½
May	......	......	57	62	51½	54	51	53	80	81¼
June	......	......	55	61	46¾	53	46½	51½	77½	81¼
July	......	......	45	55½	47	57	46½	53½	77½	80
August	59	60	52½	64	52	60	50	57¼	75	80
September	58	59¾	56½	60	52½	56	50	57¼	75	77½
October	58	61	56½	59½	53¼	56	50½	52½	75	77½
November	61½	68½	57	65½	54½	61	52½	57¼	75	77½
December	69½	71½	64½	73	59	65¾	57½	62½	75	80
1902.										
January	69	71	66	71½	56	67½	54	64	77½	90
February	68	70	64	67	56	60½	53	57½	87½	90
March	65	69	63	65	54½	58	52	54½	87½	95
April	64½	67	62	64	54½	57½	52	56	92½	95
May	64	66	60	63½	54½	58	54	57	92½	95
June	......	......	54	59	56¾	58	55¼	56½	92½	95
July	58	59	55½	58	52¼	61½	51¼	58	85	95
August	56	58½	51	56	48	54	46	51	85	90
September	57½	59	52½	55½	49	50½	47½	49	85	105
October	55½	58½	52	53	48	50½	47	49	102½	110
November	56	58½	51	54	48½	51½	49	49¾	105	110
December	54	58½	51	56	48	49¾	48	49¾	105	115
1903.										
January	57	61½	55½	59	48	50¼	48	49	112½	115
February	61	65½	57½	58½	48¾	51½	48	49	112½	117
March	61	63	56	58½	48¾	51½	49	49½	110	117½
April	59	60¾	55	58	48	51	49	50½	110	115
May	58	60	54	58	48	50½	49½	50	110	115
June	56	58	57	58	49	53¾	50	52	110	116¼
July	58½	60¼	56	57½	49½	51½	48½	50½	115	120
August	......	......	55	60	50½	53½	50½	52½	117½	125
September	62	65½	59½	63	53	60	50½	55¼	120	130
October	64	66	61	63	53	56½	52	54	125	130
November	63½	68	58	62	51½	58¼	52	54	125	130
December	67½	68½	59	62½	50½	52½	51	52½	125	130
1904.										
January	69	72	61	64	51	57	54½	57	125	130
February	72	74	63	81	56	77	58	73	127	135
March	......	......	76	80	66½	76	63	71	130	135
April	......	......	74	78	66	72	64	68½	130	135
May	......	......	75	80	69¾	78	65	69	130	135
June	78	80	76	80	63½	75	55	67	130	135
July	65	72	73	78	63	75	55	80	125	130

Wholesale prices of rye per bushel in leading cities of the United States, 1901–1905—Continued.

Date.	Philadelphia.		Cincinnati.		Chicago.		Duluth.		San Francisco (per cwt.).	
			No. 2.		No. 2.					
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1904.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
August	....	....	70	76½	62	76	62	75	125	132½
September	85	87½	75	83	69½	75	72	77	127½	140
October	88½	96	81	87	75	79½	77	79¼	137½	140
November	89	91	83	87	76	81	74	80	137½	145
December	80½	87½	81	86	73	75	71	74	140	147½
1905.										
January	81	87½	80	86	74½	75½	72½	75	142½	150
February	80	90¼	81½	86	74	78	73	75	145	160
March	80	83½	84	87	75	78½	73½	78	150	160
April	79½	83	80	86	73	78½	74	77	150	165
May	....	....	80	83	70	84	70	78	155	165
June	72	75	80	83	75	79	70	78	160	175
July	63	66	60	83	58	75	57½	72	140	150
August	65¾	69½	56	60	57½	60	55½	58	147½	152½
September	70	76½	56	66	60	72	59	64	150	152½
October	73¼	76	67	74	67	73½	63	65	145	152½
November	68	73	70	74½	66	72½	62	66½	145	147½
December	66½	73	70	72	64	68	62	60	145	150

BUCKWHEAT.

Condition of the buckwheat crop of the United States, monthly, 1887–1905.

Year.	Aug.	Sept.	When harvested.	Year.	Aug.	Sept.	When harvested.	Year.	Aug.	Sept.	When harvested.
	P. ct.	*P. ct.*	*P. ct.*		*P. ct.*	*P. ct.*	*P. ct.*		*P. ct.*	*P. ct.*	*P. ct.*
1887	93.3	89.1	76.6	1894	82.3	69.2	72.0	1900	87.9	80.5	72.8
1888	92.5	93.7	79.1	1895	85.2	87.5	84.8	1901	91.1	90.9	90.5
1889	95.2	92.1	90.0	1896	96.0	93.2	86.0	1902	91.4	86.4	80.5
1890	90.1	90.5	90.7	1897	94.9	95.1	90.8	1903	93.9	91.0	83.0
1891	97.3	96.6	92.7	1898	87.2	88.8	76.2	1904	92.8	91.5	88.7
1892	92.9	89.0	85.6	1899	93.2	75.2	70.2	1905	92.6	91.8	91.6
1893	88.8	77.5	73.5								

Acreage, production, value, and prices of buckwheat in the United States, 1866–1905.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*
1866	1,045,624	21.8	22,791,839	67.6	15,413,160
1867	1,227,826	17.4	21,359,000	78.7	16,812,070
1868	1,113,993	17.8	19,863,700	78.0	15,490,426
1869	1,028,693	16.9	17,431,100	71.9	12,534,851
1870	536,992	18.3	9,841,500	70.5	6,937,471
1871	413,915	20.1	8,328,700	74.5	6,208,165
1872	448,497	18.1	8,133,500	73.5	5,979,222
1873	454,152	17.3	7,837,700	75.0	5,878,629
1874	452,590	17.7	8,016,600	72.9	5,843,645
1875	575,530	17.5	10,082,100	62.0	6,254,564
1876	666,441	14.5	9,668,800	66.6	6,435,836
1877	649,923	15.7	10,177,000	66.9	6,808,180
1878	673,100	18.2	12,246,820	52.6	6,441,240
1879	639,900	20.5	13,140,000	59.8	7,856,191
1880	822,802	17.8	14,617,535	59.4	8,682,488
1881	828,815	11.4	9,486,200	86.5	8,205,705
1882	847,112	13.0	11,019,353	73.0	8,038,862
1883	857,349	8.9	7,668,954	82.2	6,303,980
1884	879,403	12.6	11,116,000	58.9	6,549,020

Acreage, production, value, and prices of buckwheat in the United States, 1866–1905—Continued.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1.	Farm value Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*
1885	914,394	13.8	12,626,000	55.9	7,057,363
1886	917,915	12.9	11,8[illegible]9,000	54.5	6,465,120
1887	910,506	11.9	10,844,000	56.5	6,122,320
1888	912,630	13.2	12,050,000	63.3	7,627,647
1889	837,162	14.5	12,110,329	50.5	6,113,119
1890	844,579	14.7	12,432,831	57.4	7,[illegible]32,872
1891	849,364	15.0	12,760,932	57.0	7,271,506
1892	861,451	14.1	12,143,185	51.8	6,295,643
1893	815,614	14.9	12,122,311	58.4	7,074,450
1894	789,232	16.1	12,668,200	55.6	7,040,238
1895	763,277	20.1	15,341,399	45.2	6,936,325
1896	754,898	18.7	14,089,783	39.2	5,522,339
1897	717,836	20.9	14,997,451	42.1	6,319,188
1898	678,332	17.3	11,721,927	45.0	5,271,462
1899	670,148	16.6	11,094,473	55.7	6,183,675
1900	637,930	15.0	9,566,966	55.8	5,341,413
1901	811,164	18.6	15,125,939	56.3	8,523,317
1902	804,889	18.1	14,529,770	59.6	8,654,704
1903	804,393	17.7	14,243,644	60.7	8,650,733
1904	793,625	18.9	15,008,336	62.2	9,330,768
1905	760,118	19.2	14,585,082	58.7	8,565,499

Acreage, production, and value of buckwheat in the United States in 1905, by States.

State.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*
Maine	23,013	30.0	690,390	65	448,754
New Hampshire	1,932	23.0	44,436	71	31,550
Vermont	8,027	19.0	152,513	51	77,782
Massachusetts	2,407	20.0	48,140	71	34,179
Connecticut	3,454	16.0	55,264	73	40,343
New York	331,497	19.0	6,298,443	59	3,716,081
New Jersey	11,835	21.0	248,535	63	156,577
Pennsylvania	232,398	20.0	4,647,960	56	2,602,858
Delaware	1,416	17.0	24,072	57	13,721
Maryland	8,124	19.0	154,356	63	97,244
Virginia	18,637	18.0	335,466	62	207,989
North Carolina	5,776	15.0	86,640	66	57,182
Tennessee	532	16.0	8,512	68	5,788
West Virginia	21,131	19.0	401,489	66	264,983
Ohio	8,170	17.0	138,890	62	86,112
Michigan	33,332	16.0	533,312	53	282,655
Indiana	5,018	17.0	85,306	65	55,449
Illinois	4,208	16.0	67,328	68	45,783
Wisconsin	23,158	15.0	347,370	56	194,527
Minnesota	4,538	14.0	63,532	57	36,213
Iowa	7,294	13.0	94,822	70	66,375
Missouri	1,853	16.0	29,648	82	24,311
Kansas	1,498	11.0	16,478	69	11,370
Nebraska	870	14.0	12,180	63	7,673
United States	760,118	19.2	14,585,082	58.7	8,565,499

Average yield per acre of buckwheat in the United States, 1896–1905, by States.

State.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	42.3	35.0	26.5	22.0	30.0	31.7	30.4	29.8	32.5	30.0
New Hampshire	27.2	27.0	20.0	20.0	22.0	21.0	20.0	19.6	25.1	23.0
Vermont	31.4	24.0	21.4	23.0	25.0	25.1	25.0	24.0	26.3	19.0
Massachusetts	18.3	19.0	20.0	20.0	17.0	18.9	14.4	13.7	16.2	20.0
Connecticut	14.2	17.0	19.0	19.0	16.0	18.0	18.4	17.5	16.3	16.0
New York	18.8	22.0	16.8	13.0	11.0	18.8	17.7	18.3	18.8	19.0
New Jersey	20.7	16.0	21.0	21.0	16.0	19.0	22.5	18.1	20.8	21.0
Pennsylvania	17.3	21.0	17.2	20.0	14.0	19.5	18.1	16.5	18.8	20.0
Delaware	20 0	19.0	16.5	18.0	13.0	17.8	15.2	15.2	12.1	17.0
Maryland	22.7	19.0	12.2	13.0	15.0	17.5	17.0	16.3	18.2	19.0
Virginia	18.0	14.0	17.3	14.0	13.0	15.9	16.6	18.6	17.0	18.0
North Carolina	20.0	11.0	19.5	17.0	13.0	15.6	14.5	12.1	14.7	15.0
Tennessee	24.0	18.0	18.0	12.0	14.0	14.2	18.0	14.7	15.5	16.0
West Virginia	19.5	19.0	20.5	17.0	17.0	20.6	22.5	17.2	19.1	19.0
Ohio	18.8	18.0	20.0	16.0	16.0	16.1	13.9	16.6	16.9	17.0
Michigan	15.3	17.0	14.2	11.0	14.0	14.1	13.0	15.5	15.4	16.0
Indiana	24.0	14.0	18.4	16.0	14.0	13.1	17.6	16.8	16.1	17.0
Illinois	13.8	13.0	14.0	15.0	15.0	11.0	15.5	15.3	17.9	16.0
Wisconsin	13.5	18.0	15.5	15.0	14.0	12.4	16.0	15.6	17.7	15.0
Minnesota	10.6	17.0	15.0	17.0	15.0	14.5	13.9	15.2	15.1	14.0
Iowa	16.2	17.0	16.0	16.0	15.0	13.5	16.0	15.1	14.8	13.0
Missouri	21.8	15.0	15.8	14.0	13.0	6.0	16.0	14.8	13.5	16.0
Kansas	......	......	......	......	......	7.9	12.0	18.4	14.0	11.0
Nebraska	21.3	14.0	12.8	16.0	16.0	11.5	14.7	19.0	14.7	14.0
North Dakota	......	......	......	......	......	11.5	10.0	12.7	13.5	......
Oregon	21.0	18.0	14.0	17.0	13.0	......	......	......	......	......
General average	18.7	20.9	17.3	16.6	15.0	18.6	18.1	17.7	18.9	19.2

Average value per acre of buckwheat in the United States, based upon farm value December 1, 1896–1905, by States.

State.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
Maine	$16.07	$15.40	$10.34	$9.68	$14.70	$15.22	$15.81	$15.20	$16.90	$19.50
New Hampshire	17.20	14.85	9.40	10.00	11.44	11.55	13.00	11.56	17.07	16.33
Vermont	12.56	11.04	9.84	11.96	12.50	14.81	14.00	13.20	14.73	9.69
Massachusetts	9.70	12.54	12.20	14.00	12.24	11.53	10.66	9.32	11.66	14.20
Connecticut	7.24	9.69	10.64	11.97	10.40	11.70	13.06	12.42	11.90	11.68
New York	6.96	8.80	7.56	7.67	7.98	10.72	10.44	10.80	11.47	11.21
New Jersey	8.07	7.84	11.34	11.76	9.44	9.88	14.40	11.58	13.73	13.23
Pennsylvania	6.57	8.82	7.57	10.80	7.70	10.92	11.04	10.56	11.84	11.20
Delaware	6.00	6.84	6.60	8.82	6.76	9.79	9.12	8.36	7.50	9.69
Maryland	11.12	9.69	6.47	7.28	8.55	10.50	10.37	10.27	11.47	11.97
Virginia	8.46	7.00	7.79	7.56	7.15	8.90	9.96	11.35	10.88	11.16
North Carolina	12.00	5.39	9.36	8.33	7.28	9.67	8.99	7.86	10.44	9.90
Tennessee	14.88	10.26	9.36	6.84	8.26	8.38	13.68	9.70	11.01	10.88
West Virginia	9.75	9.31	10.05	9.52	9.52	12.15	13.95	11.70	13.75	12.54
Ohio	8.08	9.00	10.20	9.28	9.28	9.66	8.48	10.79	12.17	10.54
Michigan	5.81	6.46	5.96	6.05	7.14	7.19	6.89	8.37	9.39	8.48
Indiana	12.24	6.36	9.38	9.44	8.54	7.99	10.21	11.76	11.27	11.05
Illinois	6.21	7.41	7.28	8.70	9.75	7.70	11.01	11.17	13.96	10.88
Wisconsin	5.13	6.84	6.20	9.45	8.26	7.32	9.44	9.52	11.15	8.40
Minnesota	4.35	7.65	7.35	8.84	8.55	8.99	7.92	8.06	9.06	7.98
Iowa	7.45	8.33	7.69	9.28	9.60	9.45	11.20	10.72	9.92	9.10
Missouri	15.26	9.00	9.48	8.54	8.97	4.56	9.34	11.10	11.48	13.12
Kansas	......	......	......	......	......	5.92	9.00	14.35	11.20	7.59
Nebraska	10.65	7.14	7.81	9.92	10.24	6.67	7.79	13.11	13.38	8.82
North Dakota	......	......	......	......	......	6.90	5.40	6.73	9.45	......
Oregon	14.28	9.90	8.12	12.58	10.01	......	......	......	......	......
General average	7.32	8.80	7.77	9.23	8.37	10.51	10.75	10.75	11.76	11.27

Average farm price of buckwheat per bushel in the United States, December 1, 1896–1905, by States.

State.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	38	44	39	44	49	48	52	51	52	65
New Hampshire	63	55	47	50	52	55	65	59	68	71
Vermont	40	46	46	52	50	59	56	55	56	51
Massachusetts	53	66	61	70	72	61	74	68	72	71
Connecticut	51	57	56	63	65	65	71	71	73	73
New York	37	40	45	59	57	57	59	59	61	59
New Jersey	39	49	54	56	59	52	64	64	66	63
Pennsylvania	38	42	41	51	55	56	61	64	63	56
Delaware	30	36	40	49	52	55	60	55	62	57
Maryland	49	51	53	56	57	60	61	63	63	63
Virginia	47	50	45	51	55	56	60	61	64	62
North Carolina	60	49	48	49	56	62	62	65	71	66
Tennessee	62	57	52	57	59	59	76	66	71	68
West Virginia	50	49	49	56	56	59	62	68	72	66
Ohio	43	50	51	58	58	60	61	65	72	62
Michigan	38	38	42	55	51	51	53	54	61	53
Indiana	51	49	51	59	61	61	58	70	70	65
Illinois	45	57	52	58	65	70	71	73	78	68
Wisconsin	38	38	40	63	59	59	59	61	63	56
Minnesota	41	45	49	52	57	62	57	53	60	57
Iowa	46	49	48	58	64	70	70	71	67	70
Missouri	70	60	60	61	69	76	58	75	85	82
Kansas	......	......	......	......	......	75	75	78	80	69
Nebraska	50	51	61	62	64	58	53	69	91	63
North Dakota	......	......	......	......	......	60	54	53	70	......
Oregon	68	55	58	74	77	......	......	......	......	......
General average	39.2	42.1	45.0	55.7	55.8	56.3	59.6	60.7	62.2	58.7

POTATOES.

Potato crop of countries named, 1900–1904.

Country.	1900.	1901.	1902.	1903.	1904.
	Bushels.	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
United States	210,927,000	187,598,000	284,633,000	247,128,000	332,830,000
Canada:					
Ontario	20,674,000	18,688,000	13,350,000	17,202,000	15,967,000
Manitoba	1,981,000	4,949,000	3,568,000	4,907,000	3,919,000
New Brunswick	4,796,000	4,206,000	4,288,000	4,835,000	5,550,000
Other	29,657,000	*a* 30,000,000	*a* 30,000,000	*a* 30,000,000	*a* 30,000,000
Total Canada	57,108,000	57,843,000	51,206,000	56,944,000	55,436,000
Mexico	269,000	336,000	347,000	539,000	*b* 400,000
Newfoundland	1,354,000	*a* 1,350,000	*a* 1,350,000	*a* 1,350,000	*a* 1,350,000
Total North America	269,658,000	247,127,000	337,536,000	305,961,000	390,016,000
Chile	10,000,000	10,000,000	11,616,000	10,849,000	6,131,000
Austria-Hungary:					
Austria	429,974,000	437,110,000	428,229,000	357,121,000	398,298,000
Hungary	178,654,000	176,006,000	154,596,000	184,724,000	119,712,000
Bosnia-Herzegovina	2,377,000	2,893,000	1,793,000	2,322,000	2,450,000
Total Austria-Hungary	611,005,000	616,009,000	584,618,000	544,167,000	520,460,000
Belgium	87,913,000	101,082,000	83,198,000	86,580,000	91,632,000
Denmark	23,332,000	22,002,000	27,168,000	25,256,000	24,214,000
Finland	15,367,000	16,325,000	15,298,000	19,212,000	*b* 16,500,000
France	426,422,000	411,055,000	441,534,000	450,262,000	451,029,000
Germany	1,491,255,000	1,788,950,000	1,596,969,000	1,576,361,000	1,333,326,000
Italy	*c* 29,395,000	*c* 29,395,000	*c* 29,395,000	*c* 29,395,000	*c* 29,395,000
Malta	901,000	264,000	361,000	628,000	733,000
Netherlands	80,415,000	94,910,000	94,756,000	73,394,000	94,421,000
Norway	22,924,000	24,320,000	17,735,000	22,851,000	17,253,000
Roumania	3,482,000	3,819,000	4,659,000	5,246,000	3,001,000

a Estimated from returns for census year. *b* Average production.
c Average, 1896–1900.

Potato crop of countries named, 1900–1904—Continued.

Country.	1900.	1901.	1902.	1903.	1904.
Russia, European:	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*	*Bushels.*
Russia proper	620,523,000	566,926,000	723,435,000	675,330,000	705,170,000
Poland	310,402,000	287,712,000	288,447,000	194,829,000	179,997,000
Northern Caucasia	13,290,000	10,801,000	16,154,000	17,441,000	8,741,000
Total Russia, European	944,215,000	865,439,000	1,028,036,000	887,600,000	893,908,000
Servia	1,047,000	1,237,000	1,402,000	1,527,000	718,000
Spain	a 84,481,000	a 84,481,000	a 84,481,000	a 84,481,000	a 84,481,000
Sweden	57,216,000	43,793,000	51,377,000	59,317,000	51,314,000
United Kingdom:					
Great Britain	102,106,000	137,060,000	119,250,000	108,779,000	133,961,000
Ireland	68,762,000	125,896,000	101,761,000	88,227,000	98,635,000
Total United Kingdom	170,868,000	262,956,000	221,011,000	197,006,000	232,596,000
Total Europe	4,050,238,000	4,366,037,000	4,281,998,000	4,063,283,000	3,844,991,000
Japan	9,890,000	10,153,000	7,418,000	9,824,000	11,274,000
Russia, Asiatic	18,054,000	14,273,000	13,142,000	19,364,000	18,800,000
Total Asia	27,944,000	24,426,000	20,560,000	29,188,000	30,074,000
Algeria	1,210,000	1,673,000	1,851,000	1,596,000	1,655,000
Cape of Good Hope	b 1,239,000	a 1,600,000	a 1,600,000	a 1,600,000	1,942,000
Natal	229,000	316,000	433,000	345,000	451,000
Total Africa	2,678,000	3,589,000	3,884,000	3,541,000	4,048,000
Australasia:					
New South Wales	3,037,000	2,361,000	1,461,000	1,147,000	2,118,000
Victoria	6,473,000	4,597,000	4,684,000	6,300,000	6,262,000
Queensland	847,000	747,000	836,000	122,000	659,000
South Australia	736,000	544,000	562,000	1,057,000	1,173,000
Western Australia	313,000	181,000	214,000	242,000	170,000
Tasmania	3,796,000	3,504,000	4,282,000	6,105,000	6,395,000
Total Commonwealth	15,202,000	11,934,000	12,039,000	14,973,000	16,777,000
New Zealand	6,311,000	7,721,000	7,215,000	7,795,000	5,025,000
Total Australasia	21,513,000	19,655,000	19,254,000	22,768,000	21,802,000
Total	4,382,031,000	4,670,834,000	4,674,848,000	4,435,090,000	4,297,062,000

a Average production. b Crop of 1899.

Condition of the potato crop of the United States, monthly, 1889–1905.

Year.	July.	Aug.	Sept.	Oct.	Year.	July.	Aug.	Sept.	Oct.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*		*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
1889	95.1	94.3	81.7	77.9	1898	95.5	83.9	77.7	72.5
1890	91.7	77.4	65.7	61.7	1899	93.8	93.0	86.3	81.7
1891	95.3	96.5	94.8	91.3	1900	91.3	88.2	80.0	74.4
1892	90.0	86.8	74.8	67.7	1901	87.4	62.3	52.2	54.0
1893	94.8	86.0	71.8	71.2	1902	92.9	94.8	89.1	82.5
1894	92.3	74.0	62.4	64.3	1903	88.1	87.2	84.3	74.6
1895	91.5	89.7	90.8	87.4	1904	93.9	94.1	91.6	89.5
1896	99.0	94.8	83.2	81.7	1905	91.2	87.2	80.9	74.3
1897	87.8	77.9	66.7	61.6					

Acreage, production, value, prices, exports, etc., of potatoes of the United States, 1866–1905.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per bushel, Dec. 1	Farm value, Dec. 1.	Chicago price per bushel, Burbank. December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports, fiscal years beginning July 1.	Imports during fiscal years beginning July 1.
	Acres.	*Bush.*	*Bushels.*	*Cts.*	*Dollars.*	*Cts.*	*Cts.*	*Cts.*	*Cts.*	*Bushels.*	*Bushels.*
1866....	1,069,381	100.2	107,200,976	47.3	50,722,553	......	......	......	......	512,380	198,265
1867....	1,192,195	82.0	97,783,000	65.9	64,462,486	......	......	......	......	378,605	209,555
1868....	1,131,552	93.8	106,090,000	59.3	62,918,660	......	......	......	......	508,249	138,470
1869....	1,222,250	109.5	133,886,000	42.9	57,481,362	......	......	......	......	596,968	75,336
1870....	1,325,119	86.6	114,775,000	65.0	74,621,019	......	......	......	......	553,070	458,758
1871....	1,220,912	98.7	120,461,700	53.9	64,905,189	......	......	......	......	621,537	96,259
1872....	1,331,331	85.3	113,516,000	53.5	60,692,129	......	......	......	......	515,306	346,840
1873....	1,295,139	81.9	106,089,000	65.2	69,153,709	......	......	......	......	497,413	549,073
1874....	1,310,041	80.9	105,981,000	61.5	65,223,314	......	......	......	......	609,642	188,757
1875....	1,510,041	110.5	166,877,000	34.4	57,357,515	......	......	......	......	704,379	92,148
1876....	1,741,983	71.7	124,827,000	61.9	77,319,541	......	......	......	......	529,650	3,205,555
1877....	1,792,287	94.9	170,092,000	43.7	74,272,500	......	......	......	......	744,409	528,584
1878....	1,776,800	69.9	124,126,650	58.7	72,923,575	......	......	......	......	625,342	2,624,149
1879....	1,836,800	98.9	181,626,400	43.6	79,153,673	......	......	......	......	696,080	721,868
1880....	1,842,510	91.0	167,659,570	48.3	81,062,214	......	......	......	......	638,840	2,170,372
1881....	2,041,670	53.5	109,145,494	91.0	99,291,341	......	......	......	......	408,286	8,789,860
1882....	2,171,636	78.7	170,972,508	55.7	95,304,844	......	......	......	......	439,443	2,362,362
1883....	2,289,275	90.9	208,164,425	42.2	87,849,991	......	......	......	......	554,613	425,408
1884....	2,220,980	85.8	190,642,000	39.6	75,524,290	......	......	......	......	380,868	658,633
1885....	2,265,823	77.2	175,029,000	44.7	78,153,403	......	......	33	50	494,948	1,937,416
1886....	2,287,136	73.5	168,051,000	46.7	78,441,940	44	47	65	90	434,864	1,432,490
1887....	2,357,322	56.9	134,103,000	68.2	91,506,740	70	83	65	85	403,880	8,259,538
1888....	2,533,280	79.9	202,365,000	40.2	81,413,589	30	37	24	45	471,955	883,380
1889....	2,647,989	77.4	204,881,441	35.4	72,610,934	33	45	30	60	406,613	3,415,578
1890....	2,651,579	55.9	148,289,696	75.8	112,341.708	82	93	95	110	341,189	5,401,912
1891....	2,714,770	93.7	254,423,607	35.8	91,012,962	30	40	30	50	557,022	186,871
1892..	2,547,962	61.5	156,654,819	66.1	103,567,520	60	72	70	98	845,720	4,317,021
1893....	2,605,186	70.3	183,034,203	59.4	108,661,801	51	60	64	88	803,111	3,002,578
1894....	2,737,973	62.4	170,787,338	53.6	91,526,787	43	58	40	70	572,957	1,341,533
1895....	2,954,952	100.6	297,237,370	26.6	78,984,901	18	24	10	23	680,049	175,240
1896....	2,767,465	91.1	252,234,540	28.6	72,182,350	18	26	19	26	926,646	246,178
1897....	2,534,577	64.7	164,015,964	54.7	89,643,059	50	62	60	87	605,187	1,171,378
1898....	2,557,729	75.2	192,306,338	41.4	79,574,772	30	36	33	52	579,833	530,420
1899....	2,581,353	88.6	228,783,232	39.0	89,328,832	35	46	27	39	809,472	155,861
1900....	2,611,054	80.8	210,926,897	43.1	90,811,167	40	48	35	60	741,483	371,911
1901....	2,864,335	65.5	187,598,087	76.7	143,979,470	75	82	58	100	528,484	7,656,162
1902....	2,965,587	96.0	284,632,787	47.1	134,111,436	42	48	42	60	843,075	358,505
1903....	2,916,855	84.7	247,127,880	61.4	151,638,094	60	66	95	116	484,042	3,166,581
1904....	3,015,675	110.4	332,830,300	45.3	150,673,392	32	38	20	25	1,163,270	181,035
1905....	2,996,757	87.0	260,741,294	61.7	160,821,080	55	66	......	......	....	....

Acreage, production, and value of potatoes in the United States in 1905, by States.

State or Territory.	Acreage.	Average yield per acre.	Production.	Average farm price Dec. 1.	Farm value Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*
Maine	103,317	175	18,080,475	61	11,029,090
New Hampshire	19,723	120	2,366,760	72	1,704,067
Vermont	26,566	98	2,603,468	71	1,848,462
Massachusetts	29,443	97	2,855,971	84	2,399,016
Rhode Island	6,490	125	811,250	89	722,012
Connecticut	31,931	92	2,937,652	91	2,673,263
New York	428,986	70	30,029,020	70	21,020,314
New Jersey	65,391	93	6,081,363	75	4,561,022
Pennsylvania	253,797	90	22,841,730	65	14,847,124
Delaware	7,677	93	713,961	59	421,237
Maryland	29,041	95	2,758,895	58	1,600,159
Virginia	55,105	84	4,628,820	56	2,592,139
North Carolina	25,883	77	1,992,991	68	1,355,234
South Carolina	9,250	83	767,750	103	790,782
Georgia	8,627	65	560,755	112	628,046
Florida	4,110	75	308,250	120	369,900
Alabama	9,544	80	763,520	88	671,898
Mississippi	5,863	110	644,930	85	548,190
Louisiana	9,146	64	585,344	91	532,663
Texas	34,940	64	2,236,160	93	2,079,629
Arkansas	21,934	65	1,425,710	73	1,040,768
Tennessee	23,600	80	1,888,000	58	1,095,040

Acreage, production, and value of potatoes in the United States in 1905, by States—
Continued.

State or Territory.	Acreage.	Average yield per acre.	Production.	Average farm price Dec. 1.	Farm value Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*
West Virginia	34,376	88	3,025,088	58	1,754,551
Kentucky	35,445	85	3,012,825	53	1,596,797
Ohio	161,930	78	12,630,540	63	7,957,240
Michigan	241,836	67	16,203,012	56	9,073,687
Indiana	77,818	80	6,225,440	58	3,610,755
Illinois	149,147	75	11,186,025	67	7,494,637
Wisconsin	237,497	68	16,149,796	62	10,012,874
Minnesota	134,471	82	11,026,622	50	5,513,311
Iowa	166,012	80	13,280,960	49	6,507,670
Missouri	86,089	82	7,059,298	55	3,882,614
Kansas	68,564	81	5,553,684	69	3,832,042
Nebraska	87,144	93	8,104,392	37	2,998,625
South Dakota	35,071	96	3,366,816	38	1,279,390
North Dakota	25,425	95	2,415,375	38	917,842
Montana	13,688	120	1,642,560	59	969,110
Wyoming	4,002	170	680,340	56	380,990
Colorado	51,052	160	8,168,320	57	4,655,942
New Mexico	1,470	75	110,250	89	98,122
Utah	12,358	132	1,631,256	43	701,440
Nevada	2,806	120	336,720	82	276,110
Idaho	11,782	140	1,649,480	48	791,750
Washington	34,199	142	4,856,258	46	2,233,879
Oregon	40,488	110	4,453,680	60	2,672,208
California	50,291	165	8,298,015	67	5,559,670
Oklahoma	10,935	77	841,995	88	740,956
Indian Territory	12,497	76	949,772	82	778,813
United States	2,996,757	87.0	260,741,294	61.7	160,821,080

Average yield per acre of potatoes in the United States, 1896–1905, by States.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Maine	165	59	130	139	126	150	130	196	215	175
New Hampshire	108	51	90	127	101	108	120	98	135	120
Vermont	128	70	105	132	134	90	94	138	128	98
Massachusetts	108	62	97	134	79	77	109	96	119	97
Rhode Island	105	110	123	142	94	98	164	125	137	125
Connecticut	106	54	100	130	96	81	92	96	96	92
New York	89	62	73	88	81	78	66	89	93	70
New Jersey	94	68	75	83	69	59	132	99	115	93
Pennsylvania	109	63	54	85	58	62	83	91	106	90
Delaware	78	60	49	52	48	55	79	84	84	93
Maryland	90	74	58	64	55	60	80	70	99	95
Virginia	93	61	68	66	58	71	75	84	83	84
North Carolina	79	66	67	57	61	64	64	67	78	77
South Carolina	52	65	65	56	78	70	69	81	88	83
Georgia	55	52	54	46	68	64	58	73	70	65
Florida	75	75	64	69	60	62	90	82	102	75
Alabama	64	55	74	56	69	67	50	67	61	80
Mississippi	70	59	74	61	66	62	69	82	82	110
Louisiana	55	64	78	60	70	60	65	50	70	64
Texas	52	60	78	64	62	54	66	67	72	64
Arkansas	59	55	74	63	72	46	72	70	77	65
Tennessee	62	40	52	44	54	45	62	66	71	80
West Virginia	93	56	62	72	80	52	96	80	101	88
Kentucky	85	47	64	51	70	35	80	73	83	85
Ohio	89	42	61	71	76	54	94	83	98	78
Michigan	88	72	79	66	97	81	72	78	121	67
Indiana	85	31	71	76	83	31	101	76	93	80
Illinois	97	38	70	96	92	35	118	72	108	75
Wisconsin	78	99	98	103	103	75	115	58	126	68
Minnesota	84	106	85	96	81	68	98	64	102	82
Iowa	94	60	80	100	72	32	98	56	136	80
Missouri	78	42	66	82	93	17	128	66	96	82
Kansas	69	48	70	95	72	26	138	58	80	81
Nebraska	90	69	65	94	66	33	137	64	120	93
South Dakota	96	94	72	78	73	45	74	89	96	96
North Dakota	102	99	87	103	52	110	105	84	111	95
Montana	170	156	104	141	134	157	153	176	143	120

Average yield per acre of potatoes in the United States, 1896–1905, by States—Continued.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*Bush.*
Wyoming	167	150	120	125	99	113	100	167	161	170
Colorado	88	97	77	84	56	120	100	145	159	160
New Mexico	72	90	58	49	19	50	72	87	62	75
Utah	155	148	135	120	118	114	157	177	137	132
Nevada	190	135	155	102	156	141	212	117	131	120
Idaho	162	140	120	124	136	108	149	160	139	140
Washington	125	162	108	144	116	117	136	145	120	142
Oregon	87	160	86	115	110	90	103	107	87	110
California	80	105	95	119	104	101	118	130	129	165
Oklahoma	......	......	......	......	......	55	97	78	85	77
Indian Territory	......	......	......	......	......	63	85	70	69	76
General average	91.1	61.7	75.2	88.6	80.8	65.5	96.0	84.7	110.4	87.0

Average value per acre of potatoes in the United States, based upon farm value December 1, 1896–1905, by States.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
Maine	$62.70	$52.51	$59.80	$58.38	$61.74	$100.50	$84.50	$109.76	$103.20	$106.75
New Hampshire	50.76	45.90	44.10	58.42	53.53	85.32	82.80	63.70	75.60	86.40
Vermont	37.12	49.00	44.10	47.52	53.60	57.60	54.52	69.00	60.16	69.58
Massachusetts	61.56	55.80	61.11	76.38	52.14	69.30	88.29	68.16	84.49	81.48
Rhode Island	56.70	106.70	78.72	71.00	65.80	91.14	123.00	102.50	104.12	111.25
Connecticut	48.76	48.60	55.00	59.80	67.20	76.14	67.16	74.88	69.12	83.72
New York	27.59	41.54	30.66	35.20	36.45	55.38	38.94	49.84	50.22	49.00
New Jersey	33.84	53.04	45.75	42.33	41.40	50.15	80.52	68.31	70.15	69.75
Pennsylvania	29.43	41.58	31.32	36.55	30.74	47.12	47.31	56.42	57.24	58.50
Delaware	27.30	39.00	33.81	26.52	28.80	42.90	40.29	47.04	44.52	54.87
Maryland	27.00	50.32	30.74	32.64	29.70	46.20	41.60	42.00	50.49	55.10
Virginia	31.62	42.70	37.40	36.96	34.22	52.54	43.50	53.76	45.65	47.04
North Carolina	33.97	42.24	41.54	37.62	39.65	46.08	42.88	49.58	54.60	52.36
South Carolina	34.32	68.25	65.00	58.24	78.00	77.00	66.24	84.24	88.88	85.49
Georgia	41.25	52.00	40.50	38.18	52.36	67.84	52.20	68.62	74.90	72.80
Florida	63.00	90.00	76.80	85.56	63.60	79.98	109.80	103.32	131.58	90.00
Alabama	48.00	51.70	61.42	48.72	56.58	73.03	46.50	64.32	60.39	70.40
Mississippi	43.40	48.38	53.28	62.22	54.78	71.30	63.48	72.16	69.70	93.50
Louisiana	41.80	54.40	58.50	48.60	55.30	60.60	53.30	45.50	63.70	58.24
Texas	40.56	57.00	67.08	58.24	54.56	67.50	56.10	58.96	66.96	59.52
Arkansas	31.27	46.20	40.70	44.73	41.04	57.96	48.96	55.30	57.75	47.45
Tennessee	24.80	29.20	29.64	28.60	31.32	39.56	39.68	42.24	44.02	46.40
West Virginia	28.83	36.40	33.48	37.44	40.80	44.20	48.96	52.80	54.54	51.04
Kentucky	28.05	31.49	29.44	31.11	35.00	30.45	42.40	49.64	45.65	45.05
Ohio	24.14	26.04	25.01	30.53	30.40	45.90	41.36	50.63	46.06	49.14
Michigan	16.72	30.96	21.53	21.12	25.22	55.08	29.52	38.22	35.09	37.52
Indiana	21.25	19.22	29.11	32.68	31.54	27.90	41.41	50.16	41.85	46.40
Illinois	25.22	23.56	32.20	39.36	37.72	32.55	49.56	51.84	50.76	50.25
Wisconsin	14.82	37.62	23.52	26.78	28.84	50.25	37.95	33.64	35.28	42.16
Minnesota	17.64	32.86	21.25	24.00	24.30	45.56	30.38	39.04	29.58	41.00
Iowa	20.68	28.20	24.00	23.00	26.64	30.08	33.32	42.00	38.08	39.20
Missouri	24.18	26.46	29.04	33.20	32.55	18.02	44.80	50.16	46.08	45.10
Kansas	18.63	26.40	35.70	42.75	34.56	27.04	62.10	49.30	44.80	55.89
Nebraska	22.50	31.74	24.05	23.50	32.34	34.65	36.99	41.60	31.20	34.41
South Dakota	19.20	30.08	20.16	21.06	26.28	38.25	32.56	48.06	28.80	36.48
North Dakota	21.42	32.67	29.58	27.81	25.48	53.90	31.65	40.32	35.52	36.10
Montana	54.40	62.40	57.20	74.73	71.02	114.61	76.50	77.44	87.23	70.80
Wyoming	71.81	82.50	78.00	76.25	67.32	112.40	65.27	95.19	99.82	95.20
Colorado	41.36	54.32	41.58	46.20	45.92	108.00	51.00	87.00	58.83	91.20
New Mexico	48.96	70.20	45.24	33.32	21.66	59.00	58.32	73.08	48.36	66.75
Utah	49.60	44.40	41.85	66.00	56.64	68.40	70.65	83.19	65.76	56.76
Nevada	72.20	98.55	139.50	91.80	87.36	128.31	133.56	81.90	85.15	98.40
Idaho	48.60	44.80	64.80	75.64	63.92	90.72	55.13	73.60	87.57	67.20
Washington	50.00	45.36	42 14	72.00	54.52	71.37	51.68	52.20	67.20	65.32
Oregon	33.93	61.00	40.42	56.35	49.50	63.00	56.65	53.50	51.33	66.00
California	42.40	51.45	52.25	74.97	55.12	77.77	68.44	85.80	86.43	110.55
Oklahoma	......	......	......	......	......	69.50	74.69	76.44	65.45	67.76
Indian Territory	......	......	......	......	......	78.12	54.40	60.20	51.75	62.32
General average	26.08	35.37	31.11	34.60	34.78	50.27	45.22	51.99	49.96	53.67

Average farm price of potatoes per bushel in the United States December 1, 1896–1905, by States.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
Maine	38	89	46	42	49	67	65	56	48	61
New Hampshire	47	90	49	46	53	79	69	65	56	72
Vermont	29	70	42	36	40	64	58	50	47	71
Massachusetts	57	90	63	57	66	90	81	71	71	84
Rhode Island	54	97	64	50	70	93	75	82	76	89
Connecticut	46	90	55	46	70	94	73	78	72	91
New York	31	67	42	40	45	71	59	56	54	70
New Jersey	36	78	61	51	60	85	61	69	61	75
Pennsylvania	27	66	58	43	53	76	57	62	54	65
Delaware	35	65	69	51	60	78	51	56	53	59
Maryland	30	68	53	51	54	77	52	60	51	58
Virginia	34	70	55	56	59	74	58	64	55	56
North Carolina	43	64	62	66	65	72	67	74	79	68
South Carolina	66	105	100	104	100	110	96	104	101	103
Georgia	75	100	75	83	77	106	90	94	107	112
Florida	84	120	120	124	106	129	122	126	129	120
Alabama	75	94	83	87	82	109	93	96	99	88
Mississippi	62	82	72	102	83	115	92	88	85	85
Louisiana	76	85	75	81	79	101	82	91	91	91
Texas	78	95	86	91	88	125	85	88	93	93
Arkansas	53	84	55	71	57	126	68	79	75	73
Tennessee	40	73	57	65	58	86	64	64	62	58
West Virginia	31	65	54	52	51	85	51	66	54	58
Kentucky	33	67	46	61	50	87	53	68	55	53
Ohio	26	62	41	43	40	85	44	61	47	63
Michigan	19	43	27	32	26	68	41	49	29	56
Indiana	25	62	41	43	38	90	41	66	45	58
Illinois	26	62	46	41	41	93	42	72	47	67
Wisconsin	19	38	24	26	28	67	33	58	28	62
Minnesota	21	31	25	25	30	67	31	61	29	50
Iowa	22	47	30	23	37	94	34	75	28	49
Missouri	31	63	44	40	35	106	35	76	48	55
Kansas	27	55	51	45	48	104	45	85	56	69
Nebraska	25	46	37	25	49	105	27	65	26	37
South Dakota	20	32	28	27	36	85	44	54	30	38
North Dakota	21	33	34	27	49	49	33	48	32	38
Montana	32	40	55	53	53	73	50	44	61	59
Wyoming	43	55	65	61	68	100	61	57	62	56
Colorado	47	56	54	55	82	90	51	60	37	57
New Mexico	68	78	78	68	114	118	81	84	78	89
Utah	32	30	31	55	48	60	45	47	48	43
Nevada	38	73	90	90	56	91	63	70	65	82
Idaho	30	32	54	61	47	84	37	46	63	48
Washington	40	28	39	50	47	61	38	36	56	46
Oregon	39	40	47	49	45	70	55	50	59	60
California	53	49	55	63	53	77	58	66	67	67
Oklahoma	......	......	......	......	......	126	77	98	77	88
Indian Territory	......	......	......	......	......	124	64	86	75	82
General average	28.6	54.7	41.4	39.0	43.1	76.7	47.1	61.4	45.3	61.7

Wholesale prices of potatoes per bushel in leading cities of the United States, 1901–1905.

Date.	Cincinnati.		Chicago.		Milwaukee.		St. Louis.	
	Per bushel.		Burbank, per bushel.		Per bushel.		Burbank, per bushel.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1901.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	42	50	40	49	38	50	45	54
February	40	48	38	43	35	50	18	20
March	30	47	38	42	35	45	37	43
April	35	45	30	42	32	45	41	45
May	38	75	35	60	35	60	39	53
June	64	90	35	78	30	80	50	80
July	......	......	......	......	65	125	......	......
August	95	110	110	125	85	135	......	......
September	75	120	56	107	40	110	70	145
October	40	75	59	68	40	75	70	70
November	60	95	59	82	60	82	83	100
December	78	90	75	82	65	87	83	83

Wholesale prices of potatoes per bushel in leading cities of the United States, 1901–1905—Continued.

Date.	Cincinnati. Per barrel.		Chicago Burbank, per bushel.		Milwaukee. Per bushel.		St. Louis. Burbank, per bushel.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1902.			*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	$2.20	$2.40	70	80	72	87	78	83
February	2.10	2.40	68	76	72	85	78	84
March	2.10	2.60	68	80	70	85	76	90
April	2.45	3.00	72	100	70	103	81	105
May	2.25	3.00	58	100	50	103	90	105
June	2.10	2.40	47	60	40	90	72	80
July	.90	2.40	....	....	30	85	....	....
August	.90	1.05	....	....	28	50	....	....
September	.95	1.35	30	38	28	40	....	....
October	1.25	1.35	30	44	30	40	41	44
November	1.50	1.60	42	48	34	43	50	54
December	1.35	1.50	42	48	35	43	51	55
1903.								
January	1.65	1.80	45	48	40	45	50	55
February	1.50	1.60	45	47	38	40	51	54
March	1.50	1.70	43	47	35	40	50	53
April	1.35	1.65	38	46	35	40	42	54
May	1.65	1.90	42	60	35	52	45	63
June	1.50	3.00	50	85	46	90	65	125
July	1.75	2.25	....	....	35	75	40	65
August	1.75	1.95	....	....	40	70	....	....
September	1.50	1.80	....	....	35	60	....	....
October	1.20	1.80	54	60	45	60	55	72
November	1.20	2.10	50	70	50	65	67	80
December	1.80	2.10	60	66	55	65	65	68
1904.								
January	1.95	2.55	62	95	50	85	69	73
February	2.70	2.85	85	91	78	85	90	96
March	2.80	4.50	86	102	83	95	91	97
April	3.75	4.80	89	122	90	120	115	125
May	3.30	4.80	95	116	75	118	105	115
June	2.70	4.50	115	118	75	120	....	....
July	2.00	3.00	....	....	40	90	....	....
August	1.50	1.80	....	....	30	60	....	....
September	1.35	1.65	....	....	28	78	47	52
October	1.20	1.50	31	40	25	33	42	45
November	1.20	1.50	32	42	20	30	36	43
December	1.20	1.35	32	38	20	30	36½	45
1905.	Per bushel.							
January	.38	.42	32	38	22	32	35	42
February	.35	.43	33	37	22	32	40	50
March	.25	.40	25	37	20	30	31	38
April	.25	.32	20	29	18	25	27	40
May	.25	.30	20	25	15	26	65	175
June	.25	.60	18	25	10	21	35	70
July	.45	.55	....	....	10	52	35	45
August	.45	.50	....	....	35	55	30	48
September	.45	.55	43	48	35	50	40	60
October	.50	.75	43	72	38	65	52	73
November	.60	.75	64	70	50	70	62	80
December	.55	.80	55	66	40	62	58	66

HAY.

Condition of the hay crop of the United States, monthly, 1890–1905.

Year.	Clover.		Timothy.		Year.	Clover.		Timothy.	
	June.	July.	July.	Aug.		June.	July.	July.	Aug.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*		*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
1890	95.1	94.0	93.9	93.6	1898	....	....	....	99.3
1891	91.0	89.3	87.4	90.9	1899	....	....	....	86.7
1892	94.9	95.5	96.8	93.2	1900	....	....	....	79.9
1893	92.7	92.6	89.8	89.6	1901	....	....	....	84.1
1894	87.8	80.2	77.3	75.6	1902	....	86.3	84.9	90.0
1895	82.8	73.9	70.8	69.9	1903	82.7	84.2	84.0	92.2
1896	88.4	83.7	84.8	87.5	1904	94.0	91.4	92.8	94.0
1897	96.0	....	....	....	1905	94.8	96.1	91.5	90.2

Acreage, production, value, prices, and exports of hay of the United States, 1866–1905.

Year.	Acreage.	Average yield per acre.	Production.	Average farm price per ton, Dec. 1.	Farm value, Dec. 1.	Chicago prices No. 1 timothy per ton, by carload lots. December. Low.	December. High.	May of following year. Low.	May of following year. High.	Domestic exports, fiscal years beginning July 1.
	Acres.	*Tons.*	*Tons.*	*Dolls.*	*Dollars.*	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*	*Tons.*
1866	17,668,904	1.23	21,778,627	10.14	220,835,771					5,028
1867	20,020,554	1.31	26,277,000	10.21	268,300,623					5,645
1868	21,541,573	1.21	26,141,900	10.08	263,589,235					
1869	18,591,281	1.42	26,420,000	10.18	268,933,048					6,723
1870	19,861,805	1.23	24,525,000	12.47	305,743,224					4,581
1871	19,009,052	1.17	22,239,400	14.30	317,939,799					5,266
1872	20,318,936	1.17	23,812,800	12.94	308,024,517					4,557
1873	21,894,084	1.15	25,085,100	12.53	314,241,037					4,889
1874	21,769,772	1.15	25,133,900	11.94	300,222,454					7,183
1875	23,507,964	1.19	27,873,600	10.78	300,377,839					7,528
1876	25,282,797	1.22	30,867,100	8.97	276,991,422			9.00	10.00	7,287
1877	25,367,708	1.25	31,629,300	8.37	264,879,796	9.50	10.50	9.75	10.75	9,514
1878	26,931,300	1.47	39,608,296	7.20	285,015,625	8.00	8.50	9.00	11.50	8,127
1879	27,484,991	1.29	35,493,000	9.32	330,804,494	14.00	14.50	14.00	15.00	13,739
1880	25,863,955	1.23	31,925,233	11.65	371,811,084	15.00	15.50	17.00	19.00	12,662
1881	30,888,700	1.14	35,135,064	11.82	415,131,366	16.00	16.50	15.00	16.50	10,570
1882	32,339,585	1.18	38,138,049	9.70	371,170,326	11.50	12.25	12.00	13.00	13,309
1883	35,515,948	1.32	46,864,009	8.19	384,834,451	9.00	10.00	12.50	17.00	16,908
1884	38,571,593	1.26	48,470,460	8.17	396,139,309	10.00	11.50	15.50	17.50	11,142
1885	39,849,701	1.12	44,731,550	8.71	389,752,873	11.00	12.00	10.00	12.00	13,390
1886	36,501,688	1.15	41,796,499	8.46	353,437,699	9.50	10.50	11.00	12.50	13,873
1887	37,664,739	1.10	41,454,458	9.97	413,440,283	13.50	14.50	17.00	21.00	18,198
1888	38,591,903	1.21	46,643,094	8.76	408,499,565	11.00	11.50	10.50	11.00	21,928
1889	52,947,236	1.26	66,829,612	7.04	470,374,948	9.00	10.00	9.00	14.00	36,274
1890	50,712,513	1.19	60,197,589	7.87	473,569,972	9.00	10.50	12.50	15.50	28,066
1891	51,044,490	1.19	60,817,771	8.12	494,113,616	12.50	15.00	13.50	14.00	35,201
1892	50,853,061	1.18	59,823,735	8.20	490,427,798	11.00	11.50	12.00	13.50	33,084
1893	49,613,469	1.33	65,766,158	8.68	570,882,872	10.00	10.50	10.00	10.50	54,446
1894	48,321,272	1.14	54,874,408	8.54	468,578,321	10.00	11.00	10.00	10.25	47,117
1895	44,206,453	1.06	47,078,541	8.35	393,185,615	12.00	12.50	11.50	12.00	59,052
1896	43,259,756	1.37	59,282,158	6.55	388,145,614	8.00	8.50	8.50	9.00	61,658
1897	42,426,770	1.43	60,664,876	6.62	401,390,728	8.00	8.50	9.50	10.50	81,827
1898	42,780,827	1.55	66,376,920	6.00	398,060,647	8.00	8.25	9.50	10.50	64,916
1899	41,328,462	1.35	56,655,756	7.27	411,926,187	10.50	11.50	10.50	12.50	72,716
1900	39,132,890	1.28	50,110,906	8.89	445,538,870	11.50	14.00	12.50	13.50	89,364
1901	39,390,508	1.28	50,590,877	10.01	506,191,533	13.00	13.50	12.50	13.50	153,431
1902	39,825,227	1.50	59,857,576	9.06	542,036,364	12.00	12.50	13.50	15.00	50,970
1903	39,933,759	1.54	61,305,940	9.08	556,376,880	10.00	12.00	12.00	15.00	60,730
1904	39,998,602	1.52	60,696,028	8.72	529,107,625	10.50	11.50	11.00	12.00	66,561
1905	39,361,960	1.54	60,531,611	8.52	515,959,784	10.00	12.00			

Acreage, production, and value of hay in the United States in 1905, by States.

State or Territory.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Tons.*	*Tons.*	*Dollars.*	*Dollars.*
Maine	1,303,760	1.08	1,408,061	9.90	13,939,804
New Hampshire	619,530	1.16	718,655	13.00	9,342,515
Vermont	861,911	1.35	1,163,580	9.43	10,972,559
Massachusetts	577,061	1.33	767,491	15.22	11,681,213
Rhode Island	61,980	1.09	67,558	16.27	1,099,169
Connecticut	484,751	1.12	542,921	14.60	7,926,647
New York	4,717,641	1.30	6,132,933	10.38	63,659,845
New Jersey	420,322	1.13	474,964	14.81	7,034,217
Pennsylvania	3,072,021	1.50	4,608,032	11.93	54,973,822
Delaware	75,549	1.55	117,101	13.67	1,600,771
Maryland	286,011	1.30	371,814	11.92	4,432,023
Virginia	440,467	1.30	572,607	12.62	7,226,300
North Carolina	125,633	1.60	201,013	12.80	2,572,966
South Carolina	59,492	1.42	84,479	13.36	1,128,639
Georgia	88,054	1.50	132,081	15.75	2,080,276
Florida	12,999	1.48	19,239	16.25	312,634
Alabama	55,245	1.90	104,966	12.52	1,314,174
Mississippi	43,013	1.75	75,273	11.17	840,799
Louisiana	21,488	2.30	49,422	11.50	568,353
Texas	395,663	1.90	751,760	8.12	6,104,291
Arkansas	74,665	1.75	130,664	9.60	1,254,374
Tennessee	339,446	1.60	543,114	11.52	6,256,673
West Virginia	522,610	1.48	773,463	11.65	9,010,844

Acreage, production, and value of hay in the United States in 1905, by States—Continued.

State or Territory.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Tons.*	*Tons.*	*Dollars.*	*Dollars.*
Kentucky	461,033	1.30	599,343	10.63	6,371,016
Ohio	2,632,049	1.49	3,921,753	8.00	31,374,024
Michigan	2,081,345	1.46	3,043,144	7.70	23,432,209
Indiana	1,716,132	1.48	2,539,875	7.54	19,150,658
Illinois	2,664,682	1.35	3,597,321	8.27	29,749,845
Wisconsin	1,789,994	1.80	3,221,989	7.25	23,359,420
Minnesota	858,465	1.75	1,502,314	5.80	8,713,421
Iowa	3,038,352	1.70	5,165,198	5.10	26,342,510
Missouri	2,812,731	1.10	3,094,004	7.84	24,256,991
Kansas	1,759,341	1.55	2,726,979	5.08	13,853,053
Nebraska	601,974	1.75	1,053,454	4.14	4,361,300
South Dakota	212,906	1.60	340,650	4.02	1,369,413
North Dakota	164,230	1.55	254,556	4.33	1,102,227
Montana	362,939	1.60	580,702	7.70	4,471,405
Wyoming	171,206	2.50	428,015	6.21	2,657,973
Colorado	665,226	2.65	1,762,849	8.20	14,455,362
New Mexico	79,087	2.70	213,535	10.75	2,295,501
Arizona	63,685	3.75	238,819	12.37	2,954,191
Utah	351,272	3.25	1,141,634	6.67	7,614,699
Nevada	159,042	2.50	397,605	8.50	3,379,642
Idaho	382,467	3.10	1,185,648	5.90	6,995,323
Washington	341,990	2.65	906,274	9.67	8,763,670
Oregon	390,076	2.30	897,175	7.74	6,944,134
California	589,119	2.40	1,413,886	10.05	14,209,554
Oklahoma	305,070	1.43	436,250	4.91	2,141,988
Indian Territory	45,235	1.27	57,448	5.35	307,347
United States	39,361,960	1.54	60,531,611	8.52	515,959,784

Average yield per acre of hay in the United States, 1896–1905, by States.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Maine	1.00	1.10	1.20	0.90	0.90	1.05	1.07	0.98	1.10	1.08
New Hampshire	.96	1.15	1.25	.89	.87	1.28	1.06	.92	1.02	1.16
Vermont	1.25	1.30	1.45	1.14	1.24	1.36	1.27	1.18	1.25	1.35
Massachusetts	1.28	1.40	1.42	1.13	.97	1.21	1.60	1.36	1.23	1.33
Rhode Island	1.10	1.15	1.18	.89	.92	.92	1.03	1.07	1.16	1.09
Connecticut	1.07	1.20	1.31	.94	.89	1.01	1.35	1.11	1.06	1.12
New York	.81	1.35	1.40	1.01	.81	1.30	1.34	1.26	1.36	1.30
New Jersey	1.15	1.75	1.42	.83	1.26	1.32	1.22	1.28	1.39	1.13
Pennsylvania	1.06	1.40	1.45	1.20	1.10	1.19	1.19	1.27	1.45	1.50
Delaware	1.10	1.35	1.38	1.04	.98	1.12	1.09	1.64	1.59	1.55
Maryland	.87	1.35	1.20	1.13	1.09	1.22	1.01	1.24	1.36	1.30
Virginia	1.08	1.08	1.32	1.10	1.16	1.20	1.06	1.30	1.39	1.30
North Carolina	1.26	1.25	1.70	1.50	1.41	1.66	1.44	1.60	1.72	1.60
South Carolina	1.33	1.00	1.60	1.22	1.32	1.46	1.22	1.46	1.53	1.42
Georgia	1.38	1.35	1.75	1.45	1.69	1.46	1.36	1.53	1.52	1.50
Florida	1.40	1.00	1.60	1.46	1.20	1.48	1.24	1.47	1.36	1.48
Alabama	1.40	1.45	1.90	1.66	1.85	1.75	1.50	1.77	1.71	1.90
Mississippi	1.35	1.48	1.90	1.44	1.75	1.69	1.40	1.74	1.72	1.75
Louisiana	1.90	1.90	2.10	1.95	2.00	1.85	1.80	2.04	2.06	2.30
Texas	1.00	1.40	1.50	1.43	1.80	1.25	1.40	1.84	1.77	1.90
Arkansas	1.18	1.30	1.54	1.48	1.63	1.10	1.60	1.60	1.72	1.75
Tennessee	1.40	1.45	1.50	1.31	1.40	1.52	1.44	1.58	1.66	1.60
West Virginia	1.22	1.35	1.54	1.29	1.18	1.37	1.12	1.28	1.47	1.48
Kentucky	1.20	1.17	1.45	1.29	1.40	1.34	1.44	1.46	1.41	1.30
Ohio	1.26	1.44	1.39	1.30	1.06	1.36	1.43	1.42	1.43	1.49
Michigan	1.16	1.49	1.36	1.22	1.29	1.26	1.45	1.37	1.25	1.46
Indiana	1.30	1.43	1.45	1.34	1.21	1.27	1.46	1.47	1.37	1.48
Illinois	1.38	1.29	1.56	1.29	1.27	1.08	1.50	1.54	1.36	1.35
Wisconsin	1.25	1.35	1.50	1.47	1.15	1.29	1.90	1.89	1.67	1.80
Minnesota	1.69	1.57	1.80	1.70	1.16	1.55	1.76	1.84	1.74	1.75
Iowa	1.74	1.50	1.75	1.31	1.42	1.25	1.68	1.78	1.62	1.70
Missouri	1.43	1.15	1.60	1.37	1.29	.75	1.59	1.57	1.47	1.10
Kansas	1.42	1.30	1.46	1.57	1.32	.91	1.70	1.58	1.67	1.55
Nebraska	1.66	1.60	1.60	1.66	1.38	1.25	1.74	1.68	1.76	1.75
South Dakota	1.28	1.25	1.38	1.43	1.18	1.15	1.23	1.45	1.43	1.60
North Dakota	1.65	1.60	1.50	1.58	.92	1.60	1.66	1.18	1.57	1.55
Montana	1.38	1.50	1.45	1.42	1.60	1.79	1.68	2.08	1.92	1.60
Wyoming	1.55	1.65	1.96	1.47	1.68	1.76	1.65	2.14	2.27	2.50

Average yield per acre of hay in the United States, 1896–1905, by States—Continued.

State or Territory.	1896.	1897.	[illegible]	1899.	1900.	1901.	1902.	1903.	1904.	1905.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Colorado	2.20	2.25	2.20	2.10	2.23	2.08	1.92	2.56	1.85	2.65
New Mexico	3.00	3.50	[illegible]	1.70	2.06	2.31	2.40	2.36	2.58	2.70
Arizona	3.20	3.00	[illegible]	2.63	2.31	2.85	2.34	3.46	2.71	3.75
Utah	2.70	2.95	3.25	2.50	2.65	2.45	2.62	2.95	3.54	3.25
Nevada	2.55	2.50	2.60	1.87	2.43	2.50	2.91	3.12	3.04	2.50
Idaho	2.60	2.30	3.75	2.50	2.80	2.58	2.67	2.82	3.07	3.10
Washington	1.95	2.25	1.75	2.02	2.16	2.30	2.29	2.41	2.18	2.65
Oregon	1.98	1.90	1.90	1.97	2.35	2.07	2.04	2.07	2.04	2.30
California	1.65	1.60	1.60	1.63	1.51	1.82	1.81	2.08	2.03	2.40
Oklahoma	......	......	......	......	......	.96	1.26	1.34	1.51	1.43
Indian Territory	......	......	......	......	......	1.46	1.32	1.50	1.49	1.27
General average	1.37	1.43	1.55	1.35	1.28	1.28	1.50	1.54	1.52	1.54

Average value per acre of hay in the United States, based upon farm value December 1, 1896–1905, by States.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
Maine	$10.25	$10.73	$9.12	$9.09	$11.66	$10.96	$10.74	$10.00	$10.69	$10.69
New Hampshire	12.38	13.23	11.56	10.46	13.48	15.87	14.36	12.20	13.76	15.08
Vermont	12.85	12.03	9.21	10.55	13.70	13.36	12.26	12.84	11.85	12.73
Massachusetts	20.99	19.46	17.18	17.52	16.88	21.16	26.64	22.74	19.38	20.24
Rhode Island	18.26	16.67	14.93	15.35	17.20	17.54	19.46	20.28	20.16	17.73
Connecticut	15.74	15.60	14.61	13.63	14.89	14.77	21.19	16.86	15.78	16.35
New York	9.75	11.14	8.05	10.87	11.38	13.75	14.11	13.81	14.20	13.49
New Jersey	16.50	18.81	13.63	12.74	20.22	18.86	19.08	19.70	20.39	16.74
Pennsylvania	12.88	12.81	11.46	13.80	15.29	15.90	16.66	17.15	17.14	17.90
Delaware	14.30	13.50	11.66	12.12	13.67	13.84	15.73	24.32	22.69	21.19
Maryland	10.31	14.17	11.16	13.73	15.31	16.07	14.19	17.38	16.97	15.50
Virginia	11.03	11.07	11.22	11.27	15.43	14.41	14.39	17.85	17.44	16.41
North Carolina	13.55	12.19	15.81	15.15	15.79	17.93	17.64	21.47	25.04	20.48
South Carolina	15.06	11.50	15.20	12.56	15.18	16.03	13.72	17.11	18.64	18.97
Georgia	15.25	17.55	20.56	19.07	21.55	20.92	18.22	23.18	23.01	23.63
Florida	18.20	14.25	22.56	22.41	16.44	22.72	19.02	27.67	22.67	24.05
Alabama	13.72	13.86	17.57	18.92	19.52	21.12	17.42	21.93	20.74	23.79
Mississippi	12.77	14.06	15.96	13.32	17.41	17.62	14.35	20.18	18.66	19.55
Louisiana	16.63	16.62	19.74	18.92	18.80	20.50	21.10	23.15	25.13	26.45
Texas	7.20	10.15	8.77	10.15	12.24	13.27	12.04	15.09	14.37	15.43
Arkansas	8.90	11.25	10.39	12.80	14.43	12.89	15.04	15.17	16.89	16.80
Tennessee	13.54	15.59	14.25	14.74	16.52	18.71	16.99	19.42	19.94	18.43
West Virginia	11.94	11.95	12.94	12.19	15.81	18.91	16.05	19.04	18.24	17.24
Kentucky	11.35	11.70	13.19	13.42	15.89	16.25	16.27	17.62	16.57	13.82
Ohio	9.99	9.00	7.99	11.63	11.71	11.86	14.59	14.20	13.23	11.92
Michigan	9.84	11.55	9.72	10.37	12.19	10.85	12.03	12.23	11.36	11.24
Indiana	9.33	8.44	8.12	10.45	11.80	11.79	12.66	12.58	11.75	11.16
Illinois	8.82	7.93	9.20	10.00	10.67	12.10	13.31	12.83	11.78	11.16
Wisconsin	8.25	8.44	8.62	10.07	11.10	13.58	15.03	14.17	13.18	13.05
Minnesota	6.41	7.06	6.66	7.40	8.06	8.65	9.43	12.16	9.59	10.15
Iowa	6.94	6.37	7.09	7.10	9.66	9.59	10.92	9.72	8.68	8.67
Missouri	6.94	7.07	9.28	8.56	8.97	8.99	10.96	10.49	9.73	8.62
Kansas	3.83	4.42	4.74	5.49	6.01	7.25	7.33	7.60	7.31	7.87
Nebraska	4.05	4.80	5.28	6.14	7.11	7.71	7.59	7.53	6.72	7.24
South Dakota	3.99	3.69	4.14	4.43	4.66	5.16	5.10	6.71	6.06	6.43
North Dakota	5.59	5.20	4.87	5.21	5.20	5.84	6.09	5.48	6.61	6.71
Montana	9.47	11.63	9.86	10.93	13.92	14.60	12.67	18.32	16.70	12.32
Wyoming	11.07	9.90	11.40	9.70	12.26	12.64	12.01	14.27	13.05	15.52
Colorado	13.68	12.38	11.88	15.43	16.95	18.80	18.99	19.15	12.41	21.73
New Mexico	17.10	24.50	27.56	18.02	20.39	23.89	26.83	26.24	29.46	29.03
Arizona	28.00	15.00	42.00	27.22	26.10	26.16	28.62	35.78	40.22	46.39
Utah	13.50	14.01	14.62	17.75	21.07	20.70	19.18	20.18	22.34	21.68
Nevada	12.29	12.50	18.20	14.31	18.71	19.80	29.73	31.11	23.10	21.25
Idaho	12.25	12.08	18.37	15.75	18.20	15.25	14.69	19.64	18.67	18.29
Washington	13.83	20.25	13.30	17.98	20.52	19.60	20.45	30.78	24.72	25.63
Oregon	13.07	14.73	13.78	13.49	15.98	14.82	15.26	21.07	20.77	17.80
California	10.48	14.40	22.80	13.04	12.31	14.41	17.03	24.25	21.13	24.12
Oklahoma	......	......	......	......	......	6.59	6.68	7.52	7.40	7.03
Indian Territory	......	......	......	......	......	11.01	6.57	8.86	6.88	6.79
General average	8.97	9.46	9.30	9.97	11.39	12.85	13.61	13.93	13.23	13.11

Average farm price of hay per ton in the United States December 1, 1896–1905, by States.

State or Territory.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
Maine	$10.25	$9.75	$7.60	$10.10	$12.95	$10.41	$10.04	$10.20	$9.72	$9.90
New Hampshire	12.90	11.50	9.25	11.75	15.50	12.40	13.55	13.26	13.49	13.00
Vermont	10.28	9.25	6.35	9.25	11.05	9.82	9.65	10.88	9.48	9.43
Massachusetts	16.40	13.90	12.10	15.50	17.40	17.49	16.65	16.72	15.76	15.22
Rhode Island	16.60	14.50	12.65	17.25	18.70	19.06	18.89	18.95	17.38	16.27
Connecticut	14.71	13.00	11.15	14.50	16.73	14.62	15.70	15.19	14.89	14.60
New York	12.01	8.25	5.75	10.45	14.05	10.58	10.53	10.96	10.41	10.38
New Jersey	14.35	10.75	9.60	15.35	16.05	14.29	15.64	15.39	14.67	14.81
Pennsylvania	12.15	9.15	7.90	11.50	13.90	13.64	14.00	13.50	11.82	11.93
Delaware	13.00	10.00	8.45	11.65	13.95	12.36	14.43	14.83	13.89	13.67
Maryland	11.85	10.50	9.30	12.15	14.05	13.17	14.05	14.02	12.48	11.92
Virginia	10.21	10.25	8.50	10.25	13.30	12.01	13.58	13.73	12.55	12.62
North Carolina	10.75	9.75	9.30	10.10	11.20	10.80	12.25	13.42	14.56	12.80
South Carolina	11.32	11.50	9.50	10.30	11.50	10.98	11.25	11.72	12.18	13.36
Georgia	11.05	13.00	11.75	13.15	12.75	14.33	13.40	15.15	15.14	15.75
Florida	13.00	14.25	14.10	15.35	13.70	15.35	15.34	18.82	16.67	16.25
Alabama	9.80	10.25	9.25	11.40	10.55	12.07	11.61	12.39	12.13	12.52
Mississippi	9.46	9.50	8.40	9.25	9.95	10.51	10.25	11.60	10.85	11.17
Louisiana	8.75	8.75	9.40	9.70	9.40	11.08	11.72	11.35	12.20	11.50
Texas	7.20	7.75	5.85	7.10	6.80	10.62	8.60	8.20	8.12	8.12
Arkansas	7.54	8.65	6.75	8.65	8.85	11.72	9.40	9.48	9.82	9.60
Tennessee	9.67	10.75	9.50	11.25	11.80	12.31	11.80	12.29	12.01	11.52
West Virginia	9.79	8.85	8.40	9.45	13.40	13.80	14.33	13.80	12.41	11.65
Kentucky	9.46	10.00	9.10	10.40	11.35	12.13	11.30	12.07	11.51	10.63
Ohio	7.93	6.25	5.75	8.95	11.05	8.72	10.20	10.00	9.25	8.00
Michigan	8.48	7.75	7.15	8.50	9.45	8.61	8.30	8.93	9.09	7.70
Indiana	7.18	5.90	5.60	7.80	9.75	9.28	8.67	8.56	8.58	7.54
Illinois	6.39	6.15	5.90	7.75	8.40	11.20	8.87	8.33	8.66	8.27
Wisconsin	6.60	6.25	5.75	6.85	9.65	10.53	7.91	7.50	7.89	7.25
Minnesota	3.79	4.50	3.70	4.35	6.95	5.58	5.36	6.61	5.51	5.80
Iowa	3.99	4.25	4.05	5.30	6.80	7.67	6.50	5.46	5.36	5.10
Missouri	4.85	6.15	5.80	6.25	6.95	11.99	6.89	6.68	6.62	7.84
Kansas	2.70	3.40	3.25	3.50	4.55	7.67	4.31	4.81	4.38	5.08
Nebraska	2.44	3.00	3.30	3.70	5.15	6.17	4.36	4.48	3.82	4.14
South Dakota	3.12	2.95	3.00	3.10	3.95	4.49	4.15	4.63	4.24	4.02
North Dakota	3.39	3.25	3.25	3.30	5.65	3.65	3.67	4.64	4.21	4.33
Montana	6.86	7.75	6.80	7.70	8.70	8.18	7.54	8.81	8.70	7.70
Wyoming	7.14	6.00	5.90	6.60	7.30	7.18	7.28	6.67	5.75	6.21
Colorado	6.22	5.50	5.40	7.35	7.60	9.04	9.89	7.48	6.71	8.20
New Mexico	5.70	7.00	7.35	10.60	9.90	10.34	11.18	11.12	11.42	10.75
Arizona	8.75	5.00	12.00	10.35	11.30	9.18	12.23	10.34	14.84	12.37
Utah	5.00	4.75	4.50	7.10	7.95	8.45	7.32	6.84	6.31	6.67
Nevada	4.82	5.00	7.00	7.65	7.70	7.92	9.05	9.97	7.60	8.50
Idaho	4.71	5.25	4.90	6.30	6.50	5.91	5.50	6.86	6.08	5.90
Washington	7.09	9.00	7.60	8.90	9.50	8.52	8.93	12.77	11.34	9.67
Oregon	6.60	7.75	7.25	6.85	6.80	7.16	7.48	10.18	10.18	7.74
California	6.35	9.00	14.25	8.00	8.15	7.92	9.41	11.66	10.41	10.05
Oklahoma	......	......	......	......	......	6.86	5.30	5.61	4.90	4.91
Indian Territory	......	......	......	......	......	7.54	4.98	5.91	4.62	5.35
General average	6.55	6.62	6.00	7.27	8.89	10.01	9.06	9.08	8.72	8.52

Wholesale prices of hay (baled) per ton in leading cities of the United States, 1901–1905.

Date.	Chicago. No. 1 timothy, per ton.		Cincinnati. No. 1 timothy, per ton.		St. Louis. No. 1 timothy, per ton.	
	Low.	High.	Low.	High.	Low.	High.
1901.						
January	$12.00	$13.00	$14.00	$14.50	$11.50	$13.50
February	12.00	12.50	14.00	14.25	11.50	12.75
March	12.00	13.00	13.50	14.50	11.50	14.00
April	12.50	13.00	14.00	15.50	12.50	14.50
May	12.50	13.50	14.25	14.50	12.00	14.50
June	12.50	13.00	12.50	13.50	12.00	15.50
July	13.00	14.00	12.25	15.00	12.50	17.50
August	13.00	14.00	12.25	15.00	13.00	16.00
September	12.00	12.50	12.50	13.25	12.50	15.50
October	12.00	12.50	12.50	13.25	12.50	14.50
November	13.00	13.50	12.50	13.25	13.00	14.50
December	13.00	13.50	13.00	14.00	13.50	15.00

Wholesale prices of hay (baled) per ton in leading cities of the United States, 1901–1905—Continued.

Date.	Chicago.		Cincinnati.		St. Louis.	
	No. 1 timothy, per ton.		No. 1 timothy, per ton.		No. 1 timothy, per ton.	
	Low.	High.	Low.	High.	Low.	High.
1902.						
January	$12.50	$13.00	$12.50	$13.75	$13.50	$15.50
February	12.00	12.50	12.50	13.25	13.00	14.50
March	12.00	12.50	12.75	13.25	13.00	14.50
April	12.50	13.00	12.75	13.25	13.00	15.25
May	12.50	13.50	13.00	13.50	13.00	15.50
June	12.00	12.50	12.75	13.00	12.00	15.00
July	12.00	12.50	13.75	15.50	13.00	16.00
August	12.00	12.50	12.00	15.50	10.00	15.00
September	12.00	12.50	11.00	13.00	9.50	12.00
October	12.00	12.50	13.00	14.00	11.00	13.00
November	12.00	12.50	13.00	14.00	11.00	13.50
December	12.00	12.50	13.75	16.50	13.50	15.50
1903.						
January	12.00	13.00	15.50	17.25	13.50	15.50
February	12.00	13.00	16.00	16.75	13.50	15.00
March	12.00	13.50	16.00	17.50	14.00	16.00
April	13.00	15.00	16.25	18.00	13.50	16.00
May	13.50	15.00	15.25	18.00	13.00	16.00
June	13.00	15.00	17.50	19.50	14.50	25.00
July	13.00	13.50	16.50	18.00	9.50	16.50
August	11.00	13.50	11.50	17.00	10.00	15.00
September	10.00	12.00	11.50	13.50	10.00	12.00
October	10.00	11.50	12.50	13.25	10.00	12.50
November	10.00	11.50	12.25	12.75	10.00	12.50
December	10.00	12.00	12.50	13.00	10.00	13.50
1904.						
January	10.50	12.50	12.50	13.25	10.00	11.50
February	10.50	12.50	12.50	13.50	10.50	11.50
March	10.50	13.00	12.50	14.00	10.50	12.00
April	11.50	14.50	13.75	14.00	11.00	13.00
May	12.00	15.00	14.00	15.50	12.50	13.00
June	12.00	15.00	13.00	14.00	12.00	13.50
July	10.00	14.00	12.00	13.75	12.00	13.00
August	10.00	15.00	11.50	14.00	11.50	13.50
September	9.00	12.00	11.00	12.25	10.50	12.50
October	10.00	12.50	11.50	12.50	10.50	12.50
November	10.00	12.50	11.25	12.00	11.00	11.50
December	10.50	12.50	12.00	12.50	10.50	11.50
1905.						
January	10.50	12.00	12.00	12.75	11.00	12.75
February	11.00	12.00	11.75	12.25	10.50	12.50
March	11.00	12.00	11.75	13.00	10.50	12.50
April	11.00	12.00	12.00	12.50	11.00	13.00
May	11.00	12.00	11.50	12.50	10.50	13.00
June	10.00	12.00	10.25	11.75	10.50	12.50
July	10.00	12.00	10.50	12.50	10.00	14.00
August	11.00	12.50	10.00	12.50	9.00	13.50
September	10.00	12.50	11.50	12.50	10.00	13.00
October	10.00	11.50	12.25	12.50	10.50	13.50
November	11.00	12.00	12.00	13.50	12.00	15.00
December	10.00	12.00	12.25	13.50	12.50	15.50

COTTON.

Cotton crop of countries named, 1900–1904.

[Bales of 500 pounds, gross weight, or 478 pounds of lint, net.]

Country.	1900.	1901.	1902.	1903.	1904.
	Bales.	*Bales.*	*Bales.*	*Bales.*	*Bales.*
Total United States (including the Philippine Islands)	10,129,125	9,515,846	10,637,043	9,857,492	13,444,946
United States:					
Continental [a]	10,123,027	9,509,745	10,630,945	9,851,129	13,438,012
Porto Rico [b]	....	3	....	265	836
Total United States (in North America)	10,123,027	9,509,748	10,630,945	9,851,394	13,438,848
Guatemala	[c] 147	[c] 147	[c] 147	147	[c] 147
Mexico	100,527	103,147	103,910	168,998	[d] 119,000
West Indies:					
British—					
Bahamas [b]	....	2	3	13	18
Barbados	....	....	....	11	401
Grenada [b]	616	527	518	630	658
Jamaica [b]	....	....	....	6	30
Leeward Islands	....	....	....	133	262
St. Lucia [b]	....	....	....	....	5
St. Vincent [b]	51	53	113	91	264
Trinidad and Tobago [b]	....	....	....	....	3
Turks and Caicos Islands [b]	....	5	....	1	....
Cuba	....	....	....	77	42
Guadeloupe [b]	([e])	5	([e])	1	2
Haiti [b]	[d] 5,800	[d] 5,800	4,184	6,821	6,312
Total North America	10,230,168	9,619,434	10,739,820	10,028,323	13,565,992
Brazil [f]	209,000	157,000	251,000	234,000	165,000
British Guiana [b]	....	....	....	([e])	4
Colombia and Venezuela [g]	5,200	5,200	5,200	5,200	5,200
Peru [h]	44,000	48,000	42,000	46,000	46,000
Total South America	258,200	210,200	298,200	285,200	216,204
Bulgaria [g]	590	590	590	590	590
Crete [g]	690	690	690	690	690
Greece [g]	8,200	8,200	8,200	8,200	8,200
Italy [g]	2,700	2,700	2,700	2,700	2,700
Malta	421	236	231	285	345
Turkey [g]	4,600	4,600	4,600	4,600	4,600
Total Europe	17,201	17,016	17,011	17,065	17,125
British India [i]	2,262,467	2,770,488	3,138,535	2,995,517	2,837,166
Ceylon [b]	559	485	428	317	371
China [j]	1,192,000	1,192,000	1,192,000	1,192,000	1,192,000
Cyprus	2,269	1,628	817	692	1,118
Dutch East Indies [b]	14,274	9,160	8,267	12,661	[d] 11,000
French Indo-China [b]	5,015	7,815	11,139	13,693	[k] 14,000
Japan	28,217	25,762	19,152	17,012	16,262
Persia [g]	32,000	32,000	32,000	32,000	32,000
Philippine Islands	[l] 6,098	[l] 6,098	6,098	[l] 6,098	[l] 6,098
Russia, Asiatic:					
Transcaucasia [d]	56,000	56,000	56,000	56,000	56,000
Central Asia	577,065	426,056	369,983	[k] 523,000	[k] 523,000
Total Asiatic Russia	633,065	482,056	425,983	579,000	579,000

[a] "Linters," a by-product, not included; quantity of "linters" produced as follows: 150,105 bales in 1900, 173,667 bales in 1901, 205,254 bales in 1902, 203,437 bales in 1903, and 253,077 bales in 1904.
[b] Exports.
[c] Official estimate for 1903.
[d] Average production.
[e] Less than one-half bale.
[f] Estimated from exports and an assumed annual home consumption of approximately 50,000,000 pounds.
[g] Average production as unofficially estimated.
[h] Estimated from exports and an assumed annual home consumption of approximately 5,000,000 pounds.
[i] Exports and mill consumption.
[j] Estimate of Ellison, based upon net imports and an assumed annual per capita consumption of 2¼ pounds.
[k] Unofficial estimate.
[l] Census for 1902.

Cotton crop of countries named, 1900–1904—Continued.

Country.	1900.	1901.	1902.	1903.	1904.
	Bales.	*Bales.*	*Bales.*	*Bales.*	*Bales.*
Turkey, Asiatic [a]	63,000	63,000	63,000	63,000	63,000
Total Asia	4,238,964	4,590,492	4,897,419	4,911,990	4,752,015
British Africa:					
Central Africa [b]			1	119	597
East Africa					609
Gambia [b]	1	([c])	([c])	3	125
Gold Coast [b]	44	6		22	121
Lagos [b]	50	16	26	606	1,805
Natal					3
Nigeria, northern [b]					[illegible]
Nigeria, southern [b]					[illegible]
Sierra Leone [b]				2	59
Uganda [b]					[illegible]
Total British Africa	95	22	27	752	4,563
Egypt [d]	1,124,632	1,320,307	1,209,746	1,348,759	1,316,212
Eritrea [e]	12	9	23	24	8
French Africa: [b]					
Madagascar				([c])	([c])
Mayotte				1	1
Senegal	99			2	2
Somali Coast	3		([c])		2
Total French Africa	102		([c])	3	5
German Africa: [b]					
East Africa	([c])	1	2	43	869
Togo				148	499
Total German Africa	([c])	1	2	191	1,368
Sudan (Egyptian)	[f] 23,970	[f] 23,970	[f] 23,970	[f] 23,970	23,970
Total Africa	1,148,811	1,344,309	1,233,768	1,373,699	1,346,126
Bismarck Archipelago [b]			13	240	56
Fiji [b]	7				([c])
Queensland			1	1	18
Tahiti [b]	240	110	79	71	63
Total Oceania	247	110	93	312	137
Total	15,893,591	15,781,561	17,186,311	16,616,589	19,897,599

[a] Average production as unofficially estimated.
[b] Exports.
[c] Less than one-half bale.
[d] According to Davies, Benachi & Co., as quoted by Ellison.
[e] Imports from Eritrea into Italy.
[f] Official estimate for 1904.

World's international trade in cotton, 1900–1905.

[Bales of 500 pounds, gross weight, or 478 pounds of lint, net.]

EXPORTS.

Country.	Year beginning—	1900.	1901.	1902.	1903.	1904.
		Bales.	*Bales.*	*Bales.*	*Bales.*	*Bales.*
Brazil	Jan. 1	[a] 105,000	54,262	148,225	130,229	61,170
Egypt	Jan. 1	1,124,660	1,268,856	1,378,413	1,158,029	1,225,259
France	Jan. 1	159,165	127,715	117,738	152,127	150,462
Germany [b]	Jan. 1	235,265	216,810	257,289	286,743	319,732
India (British)	April 1	847,441	1,347,878	1,429,058	1,865,791	1,334,111
Netherlands	Jan. 1	110,591	100,719	82,530	110,568	104,182
Peru	Jan. 1	33,420	36,948	30,826	35,287	34,739
United States	July 1	7,027,327	7,382,792	7,466,824	6,464,134	9,078,080
Other countries		305,900	169,700	299,100	383,500	413,200
Total		9,948,769	10,705,680	11,210,003	10,586,408	12,720,935

[a] Estimated. [b] Not including the free ports.

World's international trade in cotton, 1900-1905—Continued.

IMPORTS.

Country.	Year beginning—	1900.	1901.	1902.	1903.	1904.
		Bales.	*Bales.*	*Bales.*	*Bales.*	*Bales.*
Austria-Hungary	Jan. 1	557,548	617,908	664,313	688,041	700,062
Belgium	Jan. 1	160,699	152,334	206,087	246,879	186,228
Canada	July 1	102,646	134,364	142,138	101,800	118,583
France	Jan. 1	891,960	980,936	985,068	1,167,740	967.710
Germany [a]	Jan. 1	1,653,606	1,723,038	1,805,305	1,992,090	2,082,693
Italy	Jan. 1	565,866	623,206	679,641	711,035	713,733
Japan	Jan. 1	701,760	697,024	946,919	816,657	733,849
Mexico	July 1	43,461	29,028	77,590	64,680	84,025
Netherlands	Jan. 1	193,724	193,982	182,427	199,729	203,091
Russia	Jan. 1	777,353	783,865	820,955	1,061,822	[b] 907,051
Spain	Jan. 1	305,325	360,966	392,993	368,653	325,157
Sweden	Jan. 1	78,727	76,496	83,166	83,194	80,325
United Kingdom	Jan. 1	3,231,087	3,395,697	3,225,052	3,113,890	3,559,028
United States	July 1	97,555	206,518	156,641	102,177	126,587
Other countries	....	305,600	295,400	288,200	243,200	247,600
Total	....	9,666,917	10,270,762	10,656,495	10,961,587	11,035,722

[a] Not including the free ports.
[b] Preliminary figures excluding the trade over the Asiatic frontier (excepting the Black Sea ports of the Caucasus).
(See "General note" to "World's international trade in wheat," p. 665.)

Condition of the cotton crop of the United States, monthly, 1889-1905.

Year.	June.	July.	August.	September.	October.	Year.	June.	July.	August.	September.	October.
	P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*		*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
1889	86.4	87.6	89.3	86.6	81.5	1898	89.0	91.2	91.2	79.8	75.4
1890	88.8	91.4	89.5	85.5	80.0	1899	85.7	87.8	84.0	68.5	62.4
1891	85.7	88.6	88.9	82.7	75.7	1900	82.5	75.8	76.0	68.2	67.0
1892	85.9	86.9	82.3	76.8	73.3	1901	81.5	81.1	77.2	71.4	61.4
1893	85.6	82.7	80.4	73.4	70.7	1902	95.1	84.7	81.9	64.0	58.3
1894	88.3	89.6	91.8	85.9	82.7	1903	74.1	77.1	79.7	81.2	65.1
1895	81.0	82.3	77.9	70.8	65.1	1904	83.0	88.0	91.6	84.1	75.8
1896	97.2	92.5	80.1	64.2	60.7	1905	77.2	77.0	74.9	72.1	71.2
1897	83.5	86.0	86.9	78.3	70.0						

Acreage, production, value, prices, and exports of cotton of the United States, 1899-1905.

Year.	Acreage.	Production.		Value. [a]	New York closing prices per pound on middling upland.				Domestic exports fiscal years beginning July 1.
		Thousands of pounds. ([a])	Bales of 500 pounds gross weight. [a]		December.		May of following year.		
					Low.	High.	Low.	High.	
	Acres.	*Pounds.*	*Bales.*	*Dollars.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Bales of 500 lbs.*
1899-1900	[b]24,275,101	4,467,097	9,345,391	370,708,746	$7\frac{1}{4}$	$7\frac{3}{4}$	9	$9\frac{7}{8}$	6,201,166
1900-1901	25,758,139	4,846,471	10,123,027	....	$9\frac{3}{4}$	$10\frac{5}{16}$	$8\frac{1}{16}$	$8\frac{5}{16}$	6,661,781
1901-1902	27,220,414	4,550,950	9,509,745	....	8	$8\frac{3}{4}$	$9\frac{3}{8}$	$9\frac{3}{4}$	7,001,558
1902-1903	27,114,103	5,091,641	10,630,945	421,687,941	$8\frac{1}{4}$	$8\frac{7}{8}$	10.75	12.15	7,086,086
1903-1904	28,016,893	4,716,591	9,851,129	576,499,824	11.95	14.10	12.75	13.90	6,126,386
1904-1905	30,053,739	6,426,698	13,438,012	561,100,386	6.85	9.00	7.85	8.85	8,609,698
1905-1906	26,117,153	5,060,205	10,575,017	556,833,818	11.65	12.60	....	....	....

[a] As reported by U. S. Census Bureau.
[b] According to Report of Twelfth Census; the acreages for subsequent years are as estimated by the Bureau of Statistics, Department of Agriculture.

Cotton acreage, by States, from 1900 to 1905, inclusive.

States.	1900.	1901.	1902.	1903.	1904.	1905.
	Acres.	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*
Virginia	30,572	35,145	36,843	39,864	47,199	38,664
North Carolina	1,091,034	1,112,260	1,075,743	1,155,028	1,306,968	1,085,568
South Carolina	2,195,252	2,248,569	2,205,016	2,318,100	2,531,875	2,161,923
Georgia	3,783,015	4,006,199	3,863,542	4,048,912	4,227,188	3,738,703
Florida	235,451	254,596	253,961	268,666	267,372	256,173
Alabama	3,403,746	3,642,964	3,501,614	3,608,049	3,611,731	3,500,168
Mississippi	3,194,795	3,193,570	3,183,989	3,327,960	3,632,458	3,051,265
Louisiana	1,480,781	1,586,124	1,617,586	1,642,463	1,745,865	1,561,774
Texas	7,178,915	7,656,312	7,640,531	7,801,578	8,355,491	6,945,501
Arkansas	1,742,787	1,854,482	1,901,758	1,925,191	2,051,185	1,718,751
Tennessee	662,612	737,337	754,600	783,196	881,341	757,397
Missouri	49,504	54,628	59,341	66,496	79,403	66,444
Oklahoma	255,446	306,750	358,391	326,391	502,021	418,184
Indian Territory	453,560	530,923	658,699	702,966	813,642	816,638
All other	669	555	2,489	2,033	....	....
Total	25,758,139	27,220,414	27,114,103	28,016,893	30,053,739	26,117,153

Prices of middling upland cotton in New Orleans, monthly, 1890–1905.

[In cents per pound.]

Year.	January.		February.		March.		April.		May.		June.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1890	9 5/8	10 11/16	10 3/8	10 11/16	10 11/16	11	11	11 11/16	11 9/16	11 7/8	11 7/16	11 7/8
1891	8 15/16	9 5/16	8 3/4	9 1/16	8 5/8	8 3/4	8 5/16	8 11/16	8 5/16	8 5/8	7 7/8	8 1/4
1892	6 13/16	7 3/16	6 1/2	6 7/8	6 1/4	6 1/2	6 3/8	7	7	7 3/16	7 1/16	7 1/2
1893	9 1/4	9 5/8	8 13/16	9 1/4	8 5/16	9	7 7/16	8 3/16	7 1/4	7 5/8	7 5/16	7 7/8
1894	7 5/16	7 3/4	7 1/16	7 7/16	7 1/8	7 5/16	7	7 5/16	6 13/16	7 1/16	6 7/8	7 1/8
1895	5	5 3/16	5	5 3/16	5 1/16	5 7/8	5 3/4	6 3/8	6 3/16	7	6 5/8	7
1896	7 13/16	8	7 1/8	8	7 3/8	7 13/16	7 5/8	7 3/4	7 3/8	7 3/4	6 13/16	7 3/8
1897	6 7/8	7	6 11/16	7 3/16	6 15/16	7 3/16	6 15/16	7 9/16	7 5/16	7 9/16	7 3/8	7 5/8
1898	5 3/16	5 3/8	5 1/4	5 11/16	5 7/16	5 3/4	5 9/16	5 3/4	5 11/16	6 1/16	5 7/8	6 1/16
1899	5 3/16	5 3/4	5 3/4	6	5 11/16	6 1/16	5 5/8	5 3/4	5 11/16	5 7/8	5 1/2	5 3/4
1900	7 1/4	7 3/4	7 7/8	9	9	9 7/16	9 1/8	9 1/2	8 13/16	9 1/2	8 13/16	9 13/16
1901	9 5/16	9 11/16	9 1/16	9 5/16	7 15/16	9 1/16	8	8 5/16	7 9/16	8	7 3/4	8 7/16
1902	7 3/4	8	7 13/16	8 3/16	8 1/4	8 5/8	8 9/16	9 3/4	9 1/8	9 3/4	8 15/16	9 5/16
1903	8 7/16	8 7/8	8 7/8	9 7/8	9 9/16	9 7/8	9 3/4	10 3/16	10 3/16	11 11/16	11 11/16	13 5/8
1904	13	15 15/16	13 1/4	16 7/16	14	16	13 7/8	15 5/16	12 5/8	13 7/8	10 3/4	12 1/8
1905	6 5/8	7	7	7 11/16	7 1/4	7 11/16	7 3/8	7 5/16	7 1/2	8 7/16	8 1/4	9 9/16

Year.	July.		August.		September.		October.		November.		December.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1890	11 7/16	11 3/4	10 3/8	11 3/4	9 3/4	10 1/4	9 11/16	10 1/16	9 1/16	9 9/16	8 13/16	9 1/8
1891	7 1/4	7 13/16	7 3/8	8	8	8 1/2	7 13/16	8 3/8	7 1/8	7 7/8	7	7 1/2
1892	7	7 3/16	6 15/16	7 3/16	6 15/16	7 7/16	7 7/16	7 13/16	7 11/16	9 7/8	9 5/16	9 11/16
1893	7 1/16	7 3/4	6 13/16	7 5/8	7 5/16	8 3/16	7 3/8	8 1/4	7 7/16	7 3/4	7 1/8	7 9/16
1894	6 5/8	6 7/8	6 7/16	6 5/8	5 11/16	6 1/2	5 3/16	5 3/4	4 7/8	5 1/2	5 1/16	5 5/16
1895	6 1/2	6 3/4	6 9/16	7 11/16	7 9/16	8 3/4	8 5/16	9 3/16	8 1/16	8 5/8	7 1/4	8 3/16
1896	6 1/2	6 13/16	6 13/16	8	7 3/8	8 1/8	7 1/8	7 5/8	7 3/16	7 1/2	6 11/16	7 3/8
1897	7 11/16	7 13/16	7 1/16	7 11/16	6 1/16	7 1/16	5 1/2	6 1/8	5 1/4	5 1/2	5 1/4	5 3/8
1898	5 5/8	5 7/8	5 1/8	5 11/16	4 7/8	5 1/8	4 13/16	5	4 3/4	5 1/16	5	5 1/4
1899	5 5/8	5 3/4	5 3/4	5 15/16	5 3/4	6 1/2	6 3/4	6 15/16	6 7/8	7 7/16	7 3/16	7 1/2
1900	9 7/8	10 1/4	9 1/4	10 1/4	9 3/8	11 1/8	8 13/16	10 5/16	9	9 7/8	9 1/4	9 13/16
1901	8 1/8	8 7/16	8	8 15/16	7 15/16	8 5/8	7 7/16	8 5/16	7 1/4	7 7/16	7 3/4	8 1/16
1902	8 5/8	9 1/16	8 3/8	8 5/8	8 3/16	8 5/8	8	8 1/2	7 5/8	8	7 15/16	8 3/8
1903	12 3/8	13 3/8	12 1/2	13 1/4	9 3/4	12 1/2	9 1/8	10 1/4	10	11 3/16	11 1/2	13 5/8
1904	10 1/2	11 1/16	10 1/4	11 3/16	10	11 3/16	9 1/8	10 3/16	8 7/8	9 11/16	6 1/2	8 9/16
1905	9 3/4	11 1/8	10 3/8	10 9/16	10 1/8	10 7/16	9 3/4	10 11/16	10 3/4	11 9/16	11 3/8	1[illegible] 1/16

Closing prices middling upland cotton per pound, in leading cities of the United States, 1900–1905.

Date.	New York.		New Orleans.		Memphis.		Galveston.		Savannah.		Charleston.		Wilmington.		Norfolk.	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
1900.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.
Jan	7 1/4	8	7 1/4	7 3/4	7 3/8	7 11/16	7 1/4	7 11/16	7 5/16	7 5/8	7 1/4	7 3/8	7 1/4	7 1/2	7 7/16	7 7/8
Feb	8 1/4	9 5/16	7 3/4	8	7 11/16	8 3/4	7 3/4	8 13/16	7 11/16	8 15/16	7 5/8	8 3/4	7 1/2	8 3/4	7 7/8	9 1/8
Mar	9 5/16	9 1/2	9	9 1/16	8 7/8	9 7/16	9 1/8	9 3/8	9 3/16	9 1/2	9	9 3/8	9	9 1/2	9 1/4	9 7/8
Apr	9 5/16	9 1/2	9 1/4	9 1/2	9 1/4	9 3/8	9 1/4	9 7/16	9 3/8	9 7/16	9 1/4	9 3/8	9 1/4	9 1/2	9 1/2	9 5/8
May	9	9 1/2	8 15/16	9 1/4	8 3/4	9 7/16	8 7/8	9 7/16	9	9 7/16	9 5/16	9 3/8	9 1/4	9 1/4	9 1/4	9 3/8
June	8 15/16	10	8 13/16	9 1/16	8 3/8	9 5/8	8 1/8	9 3/8	8 3/4	9 1/4	......	......	......	......	8 3/4	9 5/8
July	9 13/16	10 1/4	9 1/4	10 1/4	9 3/8	10	9 7/8	9 1/8	9 5/16	9 7/8	9 1/8	9 3/8	......	......	9 3/4	10 1/16
Aug	9 1/4	10 1/4	9 1/4	10 1/4	9 1/8	9 3/4	8 7/8	9 5/16	9	9 3/4	8 5/8	9 1/2	......	......	9 1/4	10
Sept	9 1/4	11	9 1/4	11 1/4	9 5/16	11	9 1/4	10	9 1/16	10 3/4	8 7/8	10 3/4	9	10 3/4	9 3/8	11
Oct	9 1/16	11	8 13/16	10 1/4	8 7/8	10 1/4	8 13/16	10	8 13/16	10 1/16	8 3/4	10	9	10 1/4	9	10 5/16
Nov	9 5/16	10 1/4	9	9 3/4	8 15/16	10	9	9 3/4	8 15/16	9 3/4	9	9 11/16	9	9 5/8	9	9 13/16
Dec	9 1/4	10 5/16	9 1/4	9 11/16	9 3/8	9 13/16	9 1/4	9 11/16	9 1/16	9 11/16	9	9 5/8	9 1/4	9 5/8	9 1/4	9 1/4
1901.																
Jan	9 7/8	12	9 5/16	9 11/16	9	9 3/4	9 1/4	9 11/16	9 1/2	9 3/4	9 1/4	9 1/2	9 1/4	9 1/2	9 1/2	9 11/16
Feb	9 1/16	10	9 1/16	9 5/16	9 1/16	9 7/16	9 1/8	9 7/16	9	9 3/8	9	9 7/8	9	9 1/2	9 1/8	9 7/16
Mar	8 1/8	9 15/16	7 15/16	9 1/16	8	9 1/8	8	9 1/8	7 7/8	9	7 3/4	9	7 7/8	9	8	9 1/4
Apr	8 1/4	8 9/16	8 1/16	8 5/16	8	8 1/4	8 1/8	8 3/8	7 15/16	8 1/8	7 7/8	8	7 1/2	7 7/8	8 1/16	8 1/4
May	8 1/16	8 5/16	7 3/16	8	7 9/16	8	7 1/4	8 1/4	7 7/16	8 1/16	7 1/2	8	7 1/4	7 1/2	7 1/2	[illegible]
June	8 1/4	8 13/16	7 3/4	8 1/4	7 5/8	8 5/16	7 13/16	8 7/16	7 1/2	8 1/8	7 1/2	8 3/4	7 3/4	7 3/4	7 3/4	8 7/16
July	8 1/4	8 1/4	8 1/4	8 7/16	8	8 5/16	8 1/8	8 1/2	8	8 1/4	8 1/2	8 1/4	7 3/4	8 1/4	7 3/4	8 1/2
Aug	8	8 1/4	8	8 15/16	8	8 5/8	8 1/16	8 15/16	7 5/8	8 3/8	7 3/4	8 1/4	8	8 1/4	7 13/16	8 3/8
Sept	8 1/16	8 1/4	7 15/16	8 1/4	7 13/16	8 5/8	7 15/16	8 15/16	7 3/8	8 3/8	7 5/8	8 3/8	8	8 1/4	8	8 1/8
Oct	7	8 3/16	7 7/16	8 1/16	7 1/2	8 5/8	7 5/8	8 3/8	7 3/16	8	7 3/16	8 1/8	7 3/8	8 3/8	7 3/8	[illegible]
Nov	7 15/16	8	7 1/4	7 7/16	7 1/8	7 5/8	7 3/8	7 5/8	7 1/8	7 5/16	7 1/8	7 3/8	7 1/8	7 3/8	7 1/4	7 5/8
Dec	8	8 1/4	7 3/4	8 7/16	7 5/16	8	7 1/2	8 1/8	7 1/4	7 15/16	7 11/16	8	7 1/2	7 7/8	7 1/2	8 1/16
1902.																
Jan	8 5/16	8 9/16	7 3/4	8	7	7 15/16	7 7/8	8	7 3/4	7 7/8	7 3/16	7 7/8	7 3/4	7 7/8	7 13/16	8
Feb	8 1/4	8 13/16	7 13/16	8 3/16	7 13/16	8 1/4	7 15/16	8 5/16	7 13/16	8 5/16	7 7/8	8 5/16	7 7/8	8 1/4	7 15/16	8 1/2
Mar	8 3/4	9 3/16	8 1/4	8 5/8	8 1/4	8 5/8	8 7/16	8 5/8	8 5/16	8 5/8	8 1/4	8 5/8	8 1/4	8 5/8	8 1/2	8 13/16
Apr	9	9 1/2	8 9/16	9 1/4	8 1/2	9 1/2	8 5/8	9 5/8	8 9/16	9 9/16	8 3/16	9 3/8	8 5/8	9 3/8	8 3/4	9 3/4
May	9 3/4	9 3/4	9 1/2	9 3/4	9	9 1/2	9 3/16	9 5/8	9 3/16	9 1/2	9 1/4	9 3/8	9	9 1/2	9 3/16	9 3/4
June	9 1/4	9 7/16	8 15/16	9 5/16	8 15/16	9 1/16	8 15/16	9 1/4	9	9 1/16	8 3/4	8 3/4	9	9 1/2	9 1/2	9 1/4
July	8 13/16	9 1/2	8 5/8	9 1/16	8 13/16	9	8 3/4	8 15/16	8 3/4	8 7/8	8 5/8	8 5/8	8 3/4	9	9	9 1/8
Aug	8 1/2	9	8 5/16	8 3/4	8 1/2	8 13/16	8 7/16	8 3/4	8 1/8	8 3/4	8 3/16	8 1/4	8 1/2	8 3/4	8 3/4	9 1/16
Sept	8 1/2	9 1/2	8 5/16	8 1/4	8 1/4	8 1/2	8 1/4	8 5/8	8 1/8	8 7/16	8 1/16	8 3/8	8 3/8	8 1/2	8 1/2	9
Oct	8 9/16	8 13/16	8	8 1/4	7 15/16	8 7/16	8 3/16	8 9/16	7 7/8	8 1/4	7 7/8	8 1/4	8 1/8	8 3/8	8 1/8	8 9/16
Nov	8 5/16	8 1/4	7 3/4	8	7 5/8	8	7 3/4	8 3/16	7 9/16	7 15/16	7 9/16	8	7 3/4	8 1/8	7 3/4	8 3/16
Dec	8 1/2	8 1/4	7 11/16	8 3/8	8	8 5/16	8 1/8	8 1/2	7 7/8	8 1/4	7 7/8	8 1/4	7 3/4	8 1/8	8 1/16	8 1/4
1903.																
Jan	8.85	9.05	8 7/16	8 3/4	8 1/2	8 3/4	8 5/8	8 15/16	8 3/8	8 3/4	8 1/4	8 5/8	8 1/4	8 1/2	8 5/8	9
Feb	9.00	10.25	8 3/4	9 1/4	8 3/4	9 7/8	8 15/16	10 1/16	8 3/4	9 7/8	8 5/8	9 3/4	8 1/2	9 3/4	9	10
Mar	9.90	10.45	9 5/16	9 3/4	9 11/16	9 15/16	9 7/8	10 1/16	9 5/8	9 7/8	9 1/2	9 3/4	9 1/2	9 3/4	9 3/4	10
Apr	9.90	10.75	9 1/4	10 5/16	9 3/4	10	9 7/8	10 1/8	9 5/8	10	9 1/2	10	9 1/2	9 3/4	10	10 1/4
May	10.75	12.15	10 5/16	11 11/16	10	11 3/8	10 1/8	11 1/2	10	11 1/4	10	11	10	10 1/2	10 3/4	11 3/8
June	11.50	13.35	11 11/16	13 1/4	11 3/8	13 5/16	11 7/16	12 3/4	11 1/4	12 1/2	.....	11	.....	10 1/2	11 3/8	13
July	11.60	13.50	12 1/4	13 1/4	12 7/16	13 5/16	12	12 3/4	12 1/4	13 1/8	.....	.....	.....	.....	12	13
Aug	12.75	12.75	12 1/2	13 1/2	12 7/16	12 15/16	12	12 1/8	12 1/8	13 1/8	12 1/4	12 1/4	.....	.....	12 1/2	12 1/2
Sept	11.25	13.00	9 3/4	12 1/2	9 3/4	12 9/16	10	12 1/8	9 7/16	12 1/2	9 1/2	11 7/8	9 1/2	11 1/4	9 3/4	12 1/8
Oct	9.50	10.00	9 1/2	10 1/4	9 1/2	10 1/8	9 5/16	10 3/16	9 1/16	10 1/4	9	10	9	10 1/8	9 1/4	10 3/16
Nov	10.50	11.65	10	11 1/16	10 1/16	11 1/8	10 1/8	11 3/16	10 1/8	11 1/8	10	10 7/8	10	11	10 1/4	11 3/8
Dec	11.95	14.10	11 1/4	13 1/4	11 1/4	13 1/2	11 7/16	13 3/8	11 3/8	13 3/8	11	13 1/2	11	12 3/4	11 3/4	13 3/4
1904.																
Jan	13.10	16.75	13	15 11/16	13	15 3/8	12 3/4	15 5/16	12 5/8	15 7/8	12 1/2	15 3/4	12 3/4	15	13	16
Feb	13.50	17.25	13 1/4	16 1/16	13 1/4	16 1/4	13 1/2	16	13 1/4	16 1/4	14	16	13	15 1/2	13	16 1/2
Mar	14.00	16.65	14	16	14	15 13/16	14	15 15/16	14 1/2	15 3/4	14 1/2	15 3/4	14	15 3/4	14	16 1/4
Apr	13.75	15.45	13 1/4	15 5/16	13 7/8	15 1/8	14	15 3/16	13 3/4	14 3/4	14 1/2	15 3/8	.....	.....	14	15 1/4
May	12.75	13.90	12 1/4	13 5/16	12 1/2	13 7/8	12 5/8	13 13/16	12 7/8	13 3/4	.....	.....	.....	.....	13	14
June	10.85	12.85	10 1/4	12 1/4	10 1/2	12	10 1/2	12 1/2	10 3/4	12 3/4	.....	.....	.....	.....	10 3/4	12 1/8
July	10.60	11.25	10 1/2	11 1/16	10 3/8	11	10 1/2	10 13/16	10 3/4	11 1/8	.....	.....	.....	.....	10 5/8	11 1/4
Aug	10.45	11.65	10 1/4	11 1/16	10 1/4	11	10 1/2	11 1/4	10 1/4	11	.....	.....	.....	.....	10 1/4	11
Sept	10.70	11.30	10	11 3/16	10 1/4	11	10 1/4	11 1/4	9 13/16	11 1/4	10	10 1/16	10 1/16	10 1/16	10	11
Oct	9.90	10.65	9 1/2	10 1/16	9 1/2	10 3/16	9 1/2	10 1/16	9 1/2	9 15/16	9 1/4	9 13/16	.....	.....	9 1/2	10 1/16
Nov	9.30	10.25	8 1/2	9 11/16	8 7/8	9 11/16	8 15/16	9 13/16	8 3/4	9 11/16	9	9 9/16	9	9 5/8	9	9 11/16
Dec	6.85	9.00	6 1/2	8 1/16	6 3/4	8 5/8	6 5/8	8 9/16	6 1/8	8 1/2	6 1/8	8 1/4	.....	.....	6 3/4	8 5/8
1905.																
Jan	7.00	7.35	6 3/4	7	6 3/4	7 1/16	6 3/4	7 1/16	6 5/8	7	6 5/8	6 7/8	.....	.....	6 3/4	7 1/4
Feb	7.35	8.90	7	7 11/16	7 1/8	7 7/16	7 1/8	7 13/16	7	7 13/16	6 3/4	7 1/8	6 3/4	7 1/8	7 1/8	7 1/4
Mar	7.75	8.30	7 1/4	7 11/16	7 3/8	7 11/16	7 1/8	7 13/16	7 3/8	7 13/16	7 1/4	7 3/4	7 1/4	7 5/8	7 5/8	8
Apr	7.55	8.15	7 3/8	7 5/16	7 3/8	7 9/16	7 3/8	7 11/16	7 1/8	7 9/16	7	7 5/16	7 1/4	7 1/2	7 3/8	7 7/8
May	7.85	8.85	7 1/2	8 1/16	7 5/8	8 3/4	7 5/8	8 11/16	7 1/4	8 1/2	7 1/4	8 1/4	7 1/4	8 1/4	7 5/8	8 3/4
June	8.40	10.15	8 1/4	9 5/16	8 3/8	9 13/16	8 1/4	9 5/16	8 1/8	9 5/8	7 7/8	8 5/16	8	8 3/8	8 1/4	9 3/4
July	10.00	11.40	9 3/4	11 1/2	9 13/16	11 1/16	9 7/8	11 3/16	9 5/8	10 7/8	10	10 3/8	.....	.....	9 3/4	11
Aug	10.50	11.35	10 3/4	10 5/16	10 1/8	10 5/8	10 1/8	10 11/16	10 1/4	10 11/16	10 1/4	10 3/8	.....	10 3/8	10 1/2	11
Sept	10.65	11.10	10 1/2	10 7/16	10 1/8	10 11/16	10 1/8	10 11/16	9 7/8	10 5/16	9 7/8	10 7/16	10	10 3/8	10 1/4	10 5/16
Oct	9.85	10.75	9 3/4	10 11/16	9 1/2	10 3/16	9 3/4	10 9/16	9 7/16	10 7/16	9 1/2	10 3/16	9 1/2	10 1/4	9 3/8	10 3/4
Nov	10.90	12.00	10 3/4	11 3/16	11	11 15/16	10 3/4	11 5/16	10 3/8	11 5/16	10 1/4	11 1/4	10 3/8	11 1/4	10 3/8	11 5/16
Dec	11.65	12.60	11 3/8	12 1/16	11 1/8	12 1/8	11 1/8	12	11 3/4	11 11/16	11	11 5/16	11 1/8	11 3/8	11 3/8	12

TOBACCO.

Total tobacco crop of countries named, 1900–1904.

Country.	1900.	1901.	1902.	1903.	1901.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Total United States (including the Philippine Islands)	855,445,000	865,553,000	867,323,000	856,872,000	700,561,000
United States:					
Continental	814,345,000	818,953,000	821,824,000	815,972,000	660,461,000
Porto Rico	6,000,000	8,000,000	8,000,000	5,000,000	[a] 7,000,000
Total United States (in North America)	820,345,000	826,953,000	829,824,000	820,972,000	667,461,000
Canada:					
Ontario	[b] 3,504,000	3,114,000	3,071,000	2,423,000	3,035,000
Other	[b] 7,763,000	[c] 8,000,000	[c] 8,000,000	[c] 8,000,000	[c] 8,000,000
Total Canada	11,267,000	11,114,000	11,071,000	10,423,000	11,035,000
Cuba	[d] 54,400,000	45,892,000	57,177,000	[d] 37,700,000	[d] 45,748,000
Guatemala	1,137,000	1,051,000	1,063,000	1,065,000	1,983,000
Mexico	20,599,000	26,256,000	[d] 20,000,000	29,156,000	[a] 25,000,000
Total North America	907,748,000	911,266,000	919,135,000	899,316,000	751,227,000
Brazil [a]	55,000,000	55,000,000	55,000,000	55,000,000	55,000,000
Austria-Hungary:					
Austria	11,682,000	9,689,000	12,938,000	15,895,000	14,047,000
Hungary	132,100,000	125,934,000	99,228,000	134,567,000	88,768,000
Total Austria-Hungary	143,782,000	135,623,000	112,166,000	150,462,000	102,815,000
Belgium	10,604,000	10,647,000	11,266,000	9,685,000	13,983,000
Bulgaria	6,951,000	5,590,000	6,423,000	19,060,000	8,914,000
Denmark	368,000	293,000	363,000	342,000	340,000
France	50,177,000	55,905,000	54,610,000	57,466,000	37,767,000
Germany	76,699,000	88,213,000	83,111,000	72,911,000	75,794,000
Greece [a]	14,000,000	14,000,000	14,000,000	14,000,000	14,000,000
Italy	13,695,000	12,734,000	11,052,000	12,188,000	[a] 12,400,000
Netherlands	3,229,000	2,768,000	2,211,000	1,771,000	[d] 1,500,000
Roumania	8,841,000	6,249,000	6,096,000	10,113,000	3,999,000
Russia	153,609,000	136,630,000	232,767,000	[a] 174,000,000	[a] 174,000,000
Servia	2,021,000	1,973,000	2,358,000	2,488,000	2,380,000
Sweden	1,748,000	1,680,000	1,636,000	1,706,000	4,118,000
Total Europe	485,727,000	472,305,000	538,059,000	526,192,000	452,010,000
British India [a]	441,000,000	441,000,000	441,000,000	441,000,000	441,000,000
Dutch East Indies:					
Borneo	880,000	736,000	336,000	163,000	[a] 500,000
Java	47,922,000	31,414,000	57,958,000	59,274,000	[a] 49,100,000
Sumatra	44,116,000	44,512,000	46,850,000	50,721,000	[a] 46,500,000
Total Dutch East Indies	92,918,000	76,662,000	105,144,000	110,158,000	96,100,000
Japanese Empire:					
Japan	89,671,000	64,652,000	69,029,000	95,151,000	[b] 105,853,000
Formosa	802,000	904,000	1,095,000	1,010,000	[b] 222,000
Total Japanese Empire	90,473,000	65,556,000	70,124,000	96,161,000	106,075,000
Philippine Islands	[d] 35,100,000	[d] 38,600,000	[b] 37,499,000	[d] 35,900,000	[d] 33,100,000
Turkey [e]	[a] 66,000,000	[a] 66,000,000	[d] 71,000,000	[d] 110,000,000	[d] 90,000,000
Total Asia	725,491,000	687,818,000	724,767,000	793,219,000	766,275,000

[a] Average production.
[b] Census.
[c] Estimated from returns for census year.
[d] Unofficial estimate.
[e] Including European Turkey.

Total tobacco crop of countries named, 1900-1904—Continued.

Country.	1900.	1901.	1902.	1903.	1904.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Algeria	17,017,000	16,657,000	18,863,000	13,013,000	12,492,000
Cape of Good Hope	a 5,000,000	a 5,000,000	a 5,000,000	a 5,000,000	b 5,309,000
Mauritius	30,000	6,000	26,000	28,000	29,000
Natal	2,755,000	4,271,000	3,479,000	4,418,000	2,907,000
Orange River Colony	c 750,000	c 750,000	c 750,000	c 750,000	750,000
Total Africa	25,582,000	26,684,000	28,118,000	23,209,000	21,487,000
Australia:					
New South Wales	744,000	213,000	221,000	292,000	596,000
Victoria	153,000	35,000	39,000	87,000	95,000
Queensland	734,000	452,000	655,000	204,000	69,000
Total Australia	1,631,000	700,000	915,000	583,000	760,000
Fiji	14,000	47,000	56,000	74,000	58,000
Total Oceania	1,645,000	747,000	971,000	657,000	818,000
Total	2,201,193,000	2,153,820,000	2,266,050,000	2,297,593,000	2,046,817,000

a Unofficial estimate. b Census. c Official estimate for 1904.

World's international trade in unmanufactured tobacco, 1900-1905.

EXPORTS.

Country.	Year beginning—	1900.	1901.	1902.	1903.	1904.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Algeria	Jan. 1	6,933,395	11,212,917	7,601,206	8,346,919	7,524,375
Austria-Hungary	Jan. 1	14,983,052	17,601,923	20,846,465	18,967,906	21,628,003
Brazil	Jan. 1	a 61,000,000	73,791,238	99,473,274	51,583,095	52,852,124
Bulgaria	Jan. 1	486,785	2,397,108	4,087,076	3,763,682	1,323,732
Ceylon	Jan. 1	4,762,568	3,167,756	4,925,996	4,151,994	4,321,632
Cuba	Jan. 1	30,585,303	29,864,881	34,321,335	41,576,034	28,191,707
Dutch East Indies	Jan. 1	115,518,705	92,411,619	104,152,759	113,201,709	74,525,042
Greece	Jan. 1	8,262,796	9,408,706	10,461,326	12,776,805	9,689,636
India (British)	April 1	17,432,966	30,701,163	23,999,313	23,375,964	25,000,133
Mexico	July 1	3,825,180	2,451,593	2,669,310	3,534,917	4,648,986
Netherlands	Jan. 1	5,316,602	4,864,567	4,785,081	4,751,225	4,855,896
Philippine Islands	Jan. 1	22,028,546	17,391,595	20,196,283	19,249,094	18,640,377
Russia	Jan. 1	15,557,466	12,712,031	7,267,304	11,203,599	b 12,675,593
United States	July 1	315,787,782	301,007,365	368,184,084	311,971,831	334,302,091
Other countries c		3,900,000	3,992,000	3,751,000	8,218,000	8,310,000
Total		626,381,146	612,976,462	716,721,812	636,672,774	608,469,327

IMPORTS.

Country.	Year beginning—	1900.	1901.	1902.	1903.	1904.
Argentina	Jan. 1	3,825,793	3,574,030	3,808,839	4,420,679	6,704,152
Australia	Jan. 1	4,071,279	5,951,230	5,544,080	5,156,793	6,629,793
Austria-Hungary	Jan. 1	47,036,051	48,697,895	47,650,259	51,576,911	51,898,125
Belgium	Jan. 1	21,039,041	20,194,983	19,424,223	20,982,344	24,053,826
Denmark	Jan. 1	9,209,808	9,475,465	9,442,396	9,900,957	10,210,707
Egypt	Jan. 1	13,271,408	13,997,116	14,805,935	15,013,414	17,043,686
Finland	Jan. 1	13,507,970	5,479,491	7,380,691	9,093,316	9,437,932
France	Jan. 1	55,158,223	58,438,116	48,619,010	56,402,809	57,368,125
Germany d	Jan. 1	133,258,597	134,362,451	133,982,375	137,773,884	143,445,274
India (British)	April 1	4,834,799	4,838,835	3,666,148	4,963,937	4,181,826
Italy	Jan. 1	38,273,120	46,256,497	40,718,486	40,488,103	33,430,447
Netherlands	Jan. 1	46,417,864	45,795,081	47,201,281	52,690,827	50,279,873
Norway	Jan. 1	3,845,324	4,033,069	4,064,155	3,857,030	2,854,897
Portugal	Jan. 1	5,911,786	5,654,648	5,327,533	7,970,542	8,825,499
Spain	Jan. 1	43,395,264	50,870,200	42,488,042	42,999,521	55,741,625
Sweden	Jan. 1	8,199,024	8,390,417	8,579,174	8,585,455	11,714,014
United Kingdom	Jan. 1	92,020,000	79,481,331	119,459,961	78,424,398	102,227,367
United States	July 1	26,851,253	29,428,837	34,016,956	31,162,636	33,288,378
Other countries		37,643,000	38,018,000	45,402,000	49,470,000	32,249,000
Total		607,769,604	612,937,692	641,581,544	630,933,556	661,584,546

a Estimated.
b Preliminary figures excluding trade over the Asiatic frontier (excepting the Black Sea ports of the Caucasus.)
c Not including Turkey, an important exporting country, for which figures are not available.
d Not including free ports.
(See "General note" to "World's international trade in wheat," p. 665.)

Tobacco crops of 1900–1905.

State.	1900. Acreage.	1900. Average yield per acre.	1900. Production.	1900. Average farm price, Dec. 1.	1900. Farm value, Dec. 1.	1901. Acreage.	1901. Average yield per acre.	1901. Production.	1901. Average farm price, Dec. 1.	1901. Farm value, Dec. 1.
	Acres.	*Lbs.*	*Pounds.*	*Cents.*	*Dollars.*	*Acres.*	*Lbs.*	*Pounds.*	*Cents.*	*Dollars.*
N. H	111	1,666	184,926	15	27,739	125	1,500	187,500	15	28,125
Vt	200	1,800	360,000	12	43,200	212	1,722	365,000	10	36,500
Mass	4,041	1,823	7,367,363	15	1,141,194	4,284	1,810	7,752,200	12	964,216
Conn	10,948	1,684	18,435,765	15	2,833,041	11,782	1,586	18,682,319	15	2,756,221
N. Y	8,527	1,185	10,101,350	8	844,897	8,835	1,134	10,019,750	7	716,394
Pa	24,147	1,524	36,803,670	6	2,259,897	18,771	1,495	28,070,700	6	1,712,642
Md	43,995	527	23,182,736	6	1,314,948	44,081	597	26,315,655	6	1,675,676
Va	170,700	618	105,543,960	6	6,550,995	168,800	635	107,196,529	8	8,130,765
N. C	193,329	618	119,504,625	7	8,096,164	189,020	560	105,807,677	9	9,714,243
S. C	26,567	873	23,203,003	7	1,590,648	27,259	768	20,946,705	7	1,551,519
Ga	2,066	495	1,023,336	15	148,431	1,990	494	982,691	18	176,972
Fla	2,220	546	1,211,066	26	309,814	2,610	544	1,420,705	27	382,859
Ala	771	282	217,665	27	58,126	729	266	194,167	19	36,404
Miss	190	623	118,327	18	21,712	208	576	119,848	18	22,148
La	112	265	29,730	23	6,873	103	323	33,295	28	9,181
Tex	611	348	212,860	18	38,790	302	363	109,715	16	17,795
Ark	1,580	407	643,594	12	75,105	1,327	344	456,574	13	58,658
Tenn	65,405	657	42,971,283	6	2,403,517	66,478	717	47,659,810	6	2,860,129
W. Va	4,819	592	2,852,263	7	209,184	4,723	589	2,781,912	8	215,874
Ky	367,262	810	297,584,134	6	17,245,872	374,644	867	324,809,420	6	18,641,931
Ohio	65,503	891	58,370,304	7	3,795,869	62,357	873	54,466,263	7	3,974,205
Mich	98	600	58,800	9	5,345	100	655	65,500	7	4,585
Ind	9,279	773	7,174,722	6	440,472	8,299	788	6,541,416	5	354,143
Ill	1,563	509	796,177	7	53,980	1,324	426	563,723	7	39,825
Wis	38,651	1,400	54,126,366	7	3,857,720	38,738	1,354	52,441,051	8	4,054,830
Mo	3,732	608	2,268,316	13	287,599	2,098	459	963,248	15	144,068
U. S	1,046,427	778	814,345,341	6.6	53,661,132	1,039,199	788	818,953,373	7.1	58,283,108

State.	1902. Acreage.	1902. Average yield per acre.	1902. Production.	1902. Average farm price, Dec. 1.	1902. Farm value, Dec. 1.	1903. Acreage.	1903. Average yield per acre.	1903. Production.	1903. Average farm price, Dec. 1.	1903. Farm value, Dec. 1.
N. H	131	1,650	216,150	16	34,584	132	1,590	209,880	13.0	27,284
Vt	191	1,800	343,800	14	48,132	189	1,800	340,200	12.0	40,824
Mass	4,755	1,560	7,417,800	15	1,112,670	4,993	1,400	6,990,200	12.0	838,824
Conn	12,725	1,712	21,785,200	16	3,485,632	13,234	1,600	21,174,400	15.5	3,282,032
N. Y	8,040	1,250	10,050,000	8	804,000	7,960	1,125	8,955,000	8.0	716,400
Pa	17,269	1,275	22,017,975	6	1,321,078	15,887	1,416	22,495,992	7.3	1,642,207
Md	34,081	625	21,300,625	6	1,278,038	33,059	650	21,488,350	5.5	1,181,859
Va	182,359	750	136,769,250	7	9,573,848	162,300	745	120,913,500	6.1	7,375,724
N. C	219,263	650	142,520,950	7	9,976,466	214,878	627	134,728,506	6.3	8,487,896
S. C	34,912	734	25,625,408	7	1,793,779	40,149	610	24,490,890	5.1	1,249,035
Ga	2,050	670	1,373,500	19	260,965	2,030	640	1,299,200	15.0	194,880
Fla	3,079	520	1,601,080	30	480,324	3,726	700	2,608,200	32.0	834,624
Ala	648	400	259,200	24	62,208	629	405	254,745	16.0	40,759
Miss	175	500	87,500	18	15,750	168	502	84,336	16.0	13,494
La	89	375	33,375	20	6,675	91	375	34,125	20.0	6,825
Tex	269	650	174,850	22	38,467	237	650	154,050	20.0	30,810
Ark	1,405	640	899,200	12	107,904	1,222	646	789,412	12.0	94,729
Tenn	59,830	650	38,889,500	6	2,333,370	71,198	700	49,838,600	7.5	3,737,895
W. Va	4,676	635	2,969,260	7	207,848	4,395	640	2,812,800	6.2	174,394
Ky	322,194	800	257,755,200	6	15,465,312	338,304	790	267,260,160	6.2	16,570,130
Ohio	62,949	885	55,709,865	7	3,899,691	60,431	845	51,064,195	7.2	3,676,622
Mich	302	765	231,030	8	18,482	305	750	228,750	8.0	18,300
Ind	7,469	835	6,236,615	7	436,563	7,096	783	5,556,168	6.2	344,482
Ill	1,311	650	852,150	7	59,650	1,298	655	850,190	6.1	51,862
Wis	48,422	1,340	64,885,480	7	4,541,984	51,812	1,350	69,946,200	6.8	4,756,342
Mo	2,140	850	1,819,000	11	200,090	2,012	698	1,404,376	9.0	126,394
U. S	1,030,734	797.3	821,823,963	7.0	57,563,510	1,037,735	786.3	815,972,425	6.8	55,514,627

Tobacco crops of 1900–1905—Continued.

State.	1904. Acreage.	1904. Average yield per acre.	1904. Production.	1904. Average farm price, Dec. 1.	1904. Farm value, Dec. 1.	1905. Acreage.	1905. Average yield per acre.	1905. Production.	1905. Average farm price, Dec. 1.	1905. Farm value, Dec. 1.
	Acres.	*Lbs.*	*Pounds.*	*Cents.*	*Dollars.*	*Acres.*	*Lbs.*	*Pounds.*	*Cents.*	*Dollars.*
N. H	119	1,610	191,590	15.0	28,738	125	1,700	212,500	17.0	36,125
Vt	174	1,685	293,190	15.0	43,978	191	1,650	315,150	17.0	53,576
Mass	4,444	1,690	7,510,360	18.6	1,396,927	4,488	1,850	8,302,800	16.9	1,403,173
Conn	12,705	1,685	21,407,925	22.6	4,838,191	13,340	1,725	23,011,500	17.0	3,911,955
N. Y	5,492	1,145	6,288,340	10.0	628,834	6,151	1,148	7,061,348	10.5	741,442
Pa	14,457	1,289	18,635,073	8.9	1,658,521	15,324	1,370	20,993,880	10.8	2,267,339
Md	32,067	621	19,913,607	6.5	1,294,384	30,143	650	19,592,950	6.0	1,175,577
Va	133,086	725	96,487,350	7.4	7,140,064	118,447	675	79,951,725	7.6	6,076,331
N. C	143,968	685	98,618,080	8.6	8,481,155	136,770	608	83,156,160	8.8	7,317,742
S. C	11,643	703	8,185,029	8.2	671,172	12,574	736	9,254,464	8.7	805,138
Ga	1,868	650	1,214,200	20.6	250,125	2,036	525	1,068,900	17.0	181,713
Fla	4,434	815	3,613,710	31.5	1,138,319	5,321	600	3,192,600	18.0	574,668
Ala	585	379	221,715	15.5	34,366	521	450	234,450	16.0	37,512
Miss	170	408	69,360	15.6	10,820	155	430	66,650	15.0	9,998
La	89	438	38,982	21.5	8,381	63	500	31,500	25.0	7,875
Tex	469	600	281,400	19.5	54,873	469	500	234,500	19.0	44,555
Ark	1,234	565	697,210	12.0	83,665	1,049	700	734,300	14.0	102,802
Tenn	47,703	730	34,823,190	5.8	2,019,745	41,502	768	31,873,536	7.5	2,390,515
W. Va	4,087	710	2,901,770	8.5	246,650	4,005	790	3,163,950	8.5	268,936
Ky	277,409	827	229,417,243	6.4	14,682,704	275,874	830	228,975,420	7.0	16,028,279
Ohio	59,827	849	50,793,123	8.0	4,063,450	59,229	850	50,344,650	8.4	4,228,951
Mich	278	675	187,650	6.5	12,197	....	......	....	.....	....
Ind	6,244	691	4,314,604	8.5	366,741	6,244	819	5,113,836	6.0	306,830
Ill	1,155	670	773,850	5.4	41,788	1,132	900	1,018,800	6.0	61,128
Wis	40,931	1,282	52,473,542	7.8	4,092,936	39,291	1,370	53,832,780	10.0	5,383,278
Mo	1,771	626	1,108,646	8.5	94,235	1,665	778	1,295,370	8.0	103,630
U. S	806,409	819.0	660,460,739	8.1	53,382,959	776,112	815.6	633,033,719	8.5	53,519,068

HOPS.

Hop crop of countries named, 1901–1905.

Country.	1901.	1902.	1903.	1904.	1905.
United States: [a]	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
New York	9,000,000	5,800,000	9,000,000	11,900,000	8,200,000
California	9,400,000	10,300,000	10,900,000	12,300,000	12,700,000
Oregon	13,800,000	17,000,000	17,600,000	17,600,000	20,500,000
Washington	6,600,000	5,800,000	6,800,000	7,400,000	9,800,000
Total United States	38,800,000	38,900,000	44,300,000	49,200,000	51,200,000
Austria-Hungary:					
Austria	32,866,000	19,829,000	9,010,000	19,598,000	39,305,000
Hungary	560,000	631,000	808,000	631,000	[b] 700,000
Total Austria-Hungary	33,426,000	20,460,000	9,818,000	20,229,000	40,005,000
Belgium	9,149,000	7,360,000	4,786,000	9,830,000	[a] 11,000,000
France	7,056,000	5,251,000	7,311,000	7,753,000	[a] 6,800,000
Germany	27,599,000	50,185,000	46,562,000	49,136,000	64,500,000
Netherlands	137,000	137,000	100,000	[b] 125,000	[b] 125,000
Russia [a]	11,000,000	11,000,000	12,500,000	8,700,000	14,500,000
United Kingdom: England	72,731,000	34,837,000	47,160,000	31,621,000	77,946,000
Total Europe	161,098,000	129,230,000	128,237,000	127,394,000	214,876,000
Australasia:					
Victoria	307,000	252,000	176,000	274,000	162,000
Tasmania	697,000	651,000	809,000	865,000	912,000
New Zealand [a]	1,000,000	930,000	940,000	1,150,000	1,120,000
Total Australasia	2,004,000	1,833,000	1,925,000	2,289,000	2,194,000
Total [c]	201,902,000	169,963,000	174,462,000	178,883,000	268,270,000

[a] Unofficial estimate.
[b] Average production.
[c] Excluding Canada, for which the census of 1901 shows a production during the preceding year of 1,001,203 pounds.

Wholesale prices of hops per pound in leading cities of the United States, 1901–1905.

Date.	New York.		Cincinnati.		Chicago.	
	Choice State.		Choice.		Pacific coast, common to choice.	
	Low.	High.	Low.	High.	Low.	High.
1901.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	17	20	17¾	17¾	17	18
February	....	....	17¾	17¾	17	18
March	18	20	17¾	17¾	18	19
April	18	20	17¾	17¾	18	19
May	17½	20	17⅞	17⅞	18	19
June	17½	18	17¾	17¾	17	18
July	16	18	17⅞	17⅞	17	18
August	14	17	17⅜	17⅜	15	16
September	13	16	17¼	17¼	14	15
October	14	15½	14	14	12½	14
November	14	15½	13¾	13¾	12½	14
December	14	15½	14	14	13	15
1902.						
January	14	16	14½	14½	12½	14
February	14½	18	15½	15½	15	16
March	17	19	17½	17½	13	16½
April	18	20	18½	18½	15	18
May	19	22	19½	19½	15	20
June	20½	24	21½	21½	15	20
July	22	26	23	23	20	22
August	24½	28	25	25	22	25
September	26	28	26½	26½	25	26
October	32	37	29½	29½	26	29
November	35	38	30	30	26	30
December	35	38	30	30	29	31
1903.					Good to choice.	
January	35	37	29	29	27	31
February	33	37	29	29	27	31
March	30	35	29½	29½	25	29
April	23	30	25	25	20	25
May	23	24	25	25	20	24
June	22½	24	24	24	22	24
July	20½	23½	24	24	19	22
August	20½	26	24	24	21	25
September	24½	30	25	25	26	28
October	30	33	26	26	20	27
November	30	32	26	26	24	26
December	30	35	27	27	24	27
1904.						
January	34	37	28	31	28½	34
February	36	38	31	34	30	35
March	34	38	30	32	32	34
April	33	36	30	32	30	34
May	33	35	29	31	30	35
June	32	35	29	30	30	32
July	32	34	29	30	30	31
August	32	35	29	29	30	34
September	33	37	29	31	28½	31
October	35	41	31	36	30	35½
November	36	41	36	37	32	37
December	35	38	34	36	33	37
1905.						
January	34	37	33	33	30	34
February	30	36	31½	31½	26	30
March	27	31	30	30	26	30
April	27	29	29	29	26	29
May	27	29	29	29	26	28
June	26	29	28	28	21	25
July	25	27	24	24	20	24
August	22	26	22	22	18	23
September	20	23	18½	18½	15	18
October	19	23	17	17	10	15
November	13	22	14½	14½	12	15
December	16	21	13½	13½	10	14

FLAXSEED.

Flax crop of the countries named, 1902–1904.

Country.	Seed.			Fiber.		
	1902.	1903.	1904.	1902.	1903.	1904.
	Bushels.	*Bushels.*	*Bushels.*	*Pounds.*	*Pounds.*	*Pounds.*
United States	29,285,000	27,301,000	23,401,000	....	....	....
Manitoba	582,000	605,000	479,000	....	....	....
Mexico	152,000	49,000	130,000	....	....	....
Argentina	14,371,000	30,076,000	36,912,000	....	....	....
Total America	44,390,000	58,031,000	60,922,000	....	....	....
Ireland	....	....	....	25,182,000	19,327,000	20,924,000
Sweden	53,000	39,000	46,000	2,491,000	2,241,000	2,300,000
Netherlands	384,000	362,000	459,000	19,234,000	18,497,000	22,348,000
Belgium	266,000	272,000	300,000	24,280,000	24,790,000	27,385,000
France	450,000	514,000	490,000	39,624,000	43,587,000	42,000,000
Italy [a]	....	....	....	41,917,000	41,917,000	41,917,000
Austria	1,034,000	1,120,000	1,162,000	113,508,000	103,848,000	105,850,000
Hungary	173,000	276,000	270,000	18,533,000	30,348,000	18,500,000
Croatia-Slavonia	26,000	44,000	29,000	8,803,000	13,205,000	9,400,000
Total Austria-Hungary	1,233,000	1,440,000	1,461,000	140,844,000	147,401,000	133,750,000
Roumania	1,005,000	2,064,000	169,000	4,484,000	12,267,000	3,293,000
Bulgaria [b]	23,000	23,000	23,000	2,116,000	2,116,000	2,116,000
Servia	[c] 11,000	[c] 11,000	[c] 11,000	2,847,000	1,032,000	1,500,000
Russia [d]	21,757,000	18,510,000	18,874,000	1,261,821,000	1,108,425,000	1,056,000,000
Total Europe	25,182,000	23,265,000	21,833,000	1,564,840,000	1,421,600,000	1,353,533,000
British India	14,077,000	19,263,000	22,873,000	....	....	....
Algeria	242,000	65,000	150,000	....	....	....

RECAPITULATION.

America	44,390,000	58,031,000	60,922,000	....	....	....
Europe	25,182,000	23,265,000	21,833,000	1,564,840,000	1,421,600,000	1,353,533,000
British India	14,077,000	19,263,000	22,873,000	....	....	....
Algeria	242,000	65,000	150,000	....	....	....
Total	83,891,000	100,624,000	105,778,000	1,564,840,000	1,421,600,000	1,353,533,000

[a] Average, 1892–1895. [b] Average, 1897–1899. [c] 1897 figures. [d] Includes Poland and North Caucasus.

Acreage, production, and value of flaxseed in the United States in 1905, by States.

State.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*
Wisconsin	29,847	13.0	388,011	91	353,090
Minnesota	449,008	11.3	5,073,790	86	4,363,459
Iowa	74,879	11.4	853,621	86	734,114
Missouri	40,789	7.8	318,154	87	276,794
Kansas	110,555	8.0	884,440	83	734,085
Nebraska	18,433	10.2	188,017	88	165,455
South Dakota	405,845	11.2	4,545,464	83	3,772,735
North Dakota	1,357,171	11.6	15,743,184	84	13,224,275
Montana	16,570	10.0	165,700	82	135,874
Idaho	22,848	9.8	223,910	92	205,997
Oregon	2,276	12.0	27,312	106	28,951
Indian Territory	6,615	10.0	66,150	82	54,243
United States	2,534,836	11.2	28,477,753	84.4	24,049,072

Wholesale prices of flaxseed per bushel in leading cities of the United States, 1901–1905.

Date.	St. Louis.		Cincinnati.		Chicago.		Milwaukee.		Duluth.	
	Prime.				No. 1.					
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1901.										
January	$1.50	$1.72	$1.30	$1.45	$1.56	$1.77	$1.45	$1.76	$1.57	$1.73
February	1.58	1.72	1.30	1.50	1.60	1.76	1.60	1.75	1.59	1.72½
March	1.50	1.60	1.35	1.50	1.52	1.63	1.45	1.63½	1.53¼	1.61
April	1.49	1.52	1.20	1.50	1.52	1.70	1.45	1.70	1.54¼	1.76½
May	1.56	1.67	1.20	1.29	1.64¼	1.74	1.55	1.75	1.67	1.78
June	1.67	1.68	1.20	1.30	1.70	1.88	1.35	1.88	1.65	1.88
July	1.59	1.65	1.30	1.30	1.79	1.90	1.75	1.88	1.75	1.88
August	1.37	1.65	1.30	1.40	1.40	1.85	1.48	1.83	1.44	1.75
September	1.37	1.38	1.25	1.35	1.38	1.66	1.40	1.65	1.39	1.62
October	1.38	1.48	1.25	1.25	1.41	1.58	1.44	1.63	1.38	1.54
November	....	....	1.25	1.30	1.40	1.52½	1.40	1.52½	1.34½	1.49¾
December	....	....	1.30	1.39	1.38½	1.61	1.39	1.61	1.34½	1.55½
1902.										
January	....	....	1.30	1.40	1.58	1.73	1.61	1.73	1.56½	1.71½
February	....	....	1.30	1.40	1.63	1.74	1.66	1.73	1.65	1.72
March	....	....	1.30	1.40	1.63	1.74	1.68	1.74	1.65	1.74
April	....	....	1.30	1.40	1.65	1.80	1.74	1.80	1.72	1.78
May	1.50	1.65	1.30	1.40	1.58	1.79	1.76	1.79	1.70	1.77
June	1.50	1.50	1.25	1.35	1.54	1.76	1.73	1.76	1.60	1.76½
July	1.41	1.50	1.30	1.40	1.36	1.74	1.43	1.74	1.35	1.66
August	1.32½	1.45	1.25	1.30	1.37	1.55	1.40	1.55	1.35	1.50
September	1.22	1.38	1.25	1.25	1.25½	1.46	1.25	1.45	1.21½	1.47
October	1.12	1.25	1.25	1.25	1.15	1.28	1.19	1.28	1.15½	1.27¾
November	1.11	1.14½	1.25	1.25	1.13	1.23	1.18	1.23	1.15½	1.20
December	1.11	1.14	1.25	1.25	1.14	1.25	1.20	1.25	1.16	1.21½
1903.										
January	1.12	1.17	1.30	1.30	1.14	1.24	1.21	1.24	1.14½	1.20
February	1.10	1.14	1.30	1.30	1.12	1.22	1.16	1.22	1.11¾	1.16½
March	1.05	1.12	1.30	1.30	1.06	1.17	1.00	1.17	1.07¾	1.13½
April	1.05	1.08	1.10	1.30	1.06	1.12	1.09	1.11½	1.08¾	1.11
May	1.07	1.17	1.00	1.10	1.08	1.17½	1.11	1.17½	1.10¼	1.16
June	.95	1.08	1.00	1.00	.98	1.14	1.01½	1.14	.99½	1.13
July	.91	.96	1.00	1.00	.90	1.02½	.95½	1.02½	.95	1.00¾
August	.91	1.00	1.00	1.00	.93	1.05	.97	1.05	.96¼	1.01½
September	.92	1.00	1.00	1.00	.94	1.09	.99	1.09	.99	1.09
October	.86	.93	1.00	1.00	.89	1.03½	.94½	1.04	.92	1.02¾
November	.86	.89	1.00	1.00	.90	1.00	.94	1.00	.93½	1.00
December	.87½	.90½	1.00	1.00	.90½	1.02½	.97½	1.01½	.95¾	1.00
1904.										
January	.92½	1.07	1.00	1.00	.97	1.19	1.03½	1.19	1.01½	1.17
February	1.06	1.08½	1.00	1.00	1.09	1.18½	1.16	1.18½	1.13½	1.17
March	1.04	1.06	1.00	1.00	1.07½	1.16½	1.13	1.16½	1.14	1.15½
April	.96	1.06	1.00	1.00	.98½	1.16	1.06	1.14½	1.05½	1.15¾
May	.96	.98½	1.00	1.00	.99½	1.09½	1.06½	1.10	1.05¾	1.08
June	.97	.98	1.00	1.00	1.00	1.08	1.06½	1.08½	1.07¾	1.09¾
July	.98	1.15½	1.00	1.00	1.02	1.24	1.07½	1.24	1.09¼	1.24
August	1.13½	1.18	....	....	1.15½	1.26½	1.23	1.26½	1.23	1.26½
September	1.08	1.18½	....	....	1.09	1.28	1.24½	1.28	1.16½	1.28
October	1.06	1.10	....	....	1.07	1.18	1.14½	1.18½	1.13½	1.17¼
November	1.07	1.11	....	....	1.08	1.19½	1.15½	1.19½	1.14	1.18⅝
December	1.12	1.16	....	....	1.11	1.26	1.19	1.26	1.18	1.25¾
1905.					(a)		(a)			
January	1.14	1.15	....	....	1.15	1.23	1.21	1.23	1.23	1.24½
February	1.14	1.23	....	....	1.15	1.35	1.22	1.23½	1.24½	1.38
March	1.22	1.26½	....	....	1.23	1.39½	1.35½	1.39½	1.35	1.40¾
April	1.22	1.26	....	....	1.23	1.40	1.37	1.40	1.39	1.42
May	1.22	1.29	....	....	1.25	1.47	1.39	1.47	1.40	1.48
June	1.24	1.29	....	....	1.25	1.47	1.43	1.47	1.47½	1.50
July	1.20	1.30	....	....	1.22½	1.44	1.34	1.44	1.48	1.48
August	1.04	1.30	....	....	1.01	1.35	1.12	1.35	1.30	1.48
September	.90	1.06	1.10	1.10	.92	1.12	.98	1.12	.97¼	1.30
October	.94	.97	1.10	1.10	.92	1.03	.98	1.03	.96¼	1.00
November	.94	.95	1.10	1.10	.93	1.00	.99	1.00	.98¼	1.00⅜
December	.95	1.10	1.10	1.10	.94	1.13	1.00	1.16	.98	1.16

a No. 1 Northwestern.

RICE.

Rice crop of countries named, 1900–1904.

[Cleaned rice.]

Country.	1900.	1901.	1902.	1903.	1904.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
United States (including Philippine Islands and Hawaii)	964,300,000	1,099,200,000	1,030,600,000	1,236,200,000	1,163,400,000
United States (in North America)	a 253,100,000	a 388,000,000	a 319,400,000	a 525,000,000	586,000,000
Guatemala	300,000	300,000	700,000	1,000,000	b 1,000,000
Honduras	c 8,100,000	8,100,000	c 8,100,000	c 8,100,000	c 8,100,000
Mexico	45,800,000	41,800,000	40,000,000	48,700,000	b 48,700,000
Total North America	307,300,000	438,200,000	368,200,000	582,800,000	643,800,000
British Guiana	24,000,000	d 24,000,000	d 24,000,000	d 24,000,000	d 24,000,000
Dutch Guiana	600,000	800,000	800,000	1,000,000	b 1,000,000
Total South America	24,600,000	24,800,000	24,800,000	25,000,000	25,000,000
Italy	1,614,100,000	1,511,900,000	1,443,800,000	1,644,700,000	b 1,644,700,000
Spain	431,300,000	382,900,000	359,800,000	417,100,000	394,600,000
Total Europe	2,045,400,000	1,894,800,000	1,803,600,000	2,061,800,000	2,039,300,000
British India:					
British Provinces	46,312,800,000	43,040,900,000	52,582,300,000	49,199,400,000	48,844,900,000
Native States	e 712,000,000	e 711,000,000	e 798,000,000	e 838,000,000	b 838,000,000
Total British India	47,024,800,000	43,751,900,000	53,380,300,000	50,037,400,000	49,682,900,000
Ceylon	e 528,000,000	e 526,300,000	e 550,100,000	e 558,800,000	b 558,800,000
French Indo-China	8,500,000,000	8,500,000,000	8,500,000,000	8,500,000,000	8,500,000,000
Japanese Empire:					
Japan	12,949,100,000	14,650,400,000	11,533,200,000	14,512,600,000	16,060,600,000
Formosa	1,342,800,000	1,914,800,000	1,762,100,000	2,296,600,000	2,598,100,000
Total Japanese Empire	14,291,900,000	16,565,200,000	13,295,300,000	16,809,200,000	18,658,700,000
Java and Madura	10,644,000,000	9,203,000,000	8,703,800,000	10,091,200,000	b 10,091,200,000
Korea	f 3,800,000,000	f 3,800,000,000	f 3,700,000,000	f 3,700,000,000	b 3,700,000,000
Philippine Islands	g 677,800,000	g 677,800,000	677,800,000	g 677,800,000	544,000,000
Siam	f 3,600,000,000	f 4,200,000,000	f 4,500,000,000	f 4,000,000,000	f 4,600,000,000
Straits Settlements	e 86,000,000	e 80,000,000	e 92,000,000	e 95,000,000	b 95,000,000
Total Asia	89,152,500,000	87,304,200,000	93,399,300,000	94,469,400,000	96,430,600,000
Egypt	20,000,000	20,000,000	20,000,000	20,000,000	20,000,000
Fiji	e 1,000,000	e 1,900,000	e 3,500,000	e 3,000,000	b 3,000,000
Hawaii	h 33,400,000	h 33,400,000	h 33,400,000	h 33,400,000	h 33,400,000
Queensland	200,000	100,000	(i)	(i)	(i)
Total Oceania	34,600,000	35,400,000	36,900,000	36,400,000	36,400,000
Total	91,584,400,000	89,717,400,000	95,652,800,000	97,195,400,000	99,195,100,000

a Commercial movement.
b 1903 figures used.
c 1901 figures used.
d 1900 figures used.
e Estimated from official returns for acreage.
f Estimated from exports of this country, and from per capita consumption of Japan for 1894–1903 (300 pounds per annum).
g Census, 1902.
h Census, 1899.
i Less than 50,000 pounds.

World's international trade in rice, 1900–1905.

[Mostly cleaned rice.]

EXPORTS.

Country.	Year beginning—	1900.	1901.	1902.	1903.	1904.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Belgium	Jan. 1	37,456,971	37,833,573	40,836,811	51,066,830	62,594,036
Dutch East Indies	Jan. 1	92,572,078	85,186,473	96,676,733	85,391,653	101,059,872
France	Jan. 1	74,326,591	103,863,995	55,235,338	58,770,569	52,021,579
Germany *a*	Jan. 1	286,204,910	212,871,686	227,755,531	227,661,173	181,073,762
India (British)	April 1	3,519,670,784	3,820,729,248	5,331,694,928	5,054,477,901	5,546,790,144
Indo-China (French)	Jan. 1	2,018,631,770	2,014,099,266	2,459,480,031	1,490,364,515	*b* 1,866,975,333
Netherlands	Jan. 1	198,522,042	197,376,644	246,932,274	256,578,864	298,075,104
Penang	Jan. 1	222,337,733	228,693,333	315,152,667	229,739,333	*c* 248,980,767
Siam	Jan. 1	928,330,267	1,534,231,467	1,785,261,733	1,310,950,400	1,892,988,160
Singapore	Jan. 1	577,957,867	786,173,600	819,742,133	687,836,400	*c* 717,927,500
Other countries		419,618,000	558,800,000	519,537,000	579,245,000	544,999,000
Total		8,375,629,013	9,579,859,285	11,898,305,179	10,032,082,641	11,513,485,257

IMPORTS.

Country.	Year beginning—	1900.	1901.	1902.	1903.	1904.
Austria-Hungary	Jan. 1	176,194,713	165,785,811	171,421,706	162,532,230	189,403,926
Belgium	Jan. 1	128,732,894	142,662,657	154,653,404	164,358,287	166,709,664
Brazil	Jan. 1	*d* 193,969,140	197,038,775	222,632,829	162,235,816	*d* 193,969,140
Ceylon	Jan. 1	670,236,672	654,883,936	641,730,096	687,640,128	699,259,008
China	Jan. 1	827,630,133	588,214,533	1,297,420,533	373,585,867	447,577,333
Cuba	Jan. 1	165,382,483	195,053,948	169,841,863	149,574,339	196,439,462
Dutch East Indies	Jan. 1	258,271,467	1,339,493,984	819,659,758	440,099,790	293,920,205
Egypt	Jan. 1	67,039,471	97,567,921	89,927,953	84,159,745	104,163,198
France	Jan. 1	306,076,059	286,667,938	445,326,924	236,359,026	466,328,330
Germany *a*	Jan. 1	640,561,300	569,962,028	806,702,495	642,295,455	602,833,603
India (British)	April 1	363,500,256	302,487,248	339,482,752	381,136,672	377,021,680
Japan	Jan. 1	304,930,533	414,925,067	601,209,600	1,621,654,000	1,964,238,000
Mauritius	Jan. 1	108,036,879	142,291,685	138,228,382	141,143,562	159,853,456
Netherlands	Jan. 1	360,316,248	411,543,370	495,572,167	495,788,960	523,497,732
Penang	Jan. 1	168,544,933	170,852,267	162,345,333	153,461,067	*c* 163,800,900
Philippine Islands	Jan. 1	321,514,113	376,211,389	639,460,077	737,083,174	585,880,567
Russia	Jan. 1	106,567,464	156,543,174	138,453,658	162,267,811	*c* 140,958,027
Singapore	Jan. 1	765,343,333	1,019,341,867	1,040,446,667	849,067,467	*d* 969,618,667
United Kingdom	Jan. 1	417,401,712	474,888,176	762,437,536	607,701,584	620,591,664
United States	July 1	117,199,710	157,658,894	169,656,284	154,221,772	106,483,515
Other countries		735,000,000	872,566,000	908,083,000	1,104,359,000	466,553,000
Total		7,202,449,513	8,736,640,668	10,214,693,017	9,510,725,752	9,439,101,077

a Not including free ports.
b Cochin-China.
c Average of 1900–1903.
d Average of 1901–1903.

(See "General note" to "World's international trade in wheat," p. 665.)

Acreage, production, and value of rice in the United States in 1905, by States.

State.	Acreage.	Average yield per acre.	Production.	Average farm price, Dec. 1.	Farm value, Dec. 1.
	Acres.	*Bushels.*	*Bushels.*	*Cents.*	*Dollars.*
North Carolina	876	26.0	22,776	99	22,548
South Carolina	18,114	26.0	470,964	106	499,222
Georgia	3,053	32.0	97,696	102	99,650
Florida	2,780	28.0	77,840	100	77,840
Alabama	1,526	30.0	45,780	100	45,780
Mississippi	1,143	24.0	27,432	100	27,432
Louisiana	240,037	25.8	6,192,955	89	5,511,730
Texas	214,490	31.0	6,649,190	100	6,649,190
Arkansas	460	48.6	22,356	100	22,356
United States	482,479	28.2	13,606,989	95.2	12,955,748

Wholesale prices of rice per pound, 1901–1905.

Date.	New York. Domestic (good). Low.	New York. Domestic (good). High.	Cincinnati. Prime. Low.	Cincinnati. Prime. High.	Lake Charles. Rough.a Low.	Lake Charles. Rough.a High.	New Orleans. Honduras, cleaned. Low.	New Orleans. Honduras, cleaned. High.	Houston. (Head rice.) Cleaned. Low.	Houston. (Head rice.) Cleaned. High.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Dolls.*	*Dolls.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
1901.										
January	5	5	5½	6	1.70	3.25	2⅛	6	3	5
February	4⅞	5	5½	6½	1.70	3.25	2¼	6	3	5
March	4⅞	4⅞	5½	6½	......	......	2⅜	6⅛	3	5
April	4⅞	4⅞	5½	6½	......	......	2⅛	6	3	5
May	4⅞	4⅞	5½	6½	......	......	3	6	3	5
June	4⅞	4⅞	5½	6½	......	......	2⅜	6⅛	3	5
July	4¾	5	5½	6½	......	......	3	6½	3	5
August	5	5	5½	6½	......	......	2¼	6⅝	3	5
September	5	5	5½	6½	2.00	3.50	2⅞	5¾	3	5
October	5	5	5½	6½	2.00	3.50	2¼	5¾	3	5
November	4⅞	4⅞	5½	6½	2.00	3.50	1¾	6	3	5
December	4¾	4¾	5½	6½	1.75	3.25	2	5¾	3	5
1902.										
January	4¾	4¾	5½	6½	1.75	3.00	2⅛	5⅞	3½	5¼
February	4¾	4¾	5½	6½	1.75	3.00	2	6	3¾	5¼
March	4¾	4¾	5½	6½	......	......	2	6	4	5½
April	4¾	4¾	5½	6½	......	......	2	5¾	4	5½
May	4¾	5	5½	6½	......	......	2	5¾	4	5½
June	4⅞	5¼	5½	6½	......	......	1½	6	4	5½
July	4⅞	5¼	5½	6½	......	......	1⅞	6½	4	5½
August	4⅞	4⅞	5½	6½	......	......	1⅝	5⅞	4	5½
September	4⅞	4⅞	5½	6½	2.00	3.40	1¾	5¾	4½	5¾
October	4⅞	4⅞	5¼	5¾	1.90	3.25	1½	5⅞	4½	5¾
November	4⅞	4⅞	5¼	5¾	2.00	3.20	1⅜	6 3/16	4½	5¾
December	5	5	5¼	5¾	1.75	3.30	1⅜	6¼	4½	5¾
1903.										
January	4⅞	5	4⅜	5¼	1.75	3.40	1¼	6½	4½	5⅞
February	5	5	4⅜	5¼	1.75	3.40	1¾	6¼	4½	6
March	5⅛	5¼	4⅜	5¼	1.75	3.40	1¾	6⅜	4½	6
April	5¼	5¼	4⅜	5¼	......	......	1⅞	6½	4½	5¾
May	5¼	5¼	4⅜	5¼	......	......	2⅛	6½	4½	5¾
June	5¼	5¼	4⅜	5¼	......	......	2¼	6⅛	4½	6
July	5¼	5¼	4⅜	5¼	......	......	2½	6½	4¾	6⅛
August	5⅛	5¼	4⅜	5¼	......	......	2¼	6	4¾	6⅛
September	4⅞	5⅛	4⅜	5¼	2.00	3.60	2⅜	5⅝	4¾	6¼
October	4½	4⅞	4⅜	5½	1.75	3.60	1⅝	5⅝	4¾	6¼
November	4¼	4½	4⅝	5½	1.60	3.25	1⅛	5½	4¼	5½
December	4¼	4¼	4⅝	5½	1.50	3.00	1¼	5	4	5
1904.										
January	4¼	4¼	4¾	5¼	1.50	3.00	1½	4⅞	3½	4¾
February	4	4	4¾	5¼	1.50	2.75	1½	4⅝	3½	4⅝
March	4	4	4½	5	1.25	2.50	1⅛	4¾	3½	4½
April	4	4	4¼	4¾	1.25	2.25	1⅛	4¼	3¼	4¼
May	3¾	4	4¼	4¾	1.25	2.00	1⅜	4⅜	3¼	4
June	3⅝	3¾	4¼	4¾	1.25	2.00	1 7/10	4	3¼	4
July	3⅝	3⅝	3¾	4¼	1.25	2.00	1⅔	4¼	3	4
August	3⅜	3⅝	3¾	4¼	1.25	2.00	1⅝	5¼	3	4
September	3⅜	3⅜	3¾	4¼	1.25	2.00	1¼	4¾	3	4
October	3⅜	3⅜	3¾	4¼	1.10	2.00	1¼	5	3	3⅞
November	3⅜	3⅜	3¾	4¼	1.10	2.00	1⅛	5⅛	3	3¾
December	3⅜	3⅜	3¾	4¼	1.00	2.00	1 1/16	5¼	3	3¾
1905.										
January	3⅜	3⅜	3¾	4¼	1.00	2.00	1⅛	5⅛	3	3¾
February	3⅜	3⅜	3¾	4¼	1.00	2.00	1	4¾	3	3¾
March	3⅜	3⅜	3	4	1.00	2.35	1 3/16	4⅝	3	3¾
April	3⅜	3⅜	3	4	1.00	2.25	1⅛	4⅝	3	3½
May	3⅜	3⅜	3½	4½	1.00	2.50	1⅜	4½	3	3½
June	3½	3¾	4	5	1.00	2.50	2⅛	5	3	3¾
July	3¾	3¾	4	5	1.00	2.50	2⅛	4¾	3	4
August	3¾	3¾	4	5	1.25	3.00	1¾	5¼	3	4¼
September	3¾	4	4	5	2.00	3.25	1¾	5⅝	3	4½
October	4⅛	4⅛	4	5	2.00	3.25	2	5¾	3	4¾
November	4⅛	4⅛	4½	5¼	2.00	3.75	2⅜	5⅜	3	5
December	4½	4½	4½	5¼	2.00	3.85	2	5⅛	3½	5

a Per barrel of 162 pounds.

SUGAR.

Sugar production of countries named, 1901-2 to 1905-6.

Country.	1901-1902.	1902-1903.	1903-1904.	1904-1905.	1905-1906.
CANE SUGAR.					
United States:	*Tons.* [a]	*Tons.* [a]	*Tons.* [a]	*Tons.* [a]	*Tons.* [a]
Louisiana	321,676	329,226	215,000	335,000	330,000
Texas	(b)	(b)	19,800	15,000	12,000
Porto Rico	85,000	85,000	130,000	145,000	210,000
Hawaii	317,509	391,062	328,103	380,576	370,000
Cuba	850,181	998,878	1,040,228	1,163,258	1,300,000
British West Indies:					
Trinidad, exports	52,673	42,679	44,058	28,000	35,000
Barbados, exports	46,315	38,179	58,081	41,600	32,000
Jamaica	15,843	18,772	14,255	16,000	18,000
Antigua and St. Kitts	19,000	18,000	19,000	19,000	19,000
French West Indies:					
Martinique, exports	34,942	29,035	23,936	29,986	33,000
Guadeloupe	40,637	38,498	35,976	36,000	35,000
Danish West Indies: St. Croix	13,000	13,000	13,000	11,000	13,000
Haiti and Santo Domingo	45,000	50,000	47,000	47,000	50,000
Lesser Antilles (not named above)	15,000	12,000	13,000	13,000	13,000
Mexico	103,110	112,679	107,547	107,038	105,000
Central America:					
Guatemala	8,000	8,000	7,640	7,640	8,000
Salvador	5,000	6,000	6,300	5,588	6,000
Nicaragua	4,500	4,500	4,235	4,235	5,000
Costa Rica	3,000	3,000	3,275	2,305	3,000
South America:					
British Guiana (Demerara), exports	123,967	121,570	113,282	101,278	115,000
Dutch Guiana (Surinam)	12,750	13,046	13,000	13,000	13,000
Venezuela	3,000	3,000	3,000	3,000	3,000
Peru	138,000	123,906	131,957	150,000	150,000
Argentina	135,000	130,000	142,895	128,104	137,308
Brazil	349,088	187,500	197,000	195,000	275,000
Total America	2,742,191	2,777,530	2,731,568	2,997,608	3,291,308
Asia:					
British India [c]	2,022,476	1,906,784	1,871,986	2,166,156	1,725,300
Java	767,130	842,812	885,561	1,008,900	993,900
Philippine Islands	78,637	90,000	84,000	106,875	135,625
Total Asia	2,868,243	2,839,596	2,841,547	3,281,931	2,854,825
Oceania:					
Queensland	120,858	76,626	91,828	147,688	160,000
New South Wales	18,000	21,000	21,500	20,000	18,000
Fiji, exports	31,000	35,500	50,000	47,000	45,000
Total Oceania	169,858	133,126	163,328	214,688	223,000
Africa:					
Egypt	98,000	87,500	60,000	60,000	65,000
Mauritius	147,828	150,349	220,589	142,101	200,000
Reunion	33,098	39,624	41,117	30,000	30,000
Total Africa	278,926	277,473	321,706	232,101	295,000
Europe: Spain	28,000	28,000	28,000	28,000	28,000
Total cane-sugar production	6,087,218	6,055,725	6,086,149	6,754,328	6,692,133
BEET SUGAR.					
Europe:					
Germany	2,305,013	1,762,461	1,927,681	1,598,164	2,425,000
Austria-Hungary	1,301,548	1,057,692	1,167,959	889,373	1,510,000
France	1,123,545	833,210	804,308	622,422	1,085,000
Russia	1,098,983	1,256,311	1,206,907	953,626	1,000,000
Belgium	324,960	224,090	209,811	176,466	330,000
Netherlands	203,193	102,411	123,551	136,551	210,000
Other countries	393,236	325,082	441,116	332,098	410,000
Total Europe	6,750,478	5,561,257	5,881,333	4,708,700	6,970,000

[a] European beet-sugar production, as estimated by Licht, in metric tons of 2,204.622 pounds; sugar production of India, as officially estimated, in long tons of 2,240 pounds; and other data, as estimated by Willett and Gray, also in long tons of 2,240 pounds.
[b] Not estimated.
[c] Official estimates for such parts of India as return agricultural statistics.

Sugar production of countries named, 1901–2 to 1905–6—Continued.

Country.	1901–1902.	1902–1903.	1903–1904.	1904–1905.	1905–1906.
BEET SUGAR—continued.					
United States:	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
California	62,723	71,120	60,608	41,540	64,251
Colorado	19,977	34,623	39,566	49,606	93,253
Idaho			3,571	7,811	13,435
Illinois					550
Michigan	46,692	48,848	57,064	46,659	54,635
Minnesota	2,455	3,054	3,125	3,304	*a* 2,750
Nebraska	6,660	9,430	8,669	13,355	9,379
New York	4,049	2,799	4,479	3,214	4,235
Ohio	3,126	1,473	2,009	4,304	4,026
Oregon	1,250	2,025	1,250	2,348	1,595
Utah	12,748	16,987	20,670	25,274	21,337
Washington	857	1,641	2,213	2,679	2,321
Wisconsin	2,589	3,463	4,911	9,598	11,950
Total United States	163,126	195,463	208,135	209,722	283,717
Canada		6,696	6,710	8,034	11,419
Total beet-sugar production	6,913,604	5,763,416	6,096,178	4,926,156	7,265,136
Total cane and beet sugar	13,000,822	11,819,141	12,182,327	11,680,784	13,957,269

a Manufactured in Michigan from beets grown in Minnesota, owing to the destruction of the factory in the latter State.

World's international trade in sugar, 1900–1905.

EXPORTS.

Country.	Year beginning—	1900.	1901.	1902.	1903.	1904.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Austria-Hungary	Jan. 1	1,449,521,108	1,544,326,467	1,500,882,186	1,564,437,691	1,125,102,823
Belgium	Jan. 1	663,056,568	514,235,840	296,287,771	257,180,695	406,944,665
Brazil	Jan. 1	*a* 135,460,000	412,630,577	301,498,062	48,256,967	17,331,526
Cuba	Jan. 1	642,728,977	1,319,796,470	1,781,561,643	2,118,279,646	2,459,166,945
Dutch East Indies	Jan. 1	1,623,937,793	1,595,413,931	1,904,371,591	1,907,867,945	2,318,212,944
Egypt	Jan. 1	118,452,817	108,769,976	98,521,149	86,469,803	50,620,531
France	Jan. 1	1,294,253,828	1,460,958,265	804,993,320	469,129,814	636,360,461
Germany *b*	Jan. 1	2,218,876,204	2,399,611,997	2,367,596,256	2,249,141,034	1,720,574,091
Mauritius	Jan. 1	385,145,539	345,999,192	331,172,713	375,505,049	436,130,815
Netherlands	Jan. 1	305,149,696	312,808,840	310,694,069	287,238,939	403,476,558
Peru	Jan. 1	244,041,452	251,230,174	258,738,790	281,482,880	290,928,960
Philippine Islands	Jan. 1	143,719,971	125,799,930	217,486,869	188,114,307	191,917,567
Russia	Jan. 1	452,496,309	282,752,715	288,610,934	540,418,988	*c* 398,468,635
United Kingdom	Jan. 1	67,911,536	62,306,608	80,193,232	115,269,728	65,906,736
Other countries		1,042,973,000	1,247,642,000	1,322,229,000	1,279,386,000	723,236,000
Total		10,787,724,798	12,014,282,982	11,864,837,585	11,768,179,486	11,244,379,257

IMPORTS.

Country.	Year beginning—	1900.	1901.	1902.	1903.	1904.
Canada	July 1	336,694,833	370,075,447	388,370,832	390,544,660	346,752,590
Cape of Good Hope	Jan. 1	79,235,937	95,304,081	120,365,406	104,629,048	107,474,911
Chile	Jan. 1	111,747,375	82,274,551	97,002,936	115,467,959	124,139,619
Denmark	Jan. 1	65,716,916	66,770,702	42,051,621	77,374,516	82,865,127
Egypt	Jan. 1	13,317,839	16,367,852	22,844,441	16,920,099	45,843,510
Finland	Jan. 1	69,990,717	65,933,044	61,752,745	72,691,465	71,263,531
France	Jan. 1	209,017,668	222,415,841	220,187,363	288,073,883	179,849,557
India (British)	April 1	546,579,488	617,565,424	549,868,704	672,147,168	724,262,224
Japan	Jan. 1	539,438,000	657,076,667	351,750,533	523,131,067	547,300,400
Netherlands	Jan. 1	117,196,910	197,218,665	248,799,655	203,061,092	210,706,915
New Zealand	Jan. 1	77,919,052	79,369,066	84,878,074	88,197,686	91,841,944
Norway	Jan. 1	75,191,455	81,335,913	82,791,956	83,524,155	76,703,054
Portugal	Jan. 1	63,351,791	63,251,615	63,630,016	68,765,610	72,490,231
United Kingdom	Jan. 1	3,587,753,008	3,858,476,048	3,522,549,520	3,487,111,376	3,602,455,248
United States	July 1	3,975,005,840	3,031,915,875	4,216,108,106	3,700,623,613	3,680,932,880
Uruguay	Jan. 1	39,064,698	41,221,991	43,235,210	39,984,265	*d* 40,864,041
Other countries		994,601,000	1,161,133,000	1,444,681,000	1,471,672,000	959,589,000
Total		10,901,822,527	10,707,705,782	11,560,868,118	11,403,869,662	10,965,334,782

a Estimated.
b Not including free ports.
c Preliminary figures excluding trade over the Asiatic frontier (excepting the Black Sea ports of the Caucasus).
d Average of 1900–1903.

(See "General note" to "World's international trade in wheat," p. 665.)

Production of beet and cane sugar in the United States.[a]

Year.	Beet.	Cane (Louisiana).	Total.[b]	Year.	Beet.	Cane (Louisiana).	Total.[b]
	Tons.[c]	*Tons.*[c]	*Tons.*[c]		*Tons.*[c]	*Tons.*[c]	*Tons.*[c]
1884–85	953	94,376	95,329	1895–96	29,220	237,721	266,941
1885–86	600	127,958	128,558	1896–97	37,536	282,009	319,545
1886–87	800	80,859	81,659	1897–98	40,398	310,313	350,711
1887–88	255	157,971	158,226	1898–99	32,471	248,658	281,129
1888–89	1,861	144,878	146,739	1899–1900	72,972	142,485	215,457
1889–90	2,203	130,413	132,616	1900–1901	76,859	270,338	347,197
1890–91	3,459	215,844	219,303	1901–2	163,126	321,676	484,802
1891–92	5,356	160,937	166,293	1902–3	195,463	329,226	524,689
1892–93	12,018	217,525	229,543	1903–4	208,135	215,000	423,135
1893–94	19,950	265,836	285,786	1904–5	209,722	335,000	544,722
1894–95	20,092	317,334	337,426	1905–6	283,717	330,000	613,717

[a] Data as to beet sugar are obtained from the following sources: For 1899–1900, from the Twelfth Census; for 1897–98, from a special report of the Department of Agriculture; and for other years from Willett and Gray. Data as to cane sugar are from the following sources: For 1889–90, 1898–99, and 1899–1900, from the Eleventh and Twelfth censuses; from 1903–4 to 1905–6, inclusive, from Willett and Gray; for other years, from Bouchereau's Annual Louisiana Sugar Reports (the figures for 1892–93 being taken from his revised statement).

[b] These figures do not include cane sugar produced outside of Louisiana. In 1889–90 such sugar amounted to 4,089 tons, and in 1899–1900 to 1,510 tons, and in 1905–6 (according to Willett and Gray's estimate for Texas) to 12,000 tons.

[c] Tons of 2,240 pounds.

Quantity and value of sugar imported into the United States from the principal sources of supply during each fiscal year, from 1901 to 1905, inclusive.

QUANTITY.

Country from which imported.	Annual average, 1901–1905.	Year ended June 30—					Per cent in 1905.
		1901.	1902.	1903.	1904.	1905.	
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
Cuba	1,871,472,328	1,099,404,363	984,216,925	2,396,497,779	2,819,558,402	2,057,684,169	55.90
Dutch East Indies	729,244,022	777,986,990	636,710,315	891,758,090	440,370,139	899,394,575	24.43
Santo Domingo	107,332,780	107,193,244	111,580,425	112,988,775	95,790,189	109,111,269	2.96
British Guiana	133,248,296	183,331,202	181,237,759	172,361,345	73,295,689	56,015,487	1.52
British West Indies	153,257,225	232,989,234	194,969,474	191,924,220	65,850,114	80,553,082	2.19
Philippine Islands	34,891,741	4,693,333	11,424,000	18,773,333	61,570,614	77,997,424	2.12
Peru	83,498,287	129,534,403	102,647,624	88,848,044	48,671,777	47,789,588	1.30
Egypt	42,022,947	63,389,981	59,557,384	62,348,580	22,222,552	2,596,236	.07
Danish West Indies	22,029,957	19,217,052	16,037,682	41,205,950	20,837,461	12,851,640	.35
Brazil	156,287,187	293,327,013	349,794,460	74,159,889	14,186,540	49,968,032	1.36
Dutch Guiana	13,009,855	14,063,215	16,861,587	15,722,225	6,994,546	11,407,700	.31
Germany	247,401,547	716,824,596	217,872,627	91,745,860	5,480,349	205,084,302	5.57
Chinese Empire	4,803,529	7,914,450	2,397,107	752,285	4,602,045	8,351,757	.23
Canada	3,261,706	1,399,269	2,436,647	6,285,045	4,034,551	2,153,019	.06
Austria-Hungary	64,028,216	161,174,865	111,818,771	40,857,724	3,525,512	2,764,206	.08
Mexico	5,882,197	1,358,503	338,368	2,414,373	1,250,252	24,049,489	.65
United Kingdom	6,011,855	17,272,407	11,125,336	119,739	70	1,541,724	.04
Netherlands	6,899,034	25,327,230	8,967,942	200,000	....	....	......
Russia, European	6,773,840	32,770,130	1,099,072	....	....	....	......
Belgium	18,279,998	70,099,670	479,655	....	....	20,820,667	.57
British East Indies	8,953	....	44,766	....	....	....	......
British East Africa	1,337,515	6,687,573	....	....	....	....	......
Other countries	9,934,272	9,047,117	10,297,949	7,144,850	12,382,811	10,798,632	.29
Total	3,720,917,287	3,975,005,840	3,031,915,875	4,216,108,106	3,700,623,613	3,680,932,998	100.00

Quantity and value of sugar imported into the United States from the principal sources of supply during each fiscal year, from 1901 to 1905, inclusive—Continued.

VALUE.

Country from which imported.	Annual average, 1901–1905.	Year ended June 30—					Per cent in 1905.
		1901.	1902.	1903.	1904.	1905.	
	Dollars.	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	
Cuba	41,641,337	26,373,690	18,205,411	42,714,079	56,547,403	64,366,104	65.92
Dutch East Indies	13,112,882	16,965,511	12,325,518	13,251,816	7,409,996	15,611,568	15.99
Santo Domingo	2,473,910	2,959,067	2,061,977	2,107,428	1,750,145	3,490,933	3.57
British Guiana	2,879,603	4,803,479	3,372,104	3,333,032	1,428,433	1,460,969	1.50
British West Indies	2,828,011	5,058,565	3,226,575	3,136,172	1,092,663	1,626,078	1.67
Philippine Islands	589,061	103,857	188,159	270,729	884,160	1,498,399	1.53
Peru	1,601,764	2,702,180	1,910,311	1,517,514	860,605	1,018,208	1.04
Egypt	898,461	1,653,695	1,351,038	1,014,831	415,551	57,190	.06
Danish West Indies	464,621	460,694	377,581	705,587	396,384	382,861	.39
Brazil	2,579,733	5,317,503	4,908,735	1,176,049	200,102	1,266,275	1.30
Canada	166,350	108,137	123,441	256,894	196,633	146,644	.15
Dutch Guiana	297,218	382,876	349,242	301,235	134,902	317,837	.33
Chinese Empire	131,605	229,795	63,429	13,640	123,900	227,260	.23
Germany	5,008,999	15,556,811	3,597,234	1,370,305	117,410	4,403,237	4.51
Austria-Hungary	1,370,655	3,727,094	2,288,547	677,836	80,393	79,403	.08
Mexico	223,625	35,994	9,408	103,439	35,998	933,284	.96
United Kingdom	133,775	431,959	192,945	2,241	4	41,724	.04
Netherlands	191,255	718,422	232,963	4,888	....	....	....
Russia, European	171,719	829,401	29,193	....	....	....	....
Belgium	442,016	1,721,724	11,607	....	....	473,749	.48
British East Indies	267	....	1,333	....	....	....	....
British East Africa	16,015	80,076	....	....	....	....	....
Other countries	216,934	234,270	234,346	131,258	241,071	243,726	.25
Total	77,439,816	90,487,800	55,061,097	72,088,973	71,915,753	97,645,449	100.00

CACAO.

Cacao crop of countries named, 1902–1904.

[Gordian, Hamburg.]

Country.	1902.	1903.	1904.
	Pounds.	*Pounds.*	*Pounds.*
Ecuador	55,038,388	51,231,006	62,684,017
Brazil	44,908,150	45,719,451	51,059,046
St. Thomas Island (Portuguese)	39,614,853	47,289,142	45,252,071
Trinidad	35,174,744	32,815,798	40,948,649
Santo Domingo	19,786,483	17,251,167	29,888,060
Venezuela	21,880,873	27,668,006	28,765,908
Grenada	13,172,616	13,558,425	13,725,977
Gold Coast	5,370,459	5,064,017	12,537,685
Cuba and Porto Rico	4,133,666	5,787,133	7,200,295
Ceylon	5,892,955	6,779,213	7,173,840
Haiti	4,396,016	4,795,053	5,579,897
Jamaica	3,362,049	3,637,626	3,637,626
Martinique and Guadeloupe	2,039,275	2,535,315	2,678,616
Dutch East Indies	1,959,909	3,214,339	2,513,269
Kamerun, Samoa, and Togo	1,428,595	1,774,721	2,444,926
Dutch Guiana	5,191,885	4,903,079	1,882,747
St. Lucia	1,730,628	1,763,698	1,763,698
Dominica	....	....	1,069,242
Kongo Free State	....	....	509,268
Other countries	1,543,236	1,763,698	1,776,926
Total	266,624,780	277,550,887	323,091,763

Cacao consumption of countries named, 1902–1904.

[Gordian, Hamburg.]

Country.	1902.	1903.	1904.
	Pounds.	*Pounds.*	*Pounds.*
United States	50,970,861	62,849,364	73,103,061
Germany	45,417,418	47,379,531	59,747,461
France	42,644,003	45,498,989	48,058,555
United Kingdom	44,943,424	38,547,816	45,309,391
Holland	32,332,986	36,907,577	46,570,435
Switzerland	12,581,778	12,910,266	15,077,410
Spain	20,412,595	13,240,960	12,370,134
Belgium	5,019,924	6,100,189	6,155,305
Austria-Hungary	4,012,412	4,484,201	5,533,601
Russia	4,008,003	4,188,782	4,530,498
Denmark	1,768,107	2,535,315	2,195,804
Sweden	1,302,932	1,706,377	1,918,021
Canada	1,128,766	1,289,704	1,433,004
Australia	1,221,361	976,648	1,212,542
Italy	1,027,351	1,031,763	1,056,014
Norway	903,895	967,829	1,040,582
Portugal	246,918	299,829	396,832
Finland	103,617	134,482	138,891
Total	270,046,354	281,049,622	325,847,541

BEANS.

Wholesale prices of beans per bushel in leading cities of the United States, 1901–1905.

Date.	Boston.		Cincinnati.		Chicago.		Detroit.		San Francisco.	
	Pea.		Pea.		Pea.		Pea.		Small white (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1901.										
January	$2.25	$2.30	$2.50	$2.55	$1.75	$2.20	$1.85	$2.15	$3.60	$4.70
February	2.20	2.25	2.50	2.50	1.80	2.10	1.94	2.00	3.75	4.90
March	2.10	2.15	2.40	2.50	.90	2.02	1.80	1.88	3.60	4.90
April	2.10	2.10	2.40	2.40	1.25	1.97	1.80	1.90	3.75	4.95
May	2.00	2.10	2.40	2.40	1.25	1.90	1.74	1.80	3.70	4.95
June	2.00	2.15	2.40	2.40	1.50	2.05	1.75	1.95	3.60	4.90
July	2.15	2.15	2.40	2.40	1.60	2.50	1.85	2.40	3.40	5.00
August	2.40	2.75	2.40	3.00	2.10	2.80	2.40	2.40	2.00	4.25
September	2.35	2.70	3.00	3.00	1.65	2.80	2.40	2.40	2.05	4.25
October	2.10	2.30	2.60	3.00	1.55	2.00	1.68	1.92	2.00	5.00
November	2.00	2.05	2.60	2.75	1.50	1.92	1.66	1.85	2.50	3.50
December	2.00	2.05	2.60	2.75	1.69	1.87	1.72	1.81	2.80	3.25
1902.									Lima.	
January	1.80	2.05	2.60	2.70	1.40	1.83	1.60	1.79	4.40	4.65
February	1.80	1.85	2.60	2.70	1.40	1.75	1.53	1.62	4.40	4.60
March	1.70	1.80	2.60	2.70	1.20	1.65	1.28	1.51	4.35	4.40
April	1.60	1.75	2.30	2.70	.85	1.80	1.28	1.62	3.30	3.60
May	1.75	1.90	2.30	2.60	1.50	1.85	1.56	1.75	3.60	3.80
June	1.65	1.70	2.30	2.60	1.50	1.70	1.48	1.60	3.60	3.85
July	1.80	2.15	2.30	2.50	1.60	1.90	1.60	1.90	3.60	3.85
August	1.95	2.10	2.30	2.50	1.60	1.96	1.63	1.90	3.80	4.10
September	1.90	2.00	2.30	2.50	1.60	1.90	1.75	1.85	3.70	3.90
October	2.15	2.55	2.25	2.50	1.78	2.49	1.70	1.98	4.10	4.35
November	2.35	2.45	2.20	2.40	2.15	2.30	1.66	1.88	4.20	4.50
December	2.30	2.40	2.25	2.40	2.15	2.30	1.74	1.81	4.25	4.55
1903.			Navy.						Small white.	
January	2.40	2.45	2.40	2.50	1.25	2.40	2.24	2.35	2.90	3.40
February	2.35	2.40	2.25	2.50	1.20	2.30	2.10	2.23	2.90	3.35
March	2.25	2.30	2.30	2.40	1.25	2.25	2.10	2.16	3.00	3.30
April	2.25	2.30	2.15	2.40	.90	2.20	1.88	2.10	3.00	3.30
May	2.25	2.35	2.15	2.25	.90	2.30	2.07	2.35	2.90	3.25
June	2.35	2.35	2.15	2.25	1.25	2.35	2.20	2.25	3.00	3.25
July	2.30	2.35	2.15	2.25	1.20	2.23	2.10	2.21	3.00	3.25
August	2.20	2.30	2.15	2.25	1.15	2.25	1.91	1.96	3.00	3.20
September	2.30	2.40	2.15	2.25	1.50	2.50	2.10	2.35	2.85	3.25
October	2.25	2.40	2.15	2.25	1.05	2.25	1.90	2.28	3.00	3.25
November	2.15	2.20	2.15	2.25	1.05	2.15	1.90	2.00	2.75	3.15
December	2.10	2.15	2.05	2.25	1.35	2.00	1.82	1.90	2.40	3.00

Wholesale prices of beans per bushel in leading cities of the United States, 1901–1905—Con.

Date.	Boston.		Cincinnati.		Chicago.		Detroit.		San Francisco.	
	Pea.		Pea.		Pea.		Pea.		Small white (per cwt.).	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1904.										
January	$2.00	$2.10	$2.05	$2.10	$1.00	$1.90	$1.75	$1.77	$2.75	$3.00
February	2.00	2.20	2.05	2.10	1.25	2.05	1.74	1.98	2.80	3.00
March	2.00	2.20	2.05	2.10	1.25	2.05	1.70	1.95	2.85	3.10
April	1.95	2.00	2.05	2.10	1.00	1.85	1.70	1.80	2.90	3.15
May	1.95	2.00	2.05	2.10	1.10	1.80	1.70	1.87	2.95	3.10
June	1.85	1.95	2.05	2.10	1.10	1.78	1.60	1.70	2.90	3.05
July	1.80	1.80	2.05	2.10	1.10	1.70	1.60	1.61	2.75	3.00
August	1.75	1.90	2.05	2.10	1.10	1.65	1.61	1.78	2.75	3.00
September	1.75	1.90	2.05	2.10	.90	1.65	....	....	2.75	3.10
October	1.85	1.95	2.05	2.10	.90	1.75	1.65	1.72	2.75	3.32¼
November	1.80	1.85	1.80	1.90	1.10	1.70	1.58	1.64	2.75	3.30
December	1.72½	1.80	1.80	1.90	1.20	1.70	1.58	1.62	2.75	3.30
1905.										
January	1.75	1.75	1.80	1.90	1.25	1.62	1.56	1.65	2.75	3.30
February	1.75	2.00	1.80	1.90	1.00	1.85	1.52	1.85	2.75	3.30
March	1.80	1.97	1.80	1.90	1.30	1.80	1.70	1.77	2.75	3.45
April	1.75	1.80	1.80	1.90	1.30	1.70	1.66	1.75	2.75	3.45
May	1.75	1.80	1.80	1.90	1.30	1.70	1.62	1.68	2.75	3.40
June	1.80	1.90	1.80	1.90	1.30	1.75	1.65	1.69	2.75	3.50
July	1.85	1.90	1.80	1.90	1.25	1.78	1.66	1.68	2.75	3.60
August	1.75	1.85	1.80	1.90	1.20	1.72½	1.55	1.63	2.75	3.60
September	1.75	1.75	1.80	1.90	1.25	1.68	1.50	1.65	3.00	3.60
October	1.75	1.75	1.65	1.75	1.25	1.65	1.49	1.63	3.00	3.60
November	1.75	1.85	1.65	1.75	1.40	1.70	1.55	1.68	2.75	3.15
December	1.75	1.85	1.65	1.75	1.40	1.70	1.55	1.65	2.75	3.20

CLOVER SEED.

Wholesale prices of clover seed (60 pounds to the bushel), 1901–1905.

Date.	Cincinnati.		Chicago.		Toledo.		Detroit.	
	Prime (per bushel).		Poor to choice (per 100 pounds).		Prime (per bushel).		Per bushel.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1901.								
January	$5.50	$6.25	$4.00	$11.00	$7.10	$7.35	$6.90	$7.30
February	5.75	6.60	5.00	11.50	6.80	7.40	6.75	7.35
March	6.00	6.40	5.00	11.15	6.55	6.75	6.50	6.80
April	5.80	6.40	5.00	11.00	6.50	6.75	6.50	6.65
May	5.80	6.00	4.00	10.75	6.30	6.57½	6.00	6.50
June	....	....	5.00	9.50	6.40	6.50	6.00	6.00
July	....	....	6.00	10.00	6.20	6.60	6.00	6.25
August	6.00	6.00	7.00	10.25	5.80	6.60	5.85	6.50
September	4.85	5.80	4.50	10.40	5.15	5.90	5.15	5.90
October	4.50	5.10	4.50	8.75	5.15	5.60	5.15	5.60
November	4.60	5.25	5.00	9.25	5.40	5.65	5.40	5.65
December	4.75	5.60	6.00	9.50	5.62½	5.90	5.65	5.90
1902.	Per 100 pounds.							
January	8.65	9.60	7.00	10.00	4.25	6.15	5.70	6.10
February	8.65	9.20	6.50	9.70	4.95	5.80	5.55	5.80
March	8.00	9.20	6.00	9.00	4.30	5.65	5.10	5.55
April	7.10	8.35	4.00	8.35	3.90	5.30	4.90	5.20
May	6.85	7.50	5.50	8.35	3.90	5.22½	5.00	5.20
June	6.85	7.30	6.00	8.35	4.00	5.25	Not quoted.	
July	6.85	7.50	6.00	8.40	4.10	5.30	Not quoted.	
August	7.10	8.35	6.00	9.10	4.20	5.60	Not quoted.	
September	7.10	8.35	7.00	9.50	4.25	5.65	5.15	5.90
October	7.50	8.75	7.00	11.35	4.70	7.00	5.15	5.60
November	7.50	9.20	8.00	11.15	4.75	7.10	5.35	5.65
December	8.35	9.20	8.00	10.90	5.50	6.85	5.60	5.90
1903.	Per bushel.							
January	5.25	6.50	8.50	11.90	4.40	7.42½	7.25	7.30
February	6.00	6.50	9.25	11.90	5.25	7.25	7.00	7.10
March	6.25	7.10	....	12.50	4.00	7.42½	6.95	7.40
April	6.00	6.90	5.00	12.25	3.60	7.62½	6.60	7.25
May	5.40	7.00	8.00	12.50	4.00	7.70	7.50	7.50

Wholesale prices of clover seed (60 pounds to the bushel), 1901–1905—Continued.

Date.	Cincinnati.		Chicago.		Toledo.		Detroit.	
	Prime (per bushel).		Poor to choice (per 100 pounds).		Prime (per bushel).		Per bushel.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1903.								
June	$5.40	$6.00	$8.00	$11.75	$6.00	$6.75	Not quoted.	
July	....	....	8.00	12.50	6.40	7.10	Not quoted.	
August	....	....	8.50	12.50	4.85	7.10	Not quoted.	
September	5.00	5.70	5.00	11.00	4.00	6.65	Not quoted.	
October	5.25	5.70	6.00	11.50	3.75	6.80	$6.45	$6.90
November	5.25	5.60	4.00	11.00	3.40	6.82½	6.50	6.60
December	5.25	6.00	6.00	11.25	3.05	7.05	6.80	6.95
1904.								
January	5.75	6.25	6.00	11.50	3.10	7.07½	6.75	7.00
February	5.75	6.25	6.00	11.25	4.00	7.02½	6.75	6.90
March	5.75	6.90	6.00	11.65	2.50	7.15	6.20	7.10
April	5.50	6.50	7.50	11.00	3.00	6.62½	6.20	6.55
May	4.80	5.00	6.00	10.75	3.00	6.35	6.30	6.35
June	4.80	5.00	6.00	10.75	2.50	6.25	....	....
July	4.80	5.00	7.00	11.25	3.00	6.60	6.25	6.50
August	4.80	6.50	8.00	12.75	5.70	7.60	6.50	7.50
September	6.00	6.50	9.00	12.50	3.60	7.45	7.05	7.45
October	5.50	6.75	7.00	12.25	3.00	7.52½	7.30	7.55
November	5.50	6.50	7.00	12.25	3.30	7.70	7.35	7.65
December	5.50	7.50	7.00	13.00	3.62½	7.95	7.70	7.95
1905.			(a)					
January	6.40	7.00	8.00	13.00	3.25	8.00	7.45	7.90
February	6.40	7.00	9.00	12.50	4.00	7.60	7.40	7.55
March	6.40	7.00	9.00	13.75	3.00	8.20	7.55	8.15
April	6.40	7.75	8.00	14.40	3.00	8.85	8.00	8.75
May	6.25	7.75	8.00	13.50	3.50	8.00	7.00	8.00
June	6.25	6.75	8.00	13.00	5.50	7.40	....	....
July	6.25	6.75	9.00	13.00	5.75	7.50	....	....
August	....	....	8.50	13.00	4.00	7.50	....	....
September	5.70	6.00	9.00	12.25	3.00	7.45	6.30	7.40
October	5.70	7.00	9.50	13.25	3.00	8.22½	7.50	8.25
November	6.50	7.00	10.00	13.25	4.00	8.12½	7.95	8.10
December	6.50	7.50	10.00	13.25	4.00	8.30	8.00	8.15

[a] Poor to prime.

TIMOTHY SEED.

Wholesale prices of timothy seed (45 pounds to the bushel), 1901–1905.

Date.	Cincinnati.		Chicago.		Milwaukee.	
	Per bushel.		Per 100 pounds.		Per 100 pounds.	
	Low.	High.	Low.	High.	Low.	High.
1901.						
January	$1.70	$2.00	$4.60	$4.77½	$3.65	$4.50
February	1.85	2.05	4.35	4.60	4.00	4.50
March	1.85	2.00	4.00	4.40	3.75	4.40
April	1.80	1.95	3.75	4.15	3.50	4.20
May	1.80	1.85	3.35	3.90	3.00	4.00
June	....	....	3.60	4.30	3.00	4.60
July	....	....	4.30	5.25	3.65	5.25
August	2.00	2.40	4.90	5.75	3.75	5.25
September	2.30	2.40	5.20	5.70	4.25	5.25
October	2.35	2.60	5.50	5.90	4.25	5.60
November	2.50	2.65	5.75	6.35	4.50	6.00
December	2.50	2.90	6.35	6.55	5.00	6.50
1902.	Per 100 pounds.					
January	6.10	6.40	5.00	6.55	5.50	6.25
February	6.10	6.40	5.00	6.60	5.50	6.25
March	6.10	6.40	5.00	7.00	5.50	6.60
April	6.40	6.60	4.50	7.10	6.00	6.75
May	....	....	5.00	7.35	5.50	6.75
June	....	....	4.50	6.35	5.00	6.25
July	....	....	4.50	5.75	4.00	5.75
August	3.90	4.40	3.25	5.75	3.75	5.00
September	3.80	4.00	2.00	4.75	2.75	4.10
October	3.30	3.65	2.00	4.20	2.50	3.75
November	3.40	3.65	2.00	4.25	3.00	3.75
December	3.40	3.65	2.00	4.25	3.00	3.75

Wholesale prices of timothy seed (45 pounds to the bushel), 1901–1905—Continued.

Date.	Cincinnati. Per bushel.		Chicago. Per 100 pounds.		Milwaukee. Per 100 pounds.	
	Low.	High.	Low.	High.	Low.	High.
1903.						
January	$1.55	$1.70	$2.50	$4.35	$3.00	$3.75
February	1.55	1.70	2.50	4.35	3.00	3.75
March	1.45	1.65	2.00	3.95	2.00	3.75
April	1.35	1.50	2.00	3.70	2.00	3.25
May	1.35	1.50	2.00	3.75	2.25	2.90
June	1.35	1.60	2.00	4.00	2.35	3.35
July	....	....	1.75	3.65	2.60	3.35
August	....	....	1.75	3.40	2.50	3.25
September	1.35	1.50	2.50	3.40	2.50	3.25
October	1.25	1.50	2.00	3.17½	2.30	3.00
November	1.25	1.40	2.00	3.00	2.25	2.85
December	1.20	1.40	2.00	3.05	2.25	2.75
1904.						
January	1.20	1.35	2.00	3.25	2.25	3.15
February	1.25	1.35	2.25	3.25	2.50	3.15
March	1.25	1.35	2.00	3.25	2.00	3.15
April	1.20	1.35	2.00	3.00	2.00	2.90
May	1.20	1.30	2.00	3.05	2.25	2.90
June	1.20	1.30	2.00	3.05	2.25	2.90
July	1.20	1.30	2.00	3.25	2.00	3.00
August	1.20	1.35	2.00	3.05	2.50	3.00
September	1.15	1.35	2.00	3.00	2.25	3.00
October	1.15	1.25	1.75	2.75	2.10	2.80
November	1.15	1.30	1.75	2.70	2.10	2.65
December	1.15	1.30	1.75	2.72½	2.25	2.65
1905.			(*a*)			
January	1.15	1.30	1.75	2.80	2.25	2.65
February	1.15	1.30	2.00	2.92½	2.25	2.65
March	1.15	1.30	2.25	3.10	2.25	2.90
April	1.15	1.30	2.00	3.10	2.50	2.90
May	1.20	1.30	2.00	3.10	2.50	2.90
June	1.20	1.30	2.00	3.00	2.25	2.90
July	1.20	1.30	2.50	3.30	2.25	2.95
August	1.20	1.45	2.00	3.60	2.35	3.50
September	1.40	1.60	2.00	3.75	2.70	3.40
October	1.35	1.55	2.00	3.40	2.40	3.50
November	1.35	1.40	1.50	3.50	2.50	3.10
December	1.30	1.35	1.50	3.50	2.50	3.10

a Poor to prime.

SILK.

Raw silk production of countries named, 1900–1904.

[Estimate of the Silk Manufacturers' Association of Lyons.]

Country.	1900.	1901.	1902.	1903.	1904.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Western Europe:					
France	1,623,000	1,442,000	1,257,000	1,045,000	1,378,000
Italy	10,000,000	9,458,000	9,870,000	7,774,000	10,803,000
Spain	185,000	176,000	172,000	190,000	170,000
Austria-Hungary	690,000	717,000	688,000	606,000	694,000
Total	12,498,000	11,793,000	11,987,000	9,615,000	13,045,000
Levant and Central Asia:					
Anatolia	838,000	922,000	1,109,000	1,160,000	1,096,000
Syria and Cyprus	992,000	937,000	1,190,000	1,124,000	1,036,000
Salonika and Adrianople	331,000	441,000	419,000	517,000	561,000
Balkan States	168,000	212,000	287,000	300,000	337,000
Greece and Crete	110,000	132,000	143,000	132,000	143,000
Caucasus	772,000	970,000	1,025,000	882,000	794,000
Persia and Turkestan (exports)	683,000	562,000	1,213,000	1,433,000	939,000
Total	3,894,000	4,176,000	5,386,000	5,578,000	4,909,000

Raw silk production of countries named, 1900–1904—Continued.

Country.	1900.	1901.	1902.	1903.	1904.
Far East:					
China—	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Exports from Shanghai	10,199,000	11,164,000	7,937,000	9,356,000	9,293,000
Exports from Canton	4,422,000	4,722,000	4,892,000	4,733,000	4,705,000
Japan—					
Exports from Yokohama	9,094,000	9,921,000	10,516,000	10,159,000	12,846,000
British India—					
Exports from Calcutta	617,000	617,000	650,000	540,000	397,000
Total	24,332,000	26,424,000	23,995,000	24,788,000	27,241,000
Grand total	40,724,000	42,393,000	41,368,000	39,981,000	45,195,000

FARM ANIMALS AND THEIR PRODUCTS.

Live stock of countries named.

Country.	Year.	Cattle.		Horses.	Mules.	Sheep.	Swine.
		Total.	Milch cows.				
Total United States (including Hawaii and Philippine Islands)	......	68,968,654	....	21,871,281	3,591,750	51,001,809	55,174,579
United States:							
Continental—							
On farms	1906	66,861,522	19,793,866	18,718,578	3,404,061	50,631,619	52,102,847
Not on farms	1900	1,616,422	973,033	2,936,881	173,908	231,301	1,818,114
Alaska	1900	18	13	5	....	....	10
Porto Rico	1899	260,225	73,372	58,664	6,985	6,363	66,180
Total United States (in North America)	......	68,738,187	20,840,284	21,714,128	3,584,954	50,869,283	53,987,151
Bermuda	1904	....	....	*a* 1,242	....	....	....
Canada:							
Ontario	1905	2,889,503	1,106,984	672,781	....	1,324,153	1,896,460
Manitoba	1905	319,290	....	157,724	....	18,508	104,113
Other	1901	2,738,719	1,201,433	692,488	....	1,435,319	664,683
Total Canada	......	5,947,512	....	1,522,993	....	2,777,980	2,665,256
Central America:							
Costa Rica	1905	266,331	*b* 93,155	42,200	2,894	52	64,845
Guatemala	1898	196,768	....	50,343	....	77,593	29,784
Honduras	1904	569,812	....	43,107	14,064	11,806	111,581
Nicaragua	......	1,200,000	....	....	....	....	....
Mexico	1902	5,142,457	....	859,217	334,435	3,424,430	616,139
Newfoundland	1901	32,767	....	8,851	....	78,052	34,679
West Indies:							
British—							
Barbados	1904	....	....	2,294	....	....	....
Dominica	1904	*c* 1,437	....	650	....	*c* 1,088	....
Grenada	1901	1,908	....	1,074	....	1,975	....
Jamaica	1904	107,770	....	74,132	....	20,136	27,000
Montserrat	1904	....	....	282	....	....	....
Turks and Caicos Islands	1904	930	....	105	....	125	....
Virgin Islands	1904	2,000	....	255	....	300	....
Cuba	*d* 1905	1,703,069	*b* 821,602	265,399	38,034	*e* 9,982	*e* 358,868
Dutch	1903	4,038	....	921	194	28,117	3,797
Guadeloupe	(*f*)	30,560	....	8,819	6,311	11,731	32,656
Total North America	......	83,945,546	....	24,596,012	3,980,886	57,312,650	57,931,756

a Including mules and asses.
b Cows.
c Data for 1903.
d On December 31 of preceding year.
e Census of 1899.
f Latest official estimate, furnished by the French Embassy to the United States under date of May 4, 1906.

Live stock of countries named—Continued.

Country.	Year.	Cattle.		Horses.	Mules.	Sheep.	Swine.
		Total.	Milch cows.				
Argentina	1895	21,701,526	1,800,799	4,446,859	285,497	74,379,562	652,766
Brazil	......	30,000,000	....	....	....	....	....
British Guiana	1904	81,400	....	1,320	....	14,600	12,000
Chile	1902	969,368	104,372	177,687	27,936	1,069,159	178,383
Colombia	......	2,800,000	....	341,000	257,000	746,000	2,300,000
Dutch Guiana	1903	8,358	....	255	133	111	2,442
Falkland Islands	1904	4,000	....	3,200	....	702,444	100
Paraguay	1900	2,283,039	....	182,789	3,490	214,058	23,887
Uruguay	1900	6,827,428	....	561,408	22,992	18,608,717	93,923
Venezuela	1899	2,004,257	....	191,079	89,186	176,668	1,618,214
Total South America	......	66,679,376	....	5,905,597	686,234	95,851,319	4,881,715
Austria-Hungary:							
Austria	1900	9,511,170	[a]4,749,152	1,716,488	20,323	2,621,026	4,682,654
Hungary	1895	6,605,365	....	2,308,457	1,911	8,122,682	7,330,343
Bosnia-Herzegovina	1895	[b]1,417,341	....	[c]239,626	....	3,230,720	662,242
Total Austria-Hungary	......	17,533,876	....	4,264,571	22,234	13,974,428	12,675,239
Belgium	[d]1905	1,782,290	873,794	245,781	[e]6,915	235,722	1,154,721
Bulgaria	[d]1901	1,596,267	....	491,557	8,889	7,015,385	367,501
Denmark	1903	1,840,466	[a]1,089,073	486,935	....	876,830	1,456,699
Faroe Islands	1903	3,950	....	632	....	91,034	15
Finland	1903	1,417,503	[a]1,052,564	316,600	....	919,333	213,867
France	[d]1905	14,136,869	[a]7,438,464	3,138,507	200,727	17,800,965	7,522,383
Germany	1904	19,331,568	[a]10,456,137	4,267,403	....	7,907,173	18,920,666
Gibraltar	1904	....	....	450	....	....	....
Greece	1902	406,744	....	159,068	88,869	4,568,158	....
Iceland	1903	26,539	....	46,475	....	[f]486,347	....
Italy	1900	[g]5,000,000	....	741,739	327,276	[g]6,900,000	[g]1,800,000
Luxemburg	1900	94,849	....	19,557	[e]11	19,689	109,355
Malta	1905	7,851	....	3,475	3,100	18,529	5,078
Montenegro	......	60,000	[a]20,000	3,000	....	400,000	8,000
Netherlands	1904	1,690,463	[h]973,098	295,277	....	606,785	861,840
Norway	1900	950,201	[a]689,563	172,999	....	998,819	165,348
Portugal	......	817,000	....	90,000	59,100	3,064,100	1,200,000
Roumania	1900	2,545,051	380,720	864,324	515	5,655,444	1,709,205
Russia, European:							
Russia proper	1905	33,773,335	....	21,740,474	....	[i]49,192,800	10,687,918
Poland	1905	2,442,102	....	1,316,558	....	[i]2,835,000	848,428
Northern Caucasus	1905	3,238,119	....	1,266,262	....	[j]7,638,001	739,385
Total Russia (European)	1905	39,453,556	....	24,323,294	....	59,665,801	12,275,731
Servia	1900	956,661	170,329	184,849	178	3,061,759	959,580
Spain	1905	2,075,142	....	498,157	767,570	13,025,512	1,743,863
Sweden	1904	2,545,583	[a]1,763,176	546,943	....	1,105,903	796,572
Switzerland	1901	1,340,375	[a]739,922	124,896	3,077	219,438	555,261
Turkey and Crete	......	1,000,000	[a]300,000	600,000	....	10,000,000	....
United Kingdom:							
Great Britain	1905	6,987,020	[k]2,707,392	[l]1,572,433	....	25,257,196	2,424,919
Ireland	1905	4,645,222	[k]1,487,065	[l]534,873	....	3,749,313	1,164,322
Isle of Man and Channel Islands	1905	41,784	[k]17,460	[l]9,492	....	70,229	12,424
Total United Kingdom	1905	11,674,026	[k]4,211,917	[l]2,116,798	....	29,076,738	3,601,665
Total Europe	......	128,286,830	....	44,006,287	1,488,461	187,693,892	68,102,589
British India	1904	[m]86,517,184	[a]25,412,822	1,423,072	55,641	[n]21,577,896	....
Ceylon	1904	1,637,886	....	3,585	....	91,767	103,212
Cyprus	1905	49,952	....	[c]56,290	....	[o]235,840	37,377
Hongkong	1904	1,076	....	219	....	6	....
Japanese Empire:							
Japan	[d]1905	1,200,135	30,852	1,390,017	....	2,769	191,952
Formosa	[d]1905	98,528	[a]39,295	[i]37	....	....	976,327
Total Japanese Empire	[d]1905	1,298,663	....	1,390,054	....	2,769	1,168,279

[a] Cows.
[b] Including buffaloes.
[c] Including mules and asses.
[d] On December 31 of preceding year.
[e] Including asses.
[f] Exclusive of lambs.
[g] Data for 1890.
[h] Including cows kept for breeding purposes.
[i] Data for 1904.
[j] Including goats.
[k] Cows and heifers in milk and with calf.
[l] Used for agriculture and also unbroken.
[m] Including buffalo calves.
[n] Of which 252,763 in Alwar include goats.
[o] Exclusive of animals less than 1 year old.

Live stock of countries named—Continued.

Country.	Year.	Cattle.		Horses.	Mules.	Sheep.	Swine.
		Total.	Milch cows.				
Java	1900	2,654,809	....	418,400	....	....	....
Philippine Islands	1903	127,559	....	144,171	290	30,428	1,179,371
Russia, Asiatic:							
Transcaucasia	1902	2,304,977	....	388,936	....	[illegible]	[illegible]
Four provinces of Central Asia	1905	1,696,783	....	1,766,652	....	a 9,113,000	[illegible]
Four provinces of Siberia	1905	3,868,155	....	3,014,578	....	a 3,773,000	684,253
Other	1903	2,343,000	....	1,624,000	....	5,443,000	186,400
Total Russia (Asiatic)	......	10,212,915	....	6,794,166	....	24,631,258	[illegible]
Siam	......	1,104,751	....	35,812	....	....	....
Straits Settlements	1904	25,379	....	1,997	....	b 43,920	102,000
Turkey, Asiatic	......	3,000,000	....	800,000	....	45,000,000	....
Total Asia	......	106,630,174	....	11,067,766	55,931	91,613,884	3,842,740
Algeria	1904	1,080,554	....	229,119	172,695	8,611,747	88,178
Basutoland	1904	213,361	....	64,621	b 26	b 2,794	b 476
British Central Africa	1904	18,860	....	c 171	....	3,696	645
Cape of Good Hope	1904	1,954,390	540,310	255,060	64,433	11,818,829	385,945
Egypt	1900	350,000	....	80,000	10,000	....	....
German East Africa	1905	523,052	....	73	79	1,560,000	1,447
German Southwest Africa	1903	d 90,385	e 32,804	5,265	88	d 186,742	690
Lagos	1902	1,522	....	108	....	1,610	2,426
Madagascar f	(g)	2,867,612	....	1,074	464	373,454	522,021
Mauritius	1904	6,722	....	728	h 158	765	3,831
Mayotte	(g)	47,894	....	21	15	124	....
Natal	1904	664,874	e 202,987	54,550	2,875	726,762	53,297
Orange River Colony	1904	420,298	....	85,440	a 9,250	3,145,685	89,855
Reunion	(g)	4,720	....	1,780	4,534	4,583	....
St. Helena	1901	1,014	....	120	....	2,094	280
Seychelles	1904	1,000	....	150	....	200	5,000
Transvaal	1903	200,000	....	50,000	....	200,000	1,000
Tunis	i 1905	183,748	....	35,596	15,995	1,094,761	15,357
Total Africa	......	8,630,006	....	863,876	280,612	27,693,836	1,170,448
Australasia:							
New South Wales	i 1905	2,149,129	591,936	482,663	....	34,526,894	330,666
Victoria	1904	1,694,976	632,493	372,397	....	10,167,691	286,070
Queensland	i 1905	2,722,340	160,000	413,165	....	10,843,470	185,141
South Australia	1905	520,379	88,826	200,241	....	5,874,979	112,584
Western Australia	i 1905	561,490	27,721	90,225	j 600	2,853,424	70,299
Tasmania	1905	202,206	50,230	36,565	....	1,556,460	77,943
Total Commonwealth	......	7,850,520	1,551,206	1,595,256	600	65,822,918	1,062,703
New Zealand	1904	1,736,850	498,241	314,322	c 448	18,280,806	255,320
Total Australasia	......	9,587,370	2,049,447	1,909,578	1,048	84,103,724	1,318,023
Fiji	1904	22,366	....	3,332	....	1,204	2,141
Hawaii k	1900	102,908	4,028	12,982	6,506	102,098	8,057
New Caledonia	(g)	73,862	....	2,938	12	9,442	2,438
Total Oceania	......	9,786,506	....	1,928,830	7,566	84,216,468	1,330,659
Total	......	403,958,438	....	88,368,368	6,499,690	544,382,049	137,259,907

a Data for 1903.
b Exclusive of animals owned by natives.
c Including asses.
d Exclusive of the Windhuk district, in which the cattle were estimated at 1,774 and the sheep and goats at 2,630.
e Cows.
f Not including animals in the public service.
g Latest official estimate, furnished by the French Embassy to the United States under date of May 4, 1906.
h Including asses; data for 1903.
i On December 31 of preceding year.
j Including asses; data for 1904.
k On farms.

Live stock of countries named—Continued.

Country.	Year.	Asses.	Buffaloes.	Camels.	Goats.	Reindeer.
Total United States (including Hawaii and Philippine Islands)	......	112,535	640,871	....	2,089,930	....
United States:						
Continental—						
On farms	1900	94,165	....	....	1,870,599	....
Not on farms	1900	15,847	....	....	78,353	....
Porto Rico	1899	1,085	....	....	15,991	....
Total United States (in North America)	......	111,097	....	....	1,964,943	....
Central America:						
Costa Rica	1905	55	....	....	646	....
Mexico	1902	287,991	....	....	4,206,011	....
Newfoundland	1901	....	....	....	17,355	....
West Indies:						
British—						
Jamaica	1903	....	....	....	12,000	....
Cuba	a1905	2,327	....	....	b 18,[illegible]	....
Dutch	1903	5,222	....	....	54,918	....
Guadeloupe	(c)	4,394	....	....	13,902	....
Total North America	......	411,086	....	....	6,288,339	....
Argentina	1895	197,872	....	....	2,748,860	....
Chile	1902	17,574	....	....	157,844	....
Colombia	......	....	....	....	361,000	....
Dutch Guiana	1903	414	....	....	1,663	....
Paraguay	1900	4,067	....	....	32,334	....
Uruguay	1900	....	....	....	20,428	....
Venezuela	1899	312,810	....	....	1,667,272	....
Total South America	......	532,737	....	....	4,989,341	....
Austria-Hungary:						
Austria	1900	46,324	....	....	1,019,664	....
Hungary	1895	23,855	133,000	....	308,810	....
Bosnia-Herzegovina	1895	....	....	....	1,447,049	....
Total Austria-Hungary	......	70,179	133,000	....	2,775,523	....
Belgium	a1905	....	....	....	257,669	....
Bulgaria	a1901	107,098	431,487	....	1,405,190	....
Denmark	1903	....	....	....	38,984	....
Faroe Islands	1903	....	....	....	10	....
Finland	1903	....	....	....	5,914	133,489
France	a1905	362,545	....	....	1,461,616	....
Germany	1904	....	....	....	3,329,881	....
Greece	1902	141,179	....	....	3,339,409	....
Iceland	1903	....	....	....	344	....
Italy	1890	1,000,000	....	....	1,800,000	....
Luxemburg	1900	....	....	....	13,514	....
Malta	1905	3,851	....	....	18,419	....
Montenegro	......	....	....	....	100,000	....
Netherlands	1904	....	....	....	165,497	....
Norway	1900	....	....	....	214,594	108,784
Portugal	......	146,500	....	....	998,680	....
Roumania	1900	7,186	43,475	....	232,515	....
Russia, European:						
Russia proper	1904	....	....	233,500	1,109,800	351,000
Poland	1904	....	....	1,000	12,200	....
Total Russia, European	1904	....	....	234,500	1,122,000	351,000
Servia	1900	1,762	6,929	....	432,067	....
Spain	1905	663,004	....	1,800	2,385,664	....
Sweden	1904	....	....	....	66,223	221,226
Switzerland	1901	1,789	....	....	354,634	....
Total Europe	......	2,505,093	614,891	236,300	20,518,347	814,499

a On December 31 of preceding year.
b Census of 1899.
c Latest official estimate, furnished by the French Embassy to the United States under date of May 4, 1906.

Live stock of countries named—Continued.

Country.	Year.	Asses.	Buffaloes.	Camels.	Goats.	Reindeer.
British India	1904	a 1,319,297	14,317,9[illegible]	[illegible]	[illegible]	....
Ceylon	[illegible]	....	....	....	[illegible]	....
Cyprus	[illegible]	....	....	[illegible]	[illegible]	....
Japanese Empire:						
Japan	[illegible]	....	....	....	[illegible]	....
Formosa	[illegible]	....	[illegible]	....	[illegible]	....
Total Japanese Empire	[illegible]	....	[illegible]	....	[illegible]	....
Java	1900	....	[illegible]	....	....	....
Philippine Islands	[illegible]	....	[illegible]	....	[illegible]	....
Russia, Asiatic:						
Transcaucasia	1902	[illegible]	[illegible]	17,122	[illegible]	....
Four provinces of Central Asia	1903	....	....	[illegible]	[illegible]	....
Four provinces of Siberia	1903	....	....	500	220,000	[illegible]
Other	[illegible]	[illegible]	....	[illegible]	[illegible]	[illegible]
Total Russia, Asiatic	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Siam f	......	....	1,144,478	....	....	....
Turkey, Asiatic	......	[illegible]	....	....	[illegible]	....
Total Asia	......	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Algeria	1904	[illegible]	....	[illegible]	[illegible]	....
Basutoland	1904	[illegible]	....	....	[illegible]	....
British Central Africa	1904	....	....	....	[illegible]	....
Cape of Good Hope	1904	[illegible]	....	....	[illegible]	....
Egypt	1900	[illegible]	[illegible]	[illegible]	....	....
German East Africa	1905	[illegible]	....	24	[illegible]	....
German Southwest Africa	1903	[illegible]	....	3	h [illegible]	....
Lagos	[illegible]	....	....	....	2,000	....
Madagascar i	(j)	411	....	....	[illegible]	....
Mauritius	1903	....	....	....	[illegible]	....
Mayotte	(j)	[illegible]	....	....	[illegible]	....
Natal	1904	[illegible]	....	....	[illegible]	....
Orange River Colony	1903	[illegible]	....	....	[illegible]	....
Reunion	(j)	[illegible]	....	....	[illegible]	....
St. Helena	1901	774	....	....	[illegible]	....
Tunis	d1905	[illegible]	....	[illegible]	[illegible]	....
Total Africa	......	[illegible]	200,000	[illegible]	[illegible]	....
Australasia:						
New South Wales	d1905	....	....	[illegible]	[illegible]	....
South Australia	1904	....	....	....	[illegible]	....
Western Australia	[illegible]	....	....	[illegible]	[illegible]	....
Tasmania	[illegible]	....	....	....	[illegible]	....
Total Commonwealth	......	....	....	[illegible]	[illegible]	....
New Zealand	[illegible]	....	....	....	[illegible]	....
Total Australasia	......	....	....	[illegible]	[illegible]	....
Fiji	[illegible]	....	....	....	[illegible]	....
Hawaii k	[illegible]	[illegible]	....	....	[illegible]	....
New Caledonia	[illegible]	....	....	....	[illegible]	....
Total Oceania	......	[illegible]	....	[illegible]	[illegible]	....
Total	......	8,050,830	20,018,539	1,721,175	87,585,057	[illegible]

a Of which 58,423 in Gwalior, Marwar, Alwar, and Bengal include mules.
b Data for 1904.
c Exclusive of animals less than 1 year old.
d On December 31 of preceding year.
e Carabaos.
f Number of domesticated elephants returned as 2,036.
g Exclusive of animals owned by natives.
h Exclusive of the Windhuk district, in which the sheep and goats were estimated at 2,630.
i Not including animals in the public service.
j Latest official estimate, furnished by the French Embassy to the United States under date of May 4, 1906.
k On farms.

FARM ANIMALS AND THEIR PRODUCTS IN CONTINENTAL UNITED STATES.

HORSES AND MULES.

Number and farm value of horses and mules, 1880–1906.

January 1—	Horses.		Mules.	
	Number.	Value.	Number.	Value.
1880	11,201,800	$613,296,611	1,729,500	$105,948,319
1881	11,429,626	667,954,325	1,720,731	120,096,164
1882	10,521,554	615,824,914	1,835,166	130,945,378
1883	10,838,111	765,041,308	1,871,079	148,732,390
1884	11,169,683	833,734,400	1,914,126	161,214,976
1885	11,564,572	852,282,947	1,972,569	162,497,097
1886	12,077,657	860,823,208	2,052,593	163,381,096
1887	12,496,744	901,685,755	2,117,141	167,057,538
1888	13,172,936	946,096,154	2,191,727	174,853,563
1889	13,663,294	982,194,827	2,257,574	179,444,481
1890	14,213,837	978,516,562	2,331,027	182,394,099
1891	14,056,750	941,823,222	2,296,532	178,847,370
1892	15,498,140	1,007,593,636	2,314,699	174,882,070
1893	16,206,802	992,225,185	2,331,128	164,763,751
1894	16,081,139	769,224,799	2,352,231	146,232,811
1895	15,893,318	576,730,580	2,333,108	110,927,834
1896	15,124,057	500,140,186	2,278,946	103,204,457
1897	14,364,667	452,649,396	2,215,654	92,302,090
1898	13,960,911	478,362,407	2,190,282	96,109,516
1899	13,665,307	511,074,813	2,134,213	95,963,261
1900	13,537,524	603,969,442	2,086,027	111,717,092
1901	16,744,723	885,200,168	2,864,458	183,232,209
1902	16,531,224	968,935,178	2,757,017	186,411,704
1903	16,557,373	1,030,705,959	2,728,088	197,753,327
1904	16,736,059	1,136,940,298	2,757,916	217,532,832
1905	17,057,702	1,200,310,020	2,888,710	251,840,378
1906	18,718,578	1,510,889,906	3,404,361	334,680,520

Imports and exports of horses and mules, with average prices, 1892–1905.

Year ended June 30—	Imports of horses.			Exports of horses.			Exports of mules.		
	Number.	Value.	Average price.	Number.	Value.	Average price.	Number.	Value.	Average price.
1892	14,074	$2,455,868	$174.50	3,226	$611,188	$189.46	1,965	$238,591	$121.42
1893	15,451	2,388,267	154.57	2,967	718,607	242.20	1,634	210,278	128.69
1894	6,166	1,319,572	214.01	5,246	1,108,995	211.40	2,063	240,961	116.80
1895	13,098	1,055,191	80.56	13,984	2,209,298	157.99	2,515	186,452	74.14
1896	9,991	662,591	66.32	25,126	3,530,703	140.52	5,918	406,161	68.63
1897	6,998	464,808	66.42	39,532	4,769,265	120.64	7,473	545,331	72.97
1898	3,085	414,899	134.49	51,150	6,176,569	120.75	8,098	664,789	82.09
1899	3,042	551,050	181.15	45,778	5,444,342	118.93	6,755	516,908	76.52
1900	3,102	596,592	192.32	64,722	7,612,616	117.62	43,369	3,919,478	90.38
1901	3,785	985,738	260.43	82,250	8,873,845	107.89	34,405	3,210,267	93.31
1902	4,832	1,577,234	326.41	103,020	10,048,046	97.53	27,586	2,692,298	97.60
1903	4,999	1,536,296	307.32	34,007	3,152,159	92.69	4,294	521,725	121.47
1904	4,726	1,460,287	308.99	42,001	3,189,100	75.93	3,658	412,971	112.90
1905	5,180	1,591,083	307.16	34,822	3,175,259	91.19	5,826	645,464	110.79

Number, average price, and farm value of horses and mules in the United States January 1, 1906, by States.

State or Territory.	Horses.			Mules.		
	Number.	Average farm price, Jan. 1.	Farm value.	Number.	Average farm price, Jan. 1.	Farm value.
Maine	137,512	$93.73	$12,888,313			
New Hampshire	68,715	97.80	6,720,652			
Vermont	91,803	94.56	8,680,672			
Massachusetts	107,354	112.98	12,128,876			
Rhode Island	13,399	104.04	1,394,031			
Connecticut	59,162	111.14	6,575,528			
New York	682,232	102.81	70,160,719	4,166	$108.55	$452,230
New Jersey	100,877	112.32	11,330,486	5,223	120.96	631,773
Pennsylvania	656,106	102.57	67,296,787	40,459	106.33	4,302,002
Delaware	36,142	96.67	3,493,851	5,710	108.14	617,476
Maryland	156,614	84.35	13,210,382	19,346	104.46	2,020,869
Virginia	301,882	84.28	25,442,602	48,317	102.41	4,948,125
North Carolina	180,433	98.62	17,793,863	166,394	116.80	19,434,800
South Carolina	82,204	115.62	9,504,033	124,713	133.35	16,630,500
Georgia	137,918	115.36	15,910,168	225,187	135.04	30,409,227
Florida	49,784	89.23	4,442,000	16,986	137.15	2,329,590
Alabama	155,142	93.69	14,535,227	185,839	111.66	20,750,794
Mississippi	254,748	71.96	18,331,654	263,882	104.87	27,673,334
Louisiana	219,682	55.41	12,173,665	160,962	108.90	17,528,750
Texas	1,290,546	46.20	59,616,773	508,349	69.90	35,533,590
Arkansas	278,761	65.42	18,236,558	202,886	94.15	19,101,743
Tennessee	318,621	87.83	27,984,464	200,069	104.30	20,867,174
West Virginia	175,791	84.25	14,810,375	10,877	90.94	989,138
Kentucky	399,306	83.78	33,453,835	194,733	95.21	18,540,552
Ohio	895,918	101.07	90,550,455	18,099	99.13	1,794,145
Michigan	669,729	98.88	66,219,486	3,501	98.90	346,260
Indiana	782,453	93.87	73,452,750	74,666	97.55	7,283,693
Illinois	1,429,473	96.96	138,601,686	137,776	101.00	13,915,374
Wisconsin	595,932	91.65	54,617,148	4,985	76.84	383,047
Minnesota	723,141	85.07	61,517,592	8,405	79.93	671,819
Iowa	1,247,457	86.31	107,674,248	43,655	90.48	3,949,925
Missouri	898,975	78.31	70,398,716	292,159	91.69	26,788,074
Kansas	1,056,752	75.01	79,266,955	113,539	85.63	9,722,353
Nebraska	891,018	70.89	63,164,276	55,486	87.18	4,837,250
South Dakota	476,603	66.62	31,751,317	7,380	76.67	565,839
North Dakota	430,876	81.68	35,193,950	8,054	96.75	779,230
Montana	239,149	43.29	10,352,765	3,561	66.70	237,526
Wyoming	121,484	42.20	5,126,622	1,496	66.70	99,780
Colorado	259,064	53.98	13,984,282	9,744	73.82	719,278
New Mexico	113,579	30.29	3,440,300	4,847	60.41	292,803
Arizona	104,473	28.93	3,021,883	4,001	68.16	272,720
Utah	107,384	44.85	4,816,185	3,096	44.38	137,415
Nevada	91,944	53.92	4,958,073	2,911	60.58	176,362
Idaho	149,551	51.05	7,634,573	2,373	68.54	162,635
Washington	237,043	70.51	16,713,880	2,752	75.37	207,420
Oregon	217,167	61.33	13,318,845	7,077	71.32	504,709
California	399,673	76.32	30,505,037	69,679	91.30	6,361,689
Oklahoma	411,772	66.43	27,354,020	87,373	85.21	7,445,047
Indian Territory	213,234	52.24	11,139,348	53,648	79.49	4,264,460
United States	18,718,578	80.72	1,510,889,906	3,404,061	98.31	334,680,520

Range of prices for horses in Omaha, monthly, 1901–1905.

Date.	Drafts.		General purposes.		Southern.		Western.		Drivers.		Carriage teams.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1901.												
January	$90	$150	$55	$85	$25	$60	$10	$30	$95	$225	$200	$300
February	95	160	55	90	25	60	10	30	95	225	200	300
March	90	165	55	90	20	55	10	30	95	225	200	300
April	90	200	60	100	20	50	10	35	95	225	200	400
May	100	200	65	105	20	45	12	35	90	325	300	450
June	90	150	40	80	20	45	12	40	90	325	300	450
July	90	160	40	80	15	45	10	45	75	200	200	400
August	90	160	40	80	15	45	5	40	75	220	210	420
September	90	175	40	80	15	45	5	50	85	175	215	360
October	100	175	40	80	20	45	10	60	90	215	175	435
November	90	160	40	80	20	50	10	45	90	325	230	370
December	100	160	45	85	20	55	12	40	90	300	200	375
1902.												
January	90	175	55	85	35	80	10	50	95	225	200	350
February	95	185	60	100	35	80	10	50	95	225	200	350
March	100	200	60	100	35	80	10	50	95	225	200	350
April	100	225	60	110	30	65	10	50	100	250	200	500
May	100	250	65	105	25	60	12	60	90	325	300	500
June	90	200	60	90	20	45	12	60	90	325	300	450
July	90	175	40	80	15	45	10	65	75	200	200	400
August	90	175	40	80	15	45	10	80	75	220	210	420
September	90	175	40	80	15	45	10	100	85	175	215	360
October	100	175	40	80	20	45	10	100	90	215	175	435
November	90	160	40	80	20	65	10	80	90	325	230	370
December	100	185	45	85	20	70	12	60	90	300	200	375
1903.												
January	90	175	50	80	35	70	10	50	95	225	200	350
February	95	185	60	100	35	75	10	50	95	225	200	350
March	100	200	60	110	35	70	10	50	100	230	200	400
April	100	250	60	110	30	65	10	50	100	250	200	500
May	110	250	65	105	20	55	12	60	100	350	250	550
June	90	200	65	100	15	40	12	65	100	375	300	450
July	90	175	50	80	15	45	10	65	75	275	200	400
August	90	175	45	80	15	45	10	90	75	220	210	420
September	90	175	40	80	15	45	10	100	95	200	215	360
October	100	180	40	80	20	45	10	100	90	215	200	435
November	90	160	45	85	20	60	10	80	100	325	225	370
December	100	185	45	85	20	60	12	60	100	300	200	375
1904.												
January	120	175	65	90	45	90	10	50	75	150	300	400
February	120	175	70	90	40	80	10	50	75	150	300	400
March	120	175	75	95	35	70	10	50	75	150	300	400
April	125	200	75	100	30	65	10	50	90	175	300	400
May	140	275	90	125	30	65	15	35	125	300	300	750
June	135	250	75	110	30	60	15	40	125	300	300	700
July	125	200	65	100	30	60	15	65	120	175	300	400
August	120	175	50	90	30	60	15	90	100	175	300	400
September	120	175	60	100	30	60	15	110	100	175	300	400
October	125	200	65	100	40	75	15	100	125	200	300	450
November	130	235	70	100	40	90	10	35	125	200	300	450
December	130	225	70	100	45	75	12	60	125	200	300	400
1905.												
January	150	200	75	110	40	90	10	50	75	150	300	400
February	150	200	85	125	40	90	10	50	75	150	300	400
March	150	200	90	135	35	90	10	50	75	150	300	400
April	150	225	75	120	35	80	10	50	90	175	300	400
May	150	295	60	90	30	80	15	40	90	300	300	750
June	135	225	60	90	30	75	15	50	90	300	300	750
July	125	200	60	100	30	70	15	75	100	150	300	400
August	130	200	60	100	30	70	15	117	100	150	300	400
September	130	200	65	100	35	75	15	110	100	150	300	400
October	140	200	70	110	45	85	15	95	100	175	300	450
November	150	250	80	125	30	100	15	70	125	200	300	450
December	150	250	80	120	50	95	10	65	125	200	300	400

INTERNATIONAL TRADE IN MEAT.

Value of imports of meat animals and packing-house products into thirteen European countries and Cuba in 1904, and percentages derived from the United States.

Importing country.	Total of three following columns.	Live meat animals.	Packing-house products.	Poultry, game, rabbits, pigeons, etc.
Imported from all countries by—	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*
United Kingdom	283,158,215	50,263,256	223,171,623	9,723,336
Germany[a] (for consumption)	83,600,900	28,558,800	43,472,200	11,569,900
Netherlands (for consumption)	28,609,594	253,266	28,280,364	75,964
France (for consumption)	19,675,069	7,008,413	9,842,335	2,824,321
Belgium (for consumption)	15,938,990	5,739,069	9,698,218	501,703
Switzerland (for consumption)	15,881,517	10,352,595	3,864,307	1,664,615
Austria-Hungary (for consumption)	13,685,042	7,819,808	4,712,938	1,152,296
Cuba	13,011,989	6,639,536	6,368,058	4,395
Denmark (for consumption)	5,507,000	304,100	5,135,300	67,600
Spain	7,944,076	3,264,763	4,028,803	650,510
Italy (for consumption)	6,959,073	1,244,792	5,646,532	67,749
Russia (for consumption) (1903)	4,784,578	2,266,604	2,461,257	56,717
Norway	4,099,100	468,100	3,577,500	53,500
Sweden (1903)	3,860,369	130,646	3,637,540	92,183
Total	506,715,512	124,313,748	353,896,975	28,504,789
Imported from the United States by—				
United Kingdom	135,386,887	37,066,568	97,247,674	1,072,645
Germany[a] (for consumption)	25,207,400	....	25,206,000	1,400
Netherlands (for consumption)	16,236,441	....	16,236,433	8
France (for consumption)	(b)	(b)	(b)	(b)
Belgium (for consumption)	5,908,315	970,086	4,938,229	(b)
Switzerland (for consumption)	657,930	....	657,888	42
Austria-Hungary (for consumption)	1,683,826	....	1,683,826	....
Cuba	6,187,668	1,919,460	4,264,011	4,197
Denmark (for consumption)	(b)	(b)	(b)	(b)
Spain	486,757	22	486,732	3
Italy (for consumption)	1,764,965	....	1,764,965	....
Russia (for consumption) (1903)	122,268	....	122,268	....
Norway	821,000	....	821,000	(b)
Sweden (1903)	....	....	....	....
Total	194,463,457	39,956,136	153,429,026	1,078,295
	Percentage from the United States.			
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
United Kingdom	47.81	73.74	43.58	11.03
Germany[a]	30.15	....	57.98	....
Netherlands	56.75	....	57.41	....
France	(b)	(b)	(b)	(b)
Belgium	37.07	16.90	50.92	(b)
Switzerland	4.14	....	17.02	....
Austria-Hungary	12.30	....	35.73	....
Cuba	47.55	28.91	66.96	95.49
Denmark	(b)	(b)	(b)	(b)
Spain	6.13	....	12.08	....
Italy	25.36	....	31.26	....
Russia (1903)	2.56	....	4.97	....
Norway	20.03	....	22.95	(b)
Sweden (1903)	....	....	....	....
Total	[c] 40.38	[c] 34.15	[c] 45.27	[d] 4.30

a Not including free ports.
b Not stated.
c Omitting France and Denmark.
d Omitting France, Belgium, Denmark, and Norway.

CATTLE AND DAIRY PRODUCTS.

Number and farm value of milch cows and other cattle, 1880–1906.

January 1—	Milch cows.		Other cattle.	
	Number.	Value.	Number.	Value.
1880	12,027,000	$279,899,420	21,231,000	$341,761,154
1881	12,368,653	296,277,060	20,938,710	362,861,509
1882	12,611,632	326,489,310	23,280,238	463,069,501
1883	13,125,685	396,575.405	28,046,077	611,549,109
1884	13,501,206	423,486,649	29,046,101	683,229,054
1885	13,904,722	412,903,093	29,866,573	694,382,913
1886	14,235,388	389,985,523	31,275,242	661,956,274
1887	14,522,083	378,789,589	33,511,750	663,137,926
1888	14,856,414	366,252,173	34,378,363	611,750,520
1889	15,298,625	366,226,376	35,032,417	597,236,812
1890	15,952,883	353,152,133	36,849,024	560,625,137
1891	16,019,591	346,397,900	36,875,648	544,127,908
1892	16,416,351	351,378,132	37,651,239	570,749,155
1893	16,424,087	357,299,785	35,954,196	547,882,204
1894	16,487,400	358,998,661	36,608,168	536,789,747
1895	16,504,629	362,601,729	34,364,216	482,999,129
1896	16,137,586	363,955,545	32,085,409	508,928,416
1897	15,941,727	369,239,993	30,508,408	507,929,421
1898	15,840,886	434,813,826	29,264,197	612,296,634
1899	15,990,115	474,233,925	27,994,225	637,931,135
1900	16,292,360	514,812,106	27,610,054	689,486,260
1901	16,833,657	505,093,077	45,500,213	906,644,003
1902	16,696,802	488,130,324	44,727,797	839,126,073
1903	17,105,227	516,711,914	44,659,206	824,054,902
1904	17,419,817	508,841,489	43,629,498	712,178,134
1905	17,572,464	482,272,203	43,669,443	661,571,308
1906	19,793,866	582,788,592	47,067,656	746,171,709

Imports and exports of live cattle, with average prices, 1892–1905.

Year ended June 30—	Imports.			Exports.		
	Number.	Value.	Average price.	Number.	Value.	Average price.
1892	2,168	$47,466	$21.89	394,607	$35,099,095	$88.95
1893	3,293	45,682	13.87	287,094	26,032,428	90.68
1894	1,592	18,704	11.75	359,278	33,461,922	93.14
1895	149,781	765,853	5.11	331,722	30,603,796	92.26
1896	217,826	1,509,856	6.93	372,461	34,560,672	92.79
1897	328,977	2,589,857	7.87	392,190	36,357,451	92.70
1898	291,589	2,913,223	9.99	439,255	37,827,500	86.12
1899	199,752	2,320,362	11.62	389,490	30,516,833	78.35
1900	181,006	2,257,694	12.47	397,286	30,635,153	77.11
1901	146,022	1,931,433	13.23	459,218	37,566,980	81.81
1902	96,027	1,608,722	16.75	392,884	29,902,212	76.11
1903	66,175	1,161,548	17.55	402,178	29,848,936	74.22
1904	16,056	310,737	19.35	593,409	42,256,291	71.21
1905	27,855	464,572	16.68	567,806	40,598,048	71.50

Number, average price, and farm value of cattle in the United States on January 1, 1906.

State or Territory.	Milch cows. Number.	Milch cows. Average farm price, Jan. 1.	Milch cows. Farm value.	Other cattle. Number.	Other cattle. Average farm price, Jan. 1.	Other cattle. Farm value.
Maine	191,016	$29.50	$5,634,972	157,581	$16.73	$2,636,326
New Hampshire	132,498	35.20	4,663,930	105,297	16.26	1,712,127
Vermont	291,021	27.50	8,003,078	225,870	13.95	3,150,882
Massachusetts	196,346	39.00	7,657,494	93,371	16.56	1,546,218
Rhode Island	25,721	42.10	1,082,854	10,340	18.09	187,052
Connecticut	134,789	36.20	4,879,362	84,028	18.18	1,527,624
New York	1,755,972	34.50	60,581,034	954,277	16.52	15,764,647
New Jersey	186,464	40.65	7,579,762	81,191	20.18	1,638,431
Pennsylvania	1,097,590	34.30	37,647,337	867,436	17.40	15,093,386
Delaware	36,181	32.00	1,157,792	21,591	18.42	397,711
Maryland	148,897	29.90	4,452,020	135,319	18.16	2,458,068
Virginia	262,836	25.35	6,662,893	518,192	17.75	9,197,925
North Carolina	259,266	27.10	7,026,109	437,210	10.98	4,802,748
South Carolina	131,645	28.90	3,804,540	216,339	11.30	2,445,708
Georgia	299,479	26.75	8,011,063	673,179	10.27	6,913,546
Florida	88,750	25.90	2,298,625	588,886	10.43	6,139,138
Alabama	253,132	20.40	5,163,893	496,762	8.32	4,131,822
Mississippi	326,405	25.65	8,372,288	544,993	8.11	4,418,532
Louisiana	186,278	26.70	4,973,623	481,075	10.05	4,834,804
Texas	964,196	23.50	22,658,606	8,579,739	11.78	101,026,428
Arkansas	300,523	17.85	5,364,336	639,433	7.52	4,811,731
Tennessee	316,432	22.65	7,167,185	488,619	10.98	5,362,598
West Virginia	198,417	30.00	5,952,510	372,136	19.53	7,267,814
Kentucky	387,067	25.20	9,754,088	692,535	15.37	10,640,863
Ohio	869,764	32.70	28,441,283	1,151,437	20.32	23,391,441
Michigan	778,609	31.50	24,526,184	1,014,875	15.67	15,903,085
Indiana	646,149	31.45	20,321,386	1,201,872	20.55	24,692,464
Illinois	1,045,200	33.80	35,327,760	1,916,903	21.08	40,408,316
Wisconsin	1,183,531	29.20	34,559,105	1,171,555	13.65	15,997,577
Minnesota	903,796	28.30	25,577,427	1,035,987	11.48	11,887,954
Iowa	1,429,340	29.85	42,665,799	3,432,832	20.77	71,299,918
Missouri	968,638	25.15	24,361,246	2,235,134	18.02	40,265,942
Kansas	751,829	26.05	19,585,145	2,628,653	18.83	49,510,678
Nebraska	836,668	26.90	22,506,369	2,450,862	18.42	45,144,871
South Dakota	582,469	26.25	15,289,811	1,323,507	17.25	22,830,495
North Dakota	213,765	27.30	5,835,784	604,692	16.95	10,249,535
Montana	61,634	34.05	2,098,638	964,579	17.99	17,352,775
Wyoming	20,974	35.75	749,820	755,217	20.12	15,194,965
Colorado	130,202	30.85	4,016,732	1,362,303	18.00	24,528,259
New Mexico	20,781	31.50	654,602	903,086	14.84	13,401,800
Arizona	21,156	35.10	742,576	568,646	15.96	9,075,586
Utah	74,430	33.00	2,456,190	256,844	16.00	4,110,788
Nevada	16,988	35.85	609,020	351,018	17.15	6,019,959
Idaho	63,793	31.20	1,990,342	351,086	16.14	5,666,532
Washington	167,042	32.50	5,428,865	309,502	15.03	4,650,269
Oregon	144,480	28.60	4,132,128	587,316	14.77	8,674,653
California	390,015	34.65	13,514,020	1,167,107	17.52	20,453,549
Oklahoma	192,332	21.85	4,202,454	1,387,151	14.96	20,751,774
Indian Territory	109,360	24.20	2,646,512	470,093	14.04	6,602,452
United States	19,793,866	29.44	582,788,592	47,067,656	15.85	746,171,709

Wholesale prices of cattle per 100 pounds, 1901–1905.

Date.	Chicago.		Cincinnati.		St. Louis.		Omaha.	
	Inferior to prime.		Fair to medium.		Good to choice native steers.		Native beeves.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1901.								
January	$2.70	$6.15	$3.25	$4.35	$4.75	$5.60	$3.50	$5.35
February	2.70	6.10	3.15	4.15	4.75	5.65	3.50	5.30
March	2.70	6.25	3.15	4.25	4.75	5.60	3.75	5.40
April	2.70	6.10	3.35	4.60	4.75	5.85	3.75	5.45
May	2.70	6.10	3.60	4.65	4.80	6.00	3.75	5.60
June	2.70	6.55	3.75	4.40	5.00	6.00	4.00	5.90
July	2.20	6.55	3.25	4.25	4.75	6.35	4.00	5.75
August	2.20	6.35	3.00	4.50	5.00	6.35	4.00	5.90
September	2.20	6.60	3.15	4.25	5.00	6.40	4.00	6.25
October	2.20	6.85	3.00	4.25	5.50	6.75	4.00	6.40
November	2.10	6.90	3.00	4.15	5.50	7.00	4.00	7.25
December	2.10	7.00	3.25	4.60	5.50	8.25	3.50	6.85
1902.								
January	2.20	7.75	3.75	4.65	6.10	7.00	3.40	6.55
February	2.25	7.35	3.65	4.75	6.35	6.50	3.50	6.25
March	2.35	7.35	3.75	5.25	6.40	6.75	4.00	6.70
April	2.35	7.50	4.25	5.40	6.95	7.10	4.50	7.00
May	2.50	7.70	4.10	5.35	6.90	7.50	4.35	7.40
June	2.35	8.50	3.25	5.25	7.50	8.00	4.25	7.85
July	2.25	8.85	3.15	5.25	7.50	8.35	5.00	8.15
August	2.40	9.00	3.25	5.25	7.40	8.75	5.00	8.15
September	2.25	8.85	3.00	4.40	6.60	8.00	4.15	7.85
October	1.90	8.75	2.90	4.25	6.35	7.10	4.50	7.25
November	2.00	7.40	3.00	4.15	5.15	7.25	3.20	6.00
December	2.00	14.50	3.00	4.25	5.25	6.00	3.00	6.25
1903.								
January	2.00	6.85	3.15	4.35	5.10	5.75	3.35	5.10
February	2.35	6.15	3.10	4.25	5.10	5.25	3.15	5.15
March	2.50	5.75	3.35	4.40	5.10	5.40	3.45	5.35
April	2.50	5.80	3.75	4.40	5.10	5.60	3.20	5.25
May	2.50	5.65	3.25	4.40	5.00	5.50	3.85	5.10
June	2.25	5.65	3.00	4.40	5.10	5.25	3.75	5.30
July	2.25	5.65	2.85	4.10	5.15	5.35	3.65	5.35
August	2.15	6.10	2.50	4.00	5.25	5.55	3.85	5.75
September	2.00	6.15	2.25	3.75	5.60	5.70	3.60	5.75
October	1.65	6.00	2.50	3.65	5.40	5.55	3.90	5.50
November	1.50	5.85	2.35	3.40	5.15	5.40	3.00	5.30
December	1.50	8.35	2.35	3.75	5.10	6.00	2.65	5.30
1904.								
January	2.10	5.90	3.00	4.00	5.15	5.35	3.20	5.10
February	2.25	6.00	3.00	3.75	4.90	5.35	3.00	5.50
March	2.15	6.00	3.00	4.00	5.00	5.35	2.75	5.20
April	2.25	5.80	3.15	4.00	5.25	5.40	3.00	5.10
May	2.35	5.85	3.10	4.25	5.05	5.35	3.00	5.55
June	2.35	6.70	3.00	4.25	5.75	6.40	3.50	6.25
July	2.20	6.65	3.00	4.25	5.90	6.25	3.40	6.00
August	2.20	6.40	2.65	4.00	5.60	6.00	3.25	5.85
September	2.15	6.40	2.50	3.75	5.75	6.00	4.00	6.00
October	1.70	7.00	2.50	3.75	6.05	6.60	4.25	6.35
November	1.70	7.15	2.50	3.50	5.15	6.60	3.10	6.15
December	1.80	7.65	2.25	3.60	5.75	6.00	3.10	6.15
1905.								
January	1.85	6.30	2.65	3.85	5.15	5.50	3.05	5.35
February	1.90	6.45	2.65	4.00	5.15	6.00	3.15	5.25
March	2.20	6.25	2.50	4.40	5.50	5.65	3.20	5.65
April	2.40	7.00	3.50	4.75	5.90	6.75	3.25	6.50
May	2.35	6.85	3.15	4.65	5.85	6.50	3.75	6.30
June	2.30	6.35	3.00	4.25	5.25	6.50	3.70	5.95
July	2.00	6.25	3.00	4.40	5.25	5.85	3.50	5.40
August	2.10	6.30	2.85	4.10	5.50	5.70	3.25	6.15
September	2.00	6.50	2.75	4.00	5.50	6.35	3.40	5.90
October	2.10	6.40	2.50	3.85	6.00	6.15	3.10	5.75
November	2.15	6.60	2.35	3.75	5.40	6.15	3.50	6.50
December	2.15	7.00	2.65	4.00	5.50	7.10	3.05	5.60

BUTTER.

Wholesale prices of butter per pound in leading cities of the United States, 1901–1905.

Date.	New York.		Cincinnati.		Chicago.		Elgin.	
	Creamery extra.		Creamery.		Creamery firsts.		Creamery extra.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1901.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	21	25	18	24	15	23	21	24½
February	22	24	18	22	16	23	21	23½
March	22	23½	19	21	18	23	21¼	23½
April	18	21	17	20	16	20½	20	21½
May	18	18	17	18	15½	18½	18½	18½
June	19	19½	17	19	16	19	18½	19
July	18	19	17	19	16	20	19	20
August	20	21	17	19	17	20½	20	21
September	20	22½	18	20	16	21	20	21
October	21	22½	20	21	17	22	21½	22
November	22½	25½	22	23	18	24½	22	24½
December	24	25½	22	23	20	24½	24½	24½
1902.								
January	23	26	22	23	20	24	24	24½
February	26	30	22	26	20	29	25½	29
March	27	30	23	24	22	28	26	28
April	22	33	23	27	18	31	22	36
May	22¼	25	19	20	19	23	22	22
June	21½	22½	19	20	18½	22	21	22
July	20½	21¾	18	21	18½	21½	20	21
August	19	20½	17	19	16	20	19	20
September	19½	23	17	21½	17	22½	19	22½
October	22½	25	20½	22½	19	24½	22½	24½
November	25	28½	21½	25	21½	27	24½	27
December	28	30	25	27	23	28½	28	29
1903.								
January	28½	28½	22	27	20	28	25	29
February	26	28	22	25	20	27½	25	27
March	27	29½	24½	26	24	28½	27½	28½
April	22½	29½	19½	26	21	28½	22½	28½
May	22	23	17½	20½	17	22	20	22½
June	20½	22½	18	21	18	22	20	22
July	19	20½	15½	20	17	20	18½	20
August	19	19¾	15½	18½	16	19	18½	19½
September	19¾	21¾	16½	20	17	21¼	19½	21½
October	20	22¾	18	20	17	21½	20½	21½
November	22½	25½	19½	22½	18	24½	22	24
December	23	25½	21½	23½	19	25	24	25
1904.								
January	22	24½	19½	22½	17	23½	22	24
February	23	26½	21½	24	18	26	23	26
March	24	26½	22	24	19	26	24½	26
April	22	24½	20½	23	19	24½	23	24½
May	18	24½	17½	21½	15	23	17½	23
June	17¾	18¾	17½	19	15	18	17½	17½
July	17½	18	17	19	15	18	17	17½
August	17½	19¼	17	19	15	18½	17	19
September	19	21	19	20½	16½	19½	19	20
October	20	23¼	20	22	17	22	20	23
November	23	26½	23	25½	19	24½	23	25
December	26	28	26½	28	20	28	25	28
1905.								
January	28	30½	28	30½	22	30	28	29½
February	29½	35½	30	34	25	34	29	34
March	25	31½	24	30	22	32	25	33
April	27	32	26	32	22	31	27	31½
May	20¾	27	20½	25	18	24	21	25
June	19½	21½	19	21	18	20½	19½	20½
July	20½	21¼	19½	20½	18	20½	20	20
August	20½	22	20	21½	18½	21	20	21
September	20¼	21¾	20	21½	18	21	20½	21
October	20	22	20½	23	19	22	21	22½
November	17½	24½	22	24½	20	23	22½	24
December	24	26	23½	25	19	24½	24	25

CHEESE.

Wholesale prices of cheese per pound in leading cities of the United States, 1901–1905.

Date.	New York.		Cincinnati.		Chicago.		St. Louis.	
	September, colored.		Factory.		Young Americas.		Full cream.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1901.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	11¼	12	11	12	10½	11½	11½	11½
February	12	12½	11½	12	11½	11½	11	11½
March	12	12½	11½	12	11	11¾	12	12
April	11½	12½	11	12	11½	11¾	11	12
May	8½	9½	8½	12	10½	11¾	10	11
June	9	9¾	8½	9½	9	10½	10	10¾
July	9	9½	8½	9½	9½	10¼	10	11¼
August	9⅝	9⅞	9	10	10	10½	11	11½
September	9½	10¼	9½	10	10	10¾	10½	11⅛
October	10¼	10¾	9½	10½	10	10¾	10½	11½
November	10¼	10¾	10	10½	9¾	10¼	10¾	11¼
December	10	11¼	10	10½	10	10¾	10¾	11¼
1902.								
January	11¼	11¾	10	11	10½	11¼	10¾	11½
February	11½	12½	10½	11½	10½	12½	12½	13
March	12¼	13¼	11	11½	11¾	12¼	13	14
April	13	13¼	11	12½	13	13	13¾	14½
May	10½	13	11½	12½	12¾	13½	12¾	14
June	9½	9¾	10½	12½	10¼	12¾	11	11½
July	9¾	10¼	10½	10½	10½	10¾	11½	11⅛
August	9½	10½	10½	10½	10½	11	11½	11¾
September	10⅜	12	10½	10½	10½	11¼	11¼	12
October	12	12½	11	12½	11¼	11¾	11¾	12½
November	12½	13	12	12½	11½	12	12¾	13½
December	13	13½	12	13	11½	13¼	13¾	14
1903.								
January	14	14	12½	12¾	13	13½	14	14¼
February	14½	14½	12½	12½	12½	13	14¼	14¼
March	14½	15	12½	12½	12½	13¼	14¼	14¼
April	15	15	12½	12½	12½	13¼	13½	14¼
May	11½	12¼	12½	12½	10½	13¾	12¾	14¾
June	10½	10¾	11	11¼	10½	10½	11½	11¾
July	10	10½	10½	10¾	10	10¾	11¾	12
August	10¼	10½	10½	10½	9	11	11¾	12
September	10⅜	12¼	10½	10½	9½	11	11¾	12¼
October	11½	12¼	10½	10½	10	11	11¾	12¼
November	11½	12	10½	10½	10	10½	11½	11½
December	12	12	10½	10½	10	10	11½	11½
1904.								
January	12	12	10½	10½	10	10	11½	11½
February	12	12	10½	10½	9½	10½	11½	11¾
March	12	12	10½	10½	10	10¾	12	12
April	10¾	12	10½	10½	9	10	9	11½
May	7	8	9½	10	8	9	10¼	10¼
June	7¾	9	8	9½	7¼	8½	9¼	10¼
July	8	9	8	8½	7¼	8¾	9¼	9¾
August	8	9	8	9	7¾	8¾	9½	10
September	8¾	10	8½	9	8	8½	10	10¾
October	10	10½	8½	9	8¼	10½	11	11½
November	10¼	11¾	8½	10½	10	11½	11¾	13¼
December	11¾	12	10	10½	11	11½	13½	13½
1905.								
January	11½	11¾	12½	13	11¾	12	13½	13¾
February	11¾	13¼	12½	13	11¾	13½	13¾	14½
March	13¾	14½	12½	14¼	....	13½	14½	15
April	13¾	14¼	14	14¼	13½	14	14	15½
May	14¼	14¼	14	14¼	10	14	11½	15½
June	9	9¾	10	12¼	10	10½	11¼	11½
July	9½	11⅛	10	10½	10¼	11¼	11¾	12¼
August	10¼	12	11	11¼	11	11¾	12	12½
September	11¾	12	11	12½	11½	11¾	12½	12¾
October	11½	13¼	12	12½	11½	12¼	12½	13½
November	13¼	13¾	13½	14	13	13¾	14	14
December	12	14	13½	14	13	13½	13¼	13½

SHEEP AND WOOL.

Number and farm value of sheep, 1881–1906.

January 1—	Sheep.		January 1—	Sheep.	
	Number.	Value.		Number.	Value.
1881	43,569,899	$104,070,759	1894	45,048,017	$89,186,110
1882	45,016,224	106,595,954	1895	42,294,064	66,685,767
1883	49,237,291	124,365,835	1896	38,298,783	65,167,735
1884	50,626,626	119,902,706	1897	36,818,643	67,020,942
1885	50,360,243	107,960,650	1898	37,656,960	92,721,133
1886	48,322,331	92,443,867	1899	39,114,453	107,697,530
1887	44,759,314	89,872,839	1900	41,883,065	122,665,913
1888	43,544,755	89,279,926	1901	59,756,718	178,072,476
1889	42,599,079	90,640,369	1902	62,039,091	164,446,091
1890	44,336,072	100,659,761	1903	63,964,876	168,315,750
1891	43,431,136	108,397,447	1904	51,630,144	133,530,099
1892	44,938,365	116,121,290	1905	45,170,423	127,331,850
1893	47,273,553	125,909,264	1906	50,631,619	179,056,144

Number, average price, and farm value of sheep in the United States on January 1, 1906.

State or Territory.	Number.	Average farm price, Jan. 1.	Farm value.	State or Territory.	Number.	Average farm price, Jan. 1.	Farm value.
Maine	270,025	$4.02	$1,084,826	Indiana	1,123,423	$4.87	$5,471,070
New Hampshire	76,757	3.74	286,880	Illinois	719,465	4.86	3,494,801
Vermont	220,878	4.08	900,078	Wisconsin	930,848	3.96	3,681,504
Massachusetts	42,859	4.26	182,792	Minnesota	404,253	3.62	1,465,306
Rhode Island	7,970	4.17	33,234	Iowa	670,383	4.59	3,078,707
Connecticut	33,905	4.88	165,456	Missouri	816,560	3.88	3,166,212
New York	995,335	5.07	5,051,325	Kansas	233,581	3.75	875,346
New Jersey	44,644	4.61	205,587	Nebraska	444,499	3.72	1,651,314
Pennsylvania	1,102,058	4.63	5,102,529	South Dakota	822,838	3.59	2,953,989
Delaware	11,984	4.06	48,626	North Dakota	695,267	3.45	2,398,671
Maryland	164,873	4.30	708,130	Montana	5,751,746	3.48	20,016,076
Virginia	497,341	3.33	1,656,145	Wyoming	4,575,042	3.43	15,703,832
North Carolina	219,574	2.69	590,654	Colorado	1,677,561	3.59	6,018,250
South Carolina	60,034	2.59	155,488	New Mexico	3,999,443	3.15	12,598,246
Georgia	273,893	2.15	588,869	Arizona	734,527	3.33	2,449,647
Florida	105,474	2.22	233,888	Utah	2,625,401	3.17	8,329,085
Alabama	195,597	2.10	409,776	Nevada	1,480,370	3.49	5,170,191
Mississippi	192,926	2.07	399,357	Idaho	3,722,585	3.21	11,958,803
Louisiana	180,135	2.14	385,489	Washington	849,618	3.03	2,576,467
Texas	1,649,468	2.52	4,160,784	Oregon	2,597,595	2.86	7,422,628
Arkansas	347,930	2.33	810,677	California	2,398,439	3.03	7,273,266
Tennessee	344,954	2.58	891,706	Oklahoma	57,240	3.39	194,187
West Virginia	538,305	3.99	2,146,491	Indian Territory	28,419	2.99	84,972
Kentucky	733,599	3.54	2,595,106				
Ohio	2,991,162	4.48	13,400,406	United States	50,631,619	3.54	179,056,144
Michigan	1,970,836	4.48	8,834,272				

Imports and exports of sheep, with average prices, 1892–1905.

Year ended June 30—	Imports.			Exports.		
	Number.	Value.	Average price.	Number.	Value.	Average price.
1892	380,814	$1,440,530	$3.78	46,960	$161,105	$3.43
1893	459,484	1,682,977	3.66	37,260	126,394	3.39
1894	242,568	788,181	3.25	132,370	832,763	6.29
1895	291,461	682,618	2.34	405,748	2,630,686	6.48
1896	322,692	853,530	2.65	491,565	3,076,384	6.26
1897	405,633	1,019,668	2.51	244,120	1,531,645	6.27
1898	392,314	1,106,322	2.82	199,690	1,213,886	6.08
1899	345,911	1,200,081	3.47	143,286	853,555	5.96
1900	381,792	1,365,026	3.58	125,772	733,477	5.83
1901	331,488	1,236,277	3.73	297,925	1,933,000	6.49
1902	266,953	956,711	3.58	358,720	1,940,060	5.41
1903	301,623	1,036,934	3.44	176,961	1,067,860	6.03
1904	238,094	815,289	3.42	301,313	1,954,604	6.49
1905	186,942	704,721	3.77	268,365	1,687,321	6.29

Prices of sheep per 100 pounds in leading cities of the United States, 1901–1905.

Date.	Chicago. Inferior to choice.		Cincinnati. Good to extra.		St. Louis. Good to choice natives.		Omaha. Native	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1901.								
January	$2.75	$4.75	$2.75	$4.25	$3.75	$4.50	$3.00	$4.90
February	2.75	4.75	3.25	4.25	4.00	4.50	3.00	4.75
March	2.75	5.00	3.25	4.50	4.00	5.10	3.00	4.85
April	3.00	5.15	3.75	4.50	4.25	5.10	3.00	5.00
May	2.75	5.00	3.65	4.25	4.00	4.75	2.50	4.40
June	2.75	4.70	3.00	4.00	3.25	4.60	2.25	4.25
July	2.65	4.40	3.00	3.65	3.00	3.75	2.25	4.65
August	2.65	4.05	2.40	3.65	3.00	3.75	2.00	3.60
September	2.75	4.00	2.25	3.40	3.00	3.65	2.00	3.60
October	2.75	4.40	2.15	3.15	3.10	3.50	2.25	4.25
November	2.50	4.30	2.15	3.00	3.15	3.75	2.25	3.75
December	2.50	4.50	2.40	3.60	3.25	4.00	2.50	4.50
1902.								
January	2.00	4.75	3.00	4.25	4.25	5.00	4.00	5.15
February	2.00	5.50	3.50	5.50	4.75	5.60	4.20	5.85
March	3.00	5.75	4.25	5.50	5.50	5.75	4.40	5.90
April	2.50	6.50	3.75	5.50	5.50	6.25	4.75	6.25
May	2.25	6.50	4.35	5.75	6.00	6.35	5.40	6.00
June	1.50	6.25	3.50	4.60	3.70	5.60	4.50	6.00
July	1.75	5.00	3.10	4.00	4.00	4.60	3.80	4.50
August	1.50	4.25	2.25	4.00	3.85	4.35	....	....
September	1.50	4.50	2.00	3.40	3.65	4.00	2.00	3.40
October	1.50	4.25	2.65	3.40	3.90	4.00	3.00	4.10
November	1.50	4.25	2.50	3.35	3.75	4.00	3.40	4.25
December	1.25	4.75	2.75	4.00	3.80	4.50	3.50	4.75
1903.								
January	1.50	5.25	3.25	4.50	4.50	5.00	3.60	5.40
February	2.00	5.75	3.75	5.00	5.25	5.25	4.50	5.80
March	2.00	7.00	4.25	6.00	5.50	6.15	4.60	6.75
April	2.25	7.00	4.10	6.25	6.00	6.25	4.50	6.75
May	1.60	6.25	3.60	4.75	4.50	5.25	4.00	5.50
June	2.00	6.00	3.00	4.50	4.50	4.75	3.80	5.50
July	1.50	5.25	2.90	4.00	3.75	4.75	3.00	4.50
August	1.50	4.25	2.75	3.35	3.50	3.85	3.00	4.00
September	1.50	4.25	2.60	3.40	3.65	4.00	3.50	3.50
October	1.50	4.25	2.75	3.50	3.65	4.00	3.55	3.55
November	1.25	4.35	2.60	3.35	3.60	3.65	3.25	4.00
December	1.50	4.25	2.60	3.75	3.65	3.85	3.25	4.40
1904.								
January	2.00	4.75	3.25	4.00	3.75	4.75	2.25	5.10
February	2.00	4.75	3.40	4.60	4.75	4.75	2.60	5.25
March	2.00	5.50	3.65	4.50	4.75	4.90	2.50	5.25
April	2.50	6.00	4.00	4.50	5.40	5.60	3.25	5.65
May	2.00	6.00	3.75	4.55	5.50	5.65	4.00	5.90
June	1.75	5.50	3.00	4.40	4.60	5.50	4.00	5.25
July	1.50	5.50	2.75	4.00	4.00	4.25	3.75	5.00
August	2.00	4.25	2.75	4.00	3.75	4.00	3.40	4.35
September	1.75	4.50	2.75	3.50	3.75	4.00	....	....
October	1.50	4.75	2.75	3.50	4.10	4.50	....	....
November	1.75	5.00	2.75	4.00	4.25	4.75	3.75	4.50
December	2.50	5.65	3.50	4.50	4.75	4.90	4.00	5.50
1905.								
January	4.50	5.85	4.10	5.25	5.15	6.35	3.25	6.25
February	4.50	6.25	4.50	5.50	5.50	6.15	3.00	6.90
March	4.75	6.25	4.75	5.50	5.85	6.25	3.00	6.75
April	4.50	6.30	4.50	5.25	5.25	5.90	2.75	6.75
May	4.00	5.50	3.85	5.00	5.00	5.40	2.50	6.00
June	4.00	5.25	3.60	4.35	4.80	5.00	2.50	5.70
July	4.00	5.90	3.60	4.75	5.00	5.50	4.75	6.00
August	4.00	5.65	3.75	4.50	4.60	5.20	4.00	5.30
September	3.80	5.40	4.00	4.75	5.00	5.00	3.75	5.25
October	4.00	5.70	4.00	5.25	5.25	5.60	4.00	6.00
November	4.25	6.10	4.10	5.00	5.25	5.75	4.25	6.00
December	4.25	6.25	4.10	5.15	5.50	6.00	4.50	6.25

Wool product of the United States for 1905, by States.

[Estimate of National Association of Wool Manufacturers.]

State or Territory.	Number of sheep Apr. 1, 1905.	Average weight of fleece, 1905.	Per cent of shrinkage, 1905.	Wool, washed and unwashed.	Wool, scoured.
		Pounds.		*Pounds.*	*Pounds.*
Maine	190,000	6	40	1,140,000	684,000
New Hampshire	63,000	6.2	50	390,600	195,300
Vermont	160,000	6	51	960,000	470,400
Massachusetts	26,000	5.8	42	150,800	87,464
Rhode Island	6,500	5.5	42	35,750	20,735
Connecticut	26,000	5.5	42	143,000	82,940
New York	675,000	6	50	4,050,000	2,025,000
New Jersey	32,000	5.5	50	176,000	88,000
Pennsylvania	850,000	6	52	5,100,000	2,448,000
Delaware	6,500	6	50	39,000	19,500
Maryland	100,000	5	45	500,000	275,000
Virginia	335,000	4.5	38	1,507,500	934,650
North Carolina	205,000	4.25	42	871,250	505,325
South Carolina	50,000	4	42	200,000	116,000
Georgia	250,000	3.8	40	950,000	570,000
Florida	75,000	3	40	225,000	135,000
Alabama	200,000	3.5	40	700,000	420,000
Mississippi	230,000	4	42	920,000	533,600
Louisiana	155,000	3.7	42	573,500	332,630
Texas	1,440,000	6.5	67	9,360,000	3,088,800
Arkansas	200,000	4	42	800,000	464,000
Tennessee	260,000	4.25	40	1,105,000	663,000
West Virginia	475,000	5	46	2,375,000	1,282,500
Kentucky	575,000	4.75	38	2,731,250	1,693,375
Ohio	1,809,226	6.25	50	11,307,663	5,653,832
Michigan	1,300,000	6.5	50	8,450,000	4,225,000
Indiana	700,000	6.3	45	4,410,000	2,425,500
Illinois	525,000	7	52	3,675,000	1,764,000
Wisconsin	700,000	6.75	48	4,725,000	2,471,040
Minnesota	350,000	7	52	2,450,000	1,176,000
Iowa	500,000	6.5	50	3,250,000	1,625,000
Missouri	592,250	6.5	48	3,849,625	2,001,805
Kansas	170,000	7.5	67	1,275,000	420,750
Nebraska	250,000	7.5	66	1,875,000	637,500
South Dakota	575,000	6.5	63	3,737,500	1,382,875
North Dakota	450,000	6.5	61	2,925,000	1,140,750
Montana	5,200,000	7.25	66	37,700,000	12,818,000
Wyoming	4,500,000	7	68	31,500,000	10,080,000
Colorado	1,400,000	6.5	66	9,100,000	3,094,000
New Mexico	3,100,000	5.5	60	17,050,000	6,820,000
Arizona	680,000	6.5	68	4,420,000	1,414,400
Utah	2,000,000	6.5	65	13,000,000	4,550,000
Nevada	650,000	7	68	4,550,000	1,456,000
Idaho	2,300,000	7	66	16,100,000	5,474,000
Washington	575,000	8.5	70	4,887,500	1,466,250
Oregon	1,900,000	8	70	15,200,000	4,560,000
California	1,750,000	7.25	68	12,687,500	4,060,000
Oklahoma and Indian Territory	60,000	6	68	360,000	115,200
United States	38,621,476	6.56	61.3	253,488,438	97,967,121
Pulled wool			32	42,000,000	28,560,000
Total product, 1905				295,488,438	126,527,121

World's international trade in wool,[a] 1900–1905.

EXPORTS.

Country.	Year beginning—	1900.	1901.	1902.	1903.	1904.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Algeria	Jan. 1	12,221,851	7,042,341	9,634,557	16,689,429	21,519,315
Argentina	Jan. 1	222,915,944	503,443,071	436,374,060	425,467,795	371,697,065
Australia	Jan. 1	335,722,862	451,560,039	335,953,936	324,563,030	395,130,825
Belgium	Jan. 1	24,174,749	35,762,540	45,613,081	47,128,185	42,106,322
Cape of Good Hope	Jan. 1	27,671,036	65,209,699	79,327,850	65,524,078	38,733,879
France	Jan. 1	103,492,296	103,001,990	138,081,466	117,425,271	130,119,445
India (British)	April 1	22,148,531	19,651,756	28,038,050	33,326,503	38,602,768
Netherlands	Jan. 1	20,139,509	34,060,782	36,231,009	42,214,830	33,032,572
New Zealand	Jan. 1	140,706,486	146,820,079	160,419,023	155,128,381	126,834,850
Peru	Jan. 1	7,793,334	8,608,923	8,182,423	9,257,920	7,952,000
Russia	Jan. 1	30,775,906	23,757,528	29,354,903	30,071,056	[b] 35,137,754
Spain	Jan. 1	13,791,481	20,459,512	25,835,165	25,096,103	28,808,285
United Kingdom	Jan. 1	24,928,800	20,205,000	37,204,800	35,950,200	37,858,500
Uruguay	Jan. 1	58,981,957	101,867,309	95,637,488	92,124,262	[c] 87,153,504
Other countries		120,434,000	129,774,000	157,005,000	165,342,000	143,228,000
Total		1,165,904,742	1,671,221,571	1,622,922,811	1,585,309,043	1,537,915,084

IMPORTS.

Country.	Year beginning—	1900.	1901.	1902.	1903.	1904.
Belgium	Jan. 1	92,500,170	117,796,203	121,559,518	118,802,547	116,471,580
Canada	July 1	8,574,605	10,360,738	7,994,702	7,339,369	7,617,211
France	Jan. 1	418,173,779	547,568,307	519,152,812	523,823,309	465,475,496
Germany[d]	Jan. 1	346,268,073	370,476,806	416,038,627	425,726,618	413,781,976
India (British)	April 1	8,264,547	9,784,739	7,452,021	7,431,310	8,807,926
Japan	Jan. 1	6,113,225	6,652,876	5,505,283	7,282,080	21,281,995
Netherlands	Jan. 1	28,122,934	43,732,352	45,481,019	49,996,876	42,618,842
Russia	Jan. 1	39,046,676	58,087,872	65,114,737	71,607,060	[b] 35,354,431
Sweden	Jan. 1	9,027,832	8,499,894	9,809,111	10,164,381	10,471,451
Switzerland	Jan. 1	11,568,313	12,462,949	13,305,114	13,465,390	14,139,564
United Kingdom	Jan. 1	382,432,027	421,520,875	392,752,036	351,928,151	344,758,631
United States	July 1	103,583,505	166,576,966	177,137,796	173,742,834	249,135,746
Other countries		112,390,000	124,004,000	144,753,000	142,294,000	139,526,000
Total		1,566,065,686	1,897,524,577	1,926,055,776	1,903,603,925	1,869,440,852

[a] Including wool combed, carded, and dyed.
[b] Preliminary figures excluding the trade over the Asiatic frontier (excepting the Black Sea ports of the Caucasus).
[c] Average of 1900–1903.
[d] Not including free ports.

(See "General note" to "World's international trade in wheat," p. 665.)

Wholesale prices of wool per pound in leading cities of the United States, 1901–1905.

Date.	Boston.		New York.		Philadelphia.		St. Louis.	
	XX Ohio, washed.		XX Ohio.		XX Ohio, washed.		Best tub-washed.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1901.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	27	28	26½	27	27	28	28	29¼
February	27	27	26	26½	27	28	27	28
March	26	27	25½	26	26	27	27	27½
April	26½	26½	25½	26	25	27	27	27
May	26	26	25½	25½	25	27	25	27
June	26	26½	25½	25½	25	27	24	25
July	26½	27	25½	25½	25	26	......	......
August	27	27	25½	25½	26	27	24	24
September	26	27	25½	25½	26	27	24	25
October	26	26	25½	25½	26	27	24	24
November	26	27	25½	25½	26	27	24	25
December	26½	27	25½	25½	26	27	24	24½
1902.								
January	27	27	26	27	26	27	24	24½
February	27	27	26	27	26	27	24½	24½
March	27	27	26	27½	26	27	24	24
April	27	27	26½	27½	26	27	24	24
May	27	27	26½	27½	26	27	24	25
June	27	27½	26½	27½	26	27	24	25
July	27	28	26½	27½	26½	27½	24	25½
August	28	28	26½	27½	27½	28	25½	26½
September	29	29	26½	27½	27	29	26	26½
October	30	30	......	......	27	29	26	27
November	29	31	28	29	29	30	27½	28½
December	32	32	30	32	31	32	28	29
1903.								
January	32	32½	31	32	31	32	29	29
February	31	33	31	32	31	32	29	29
March	31	32	31	32	31	32	28	29
April	31	32	31	32	31	32	27	28½
May	30	32	30	33	31	32	27	28½
June	31	34	30	31	30	31	28	29
July	33	34	30	31	32	33	29	29½
August	33	35	31	33	32	33	29	29½
September	34	35	28	32	32	33	30	30
October	34	35	28	32	33	34	30	30½
November	34	35	28	32	33	34	30½	31
December	34	35	28	32	33	34	30½	30½
1904.								
January	33½	34	28	32	33	33	30½	30½
February	33	34	28	32	33	33	30½	31
March	33	34	28	32	33	33	30½	31
April	32	34	28	32	33	33	30½	31
May	32	33	28	32	32½	32½	30½	32
June	32	34	28	32	31½	31½	32	33
July	34	35	28	35	31½	33	33	34½
August	34	35	32	35	33	33	35	35
September	34	35	34	35	33	33	35	36
October	34	35	32	35	33	33	34½	36½
November	35	36	32	35	33	33½	37	40
December	34	36	32	35	33½	33½	40	41
1905.								
January	34	35	32	35	34	36	40	41
February	34	35	32	35	34	35	39	41
March	34	35	31	34	34	35	37	38
April	34	35	31	36	34	35	37	39½
May	34	36	32	36	34	36	39	43
June	36	37	32	36	34	36	41	42½
July	35	37	32	39	35	36	41	42
August	36	37	35	39	35	36	41½	41½
September	36	37	35	38	35	36	42	42
October	36	37	35	38	34	35	42	42½
November	35	36	34	38	34	35	41	42
December	35	36	35	38	34	35	41	41½

Range of prices of wool in Boston, monthly, 1901–1905.[a]

[Cents per pound.]

Date.	Ohio fine, unwashed.		Indiana quarter-blood, unwashed.		Ohio XX, washed.		Ohio, No. 1, washed.		Ohio Delaine, washed.		Michigan X, washed.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1901.												
January	17	18	23	23½	27	28	28	29	29	30	22	22
February	16½	17	23	24	27	27	27½	28	28	30	21	22
March	16½	18	22½	23	26	27	26	27	29	30	21	21
April	17	18	22	22½	26½	26½	26	27	28	30	21	21
May	17	17	20	21	26	26	25	26	28	30	20	20
June	17½	18	19½	20	26	26½	25	26	28	29	20	20½
July	18	18	20	20	26½	27	26	26	28	30	21	21½
August	18	18½	20	20	27	27	26½	26½	28	30	20½	21
September	18½	18½	20½	20½	26	27	26	26½	28	28½	21	21
October	18½	18½	20	20	26	26	25	26	28	28	20	21
November	19	19	20	21½	26	27	26	26½	27½	29	21	21
December	19	19½	21½	22	26½	27	26	27	28	29	21	21
1902.												
January	19½	20	22	22	27	27	27	27	28	29	21	21
February	20	20	22	22	27	27	27	27	28	29	21	21
March	19½	19½	21½	22	27	27	26½	27	28	29	21	21
April	19½	19½	21½	21½	27	27	26½	26½	28	28½	20½	21
May	19	19½	20½	20½	27	27	26	26	28	28½	21	22
June	19	20	20½	21	27	27½	26	26	28	29	22	22
July	20	20	21	22	27	28	26	27	28	31	22	22
August	20	21	22	23	28	28	28	29	30	33	22	23
September	21½	21½	22	23	29	29	29	30	31½	32	23	23
October	21½	21½	23	23	30	30	30	30	31½	32	23	24
November	21½	22	23	23	29	31	30	31	31½	33	24	25
December	23	23	24	24	32	32	31	31	33	35	26	27
1903.												
January	22	23	23½	24	32	32½	31	32	34	35	27	27½
February	22	23	24	25	31	33	31	33	34	35	27	27½
March	22	23	22	24	31	32	31	32	33½	34	26	27
April	20	22	22	23½	31	32	30	31	33½	34	26	26½
May	20	22	22	23½	30	32	29	31	33½	35	25	26
June	21	24	22	25	31	34	30	33	34	37	25	26
July	23	24	23	25	33	34	32	33	36	37	[b] 21	22
August	23	25	24	25	33	35	32	33	36	37	21½	22
September	24	25	24	25	34	35	32	33	36	37	21	22
October	24	25	24	25	34	35	32	34	36	37	21	22
November	24	25	24	25	34	35	33	34	35	37	21	22
December	24	25	24	25	34	35	33	34	35	36	21	22
1904.												
January	23	24	24	25	33½	34	32	33	35	36	21	22
February	22	24	24½	25½	33	34	32	33	35	36	20	22
March	22	24	24½	25½	33	34	32	33	35	36	20	21
April	22	23	25	25½	32	34	30	32	34	35	19	21
May	22	23	24	25	32	33	30	32	34	35	19	20
June	22	23	24	27	32	34	30	33	34	36	19	22
July	21	24	27	30	34	35	33	34	35	36	21	22
August	24	25	28	30	34	35	33	34	35½	36	21	22
September	24	25	28	29	34	35	33	34	35½	36	21	22
October	23	25	28	30	34	35	33	35	35½	36	21	22
November	23	25	30	32	35	36	35	38	35½	38	21	22
December	24	25	31	33	34	36	37	40	37	38	21	22
1905.												
January	24	25	31	33	34	35	38	39	37	38	21	22
February	24	25	31	32	34	35	38	39	36	33	21	22
March	23	25	30	32	34	35	36	37	36	37	20	22
April	23	24	30	31	34	35	36	37	36	37	20	21
May	23	27	30	35	34	36	36	38	36	39	20	25
June	26	30	34	36	36	37	37	42	39	40	25	27
July	27	28	33	37	35	37	39	43	38	40	25	26
August	27	28	34	36	36	37	40	42	39	40	25	27
September	27	28	34	35	36	37	40	42	39	40	25	26
October	27	28	34	35	36	37	41	42	37	39	25	26
November	27	28	34	35	35	36	41	42	36½	37	25	26
December	27	28	33	34	35	36	39	42	36½	37	25	26

[a] Furnished by Commercial Bulletin, Boston.
[b] Since June 12, 1903, the standard quotation has been Michigan fine unwashed.

Range of prices of wool in Boston, monthly, 1901–1905 [a]—Continued.

[Cents per pound.]

Date.	Fine selected Territory, staple scoured.		Fine medium Territory, clothing scoured.		Texas, 12 months, scoured.		Fine free fall, Texas or California scoured.		Pulled, A super, scoured.		Pulled, B super, scoured.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1901.												
January	50	50	39	43	48	48	38	40	42	45	37	38
February	48	50	38	39	47	50	37	40	40	45	35	35
March	43	45	35	38	43	45	36	38	38	42	34	35
April	45	47	38	40	43	47	36	37	38	40	33	34
May	45	47	40	40	45	47	36	37	35	38	31	32
June	45	47	40	42	45	47	36	37	35	39	30	30
July	46	48	42	43	47	50	36	40	37	40	31	33
August	47	50	43	44	48	50	40	40	38	40	33	33
September	49	50	44	44	50	50	40	40	38	40	33	33
October	49	50	42	44	50	50	40	40	38	40	32	32
November	49	50	43	44	48	50	40	42	38	40	32	33
December	49	50	43	44	48	50	40	42	38	40	34	31
1902.												
January	49	55	44	47	48	50	40	42	38	42	34	36
February	54	55	46	47	48	55	40	45	38	42	36	36
March	50	55	45	46	52	55	40	45	38	42	35	36
April	50	52	44	44	52	53	40	42	38	42	33	33
May	50	52	42	45	48	52	38	40	38	41	33	34
June	48	52	42	44	50	55	38	40	38	42	34	35
July	50	55	45	47	52	57	38	40	38	45	36	38
August	55	57	47	49	55	57	40	40	42	45	39	39
September	55	57	49	49	55	57	40	40	40	45	37	38
October	55	57	49	49	55	57	40	45	40	45	37	37
November	55	58	49	50	55	60	44	48	40	44	37	39
December	58	59	50	50	57	60	46	48	44	46	40	40
1903.												
January	56	60	54	58	57	60	46	48	44	46	40	42
February	55	58	52	56	55	58	45	48	43	46	40	43
March	54	56	52	54	55	57	45	46	42	45	39	42
April	54	55	52	53	55	57	45	46	40	44	39	41
May	52	55	50	53	53	57	45	46	40	45	39	42
June	52	55	50	53	53	57	45	48	42	46	40	42
July	53	55	52	53	55	57	46	48	43	47	40	44
August	54	56	52	53	55	57	46	48	45	47	43	44
September	55	56	52	53	55	57	46	48	44	47	42	44
October	55	56	52	53	55	57	46	48	44	47	42	43
November	53	56	51	53	55	56	45	48	44	47	40	43
December	53	55	51	52	55	56	44	46	43	45	40	42
1904.												
January	50	52	50	52	55	56	45	46	43	47	40	43
February	53	55	50	52	55	56	45	46	44	47	41	43
March	53	55	50	52	54	56	45	46	44	47	41	43
April	53	55	50	52	53	55	44	46	44	47	42	43
May	52	53	50	51	52	53	44	45	45	47	42	44
June	52	58	50	52	52	60	44	45	45	48	43	45
July	58	62	53	60	58	60	44	45	46	49	43	46
August	60	63	58	60	58	60	44	45	48	50	45	48
September	62	65	58	62	58	63	44	47	48	52	47	50
October	63	65	60	62	62	63	45	50	50	54	48	50
November	64	70	60	65	62	63	48	53	54	57	50	53
December	68	70	65	68	62	68	52	56	58	60	52	55
1905.												
January	68	70	62	63	65	68	55	56	56	60	53	55
February	65	70	60	63	63	68	54	56	57	60	52	55
March	65	68	60	62	63	65	54	56	55	60	52	54
April	65	70	60	63	63	68	54	56	55	60	52	54
May	68	74	62	67	67	72	54	56	58	65	52	58
June	73	76	65	70	70	75	54	60	58	62	55	58
July	73	78	67	70	74	76	57	63	58	62	55	58
August	76	78	67	72	74	76	62	63	60	63	56	60
September	76	78	68	72	74	76	62	63	62	63	58	60
October	76	78	68	72	74	76	62	63	62	63	57	60
November	76	78	66	70	74	76	62	63	62	63	55	57
December	76	78	66	70	74	76	62	63	62	63	54	56

SWINE.

Number and farm value of swine, 1880 to 1906, with exports.

Year.	On farms, January 1.			Exports for year ended June 30.		
	Number.	Value.	Average farm value.	Number.	Value.	Average price.
1880	34,034,100	$145,781,515	$4.28	83,434	$421,089	$5.05
1881	36,247,683	170,535,435	4.70	77,456	572,138	7.39
1882	44,122,200	263,543,195	5.97	36,368	509,651	14.01
1883	43,270,086	291,951,221	6.75	16,129	272,516	16.90
1884	44,200,893	246,301,139	5.57	46,382	627,480	13.53
1885	45,142,657	226,401,683	5.02	55,025	579,183	10.53
1886	46,092,043	196,569,894	4.26	74,187	674,297	9.09
1887	44,612,836	200,043,291	4.48	75,383	564,753	7.49
1888	44,346,525	220,811,082	4.98	23,755	193,017	8.13
1889	50,301,592	291,307,193	5.79	45,128	356,764	7.91
1890	51,602,780	243,418,336	4.72	91,148	909,042	9.97
1891	50,625,106	210,193,923	4.15	95,654	1,146,630	11.99
1892	52,398,019	241,031,415	4.60	31,963	364,081	11.39
1893	46,094,807	295,426,492	6.41	27,375	397,162	14.51
1894	45,206,498	270,384,626	5.98	1,553	14,753	9.50
1895	44,165,716	219,501,267	4.97	7,130	72,424	10.16
1896	42,842,759	186,529,745	4.35	21,049	227,297	10.80
1897	40,600,276	166,272,770	4.10	28,751	295,998	10.30
1898	39,759,993	174,351,409	4.39	14,411	110,487	7.67
1899	38,651,631	170,109,743	4.40	33,031	227,241	6.88
1900	37,079,356	185,472,321	5.00	51,180	394,813	7.71
1901	56,982,142	353,012,143	6.20	22,318	238,465	10.68
1902	48,698,890	342,120,780	7.03	8,368	88,330	10.56
1903	46,922,624	364,973,688	7.78	4,031	40,923	10.15
1904	47,009,367	289,224,627	6.15	6,345	53,780	8.48
1905	47,320,511	283,254,978	5.99	44,496	414,692	9.32
1906	52,102,847	321,802,571	6.18	....	....	....

Number, average price, and farm value of swine in the United States on January 1, 1906.

State or Territory.	Number.	Average farm price, Jan. 1.	Farm value.	State or Territory.	Number.	Average farm price, Jan. 1.	Farm value.
Maine	69,877	$8.75	$611,424	Indiana	3,078,820	$6.45	$19,858,389
New Hampshire	52,229	10.25	535,347	Illinois	4,683,900	6.95	32,553,105
Vermont	94,925	7.70	730,922	Wisconsin	1,702,915	7.20	12,260,988
Massachusetts	73,358	9.50	696,901	Minnesota	1,293,932	7.40	9,575,097
Rhode Island	13,072	10.25	133,988	Iowa	7,946,781	7.20	57,216,823
Connecticut	47,417	9.90	469,428	Missouri	3,514,958	4.95	17,399,042
New York	682,369	8.25	5,629,544	Kansas	2,495,721	6.35	15,847,828
New Jersey	158,537	10.50	1,664,638	Nebraska	3,004,398	6.60	19,829,027
Pennsylvania	999,682	8.45	8,447,313	South Dakota	845,192	7.20	6,085,382
Delaware	46,031	7.40	340,629	North Dakota	220,271	7.45	1,641,019
Maryland	296,130	7.20	2,132,136	Montana	59,896	8.55	512,111
Virginia	790,178	4.60	3,634,819	Wyoming	15,978	8.80	140,606
North Carolina	1,153,379	4.80	5,536,219	Colorado	108,300	6.75	731,025
South Carolina	664,907	5.40	3,590,498	New Mexico	22,182	5.65	125,328
Georgia	1,438,830	5.45	7,841,624	Arizona	18,730	5.85	109,570
Florida	387,578	3.50	1,356,523	Utah	60,188	6.95	418,307
Alabama	1,137,501	4.65	5,289,380	Nevada	15,006	6.65	99,790
Mississippi	1,196,558	4.20	5,025,544	Idaho	120,525	6.85	825,596
Louisiana	649,307	4.85	3,149,139	Washington	179,352	7.40	1,327,205
Texas	2,600,799	4.65	12,093,715	Oregon	263,554	5.70	1,502,258
Arkansas	1,185,932	3.10	3,676,389	California	573,522	5.45	3,125,695
Tennessee	1,102,552	4.40	4,851,229	Oklahoma	595,612	5.40	3,216,305
West Virginia	324,847	6.30	2,046,536	Indian Territory	751,352	4.95	3,719,192
Kentucky	1,410,907	4.70	6,631,263				
Ohio	2,620,212	6.65	17,424,410	United States	52,102,847	6.18	321,802,571
Michigan	1,334,648	7.60	10,143,325				

Wholesale prices of live hogs per 100 pounds in leading cities of the United States, 1901–1905.

Date.	Cincinnati. Packing, fair to good.		St. Louis. Mixed packers.		Chicago.		Omaha.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1901.								
January	$4.95	$5.40	$4.90	$5.30	$4.25	$5.47½	$4.90	$5.35
February	5.20	5.75	5.05	5.45	5.10	5.65	5.10	5.42½
March	5.60	6.05	5.25	6.10	4.90	6.20	5.17½	6.00
April	5.65	6.20	5.60	6.15	4.40	6.25	5.50	6.10
May	5.60	5.95	5.50	5.90	4.15	5.97½	5.00	5.82½
June	5.75	6.20	5.70	6.25	4.25	6.30	5.50	6.07½
July	5.70	6.20	5.80	6.20	3.00	6.35	5.25	6.02½
August	5.85	6.80	5.75	6.60	3.00	6.60	5.05	6.45
September	6.75	7.20	6.60	7.10	3.00	7.40	5.85	6.90
October	5.70	6.95	5.90	7.00	4.25	7.10	5.60	6.85
November	5.35	5.70	5.45	6.10	3.75	6.30	4.15	6.15
December	5.80	6.40	6.00	6.50	4.00	6.70	5.40	6.80
1902.								
January	6.00	6.50	6.10	6.90	4.40	6.85	5.10	6.70
February	6.05	6.50	5.85	6.50	4.40	6.85	5.25	6.45
March	6.20	6.95	5.80	6.92½	4.75	7.00	5.50	6.75
April	6.75	7.30	6.80	7.50	5.40	7.50	6.20	7.30
May	6.65	7.25	6.70	7.50	5.40	7.50	6.50	7.35
June	6.70	7.70	6.95	7.95	5.65	7.95	6.70	7.75
July	7.25	8.00	7.50	8.15	5.70	8.75	6.85	8.05
August	6.40	7.70	6.70	8.12½	5.30	7.95	6.50	7.65
September	6.90	7.80	7.30	8.20	5.50	8.20	7.05	7.75
October	6.50	7.70	6.40	7.90	4.50	7.90	6.40	7.45
November	5.85	6.60	6.05	6.90	4.60	6.95	5.95	6.55
December	6.05	6.65	5.95	6.70	4.60	6.85	5.75	6.60
1903.								
January	6.25	6.95	6.15	6.95	5.00	7.00	6.00	6.85
February	6.70	7.30	6.60	7.30	5.30	7.55	6.35	7.20
March	7.05	7.75	6.95	7.60	6.00	7.85	6.75	7.55
April	6.70	7.45	6.50	7.40	6.30	7.65	6.60	7.40
May	5.75	6.85	5.80	7.05	5.10	7.15	5.50	6.90
June	5.70	6.25	5.50	6.20	5.25	6.35	5.50	6.20
July	5.15	5.90	5.30	5.95	4.60	6.20	4.90	5.65
August	5.40	6.05	5.20	5.90	4.50	6.15	4.92½	5.80
September	5.80	6.35	5.55	6.20	4.85	6.45	5.05	6.00
October	5.10	6.20	5.30	6.25	4.00	6.50	4.80	5.85
November	4.15	5.35	4.50	5.50	3.75	5.50	4.10	5.25
December	4.25	4.95	4.20	4.85	3.80	4.90	4.15	4.70
1904.								
January	4.75	5.25	4.65	5.25	3.85	5.20	4.20	5.00
February	4.85	5.85	4.70	5.80	3.90	5.80	4.50	5.60
March	5.35	6.00	5.20	5.75	4.00	5.82½	4.60	5.40
April	4.90	5.50	4.75	5.67½	3.75	5.30	4.50	5.17½
May	4.50	5.00	4.55	4.90	3.70	4.95	4.20	4.77½
June	4.55	5.55	4.57½	5.50	4.00	5.47½	4.27½	5.27½
July	5.25	5.95	5.10	5.75	4.70	5.90	4.50	5.37½
August	5.20	5.85	5.10	5.72½	4.60	5.80	4.65	5.40
September	5.55	6.25	5.30	6.25	4.70	6.37½	5.00	6.05
October	5.00	6.10	4.90	6.30	1.40	6.27½	4.92½	5.85
November	4.45	5.20	4.50	5.17½	3.65	5.25	4.45	5.00
December	4.35	4.90	4.25	4.85	3.60	4.87½	4.25	4.65
1905.								
January	4.60	4.95	4.75	5.02	3.90	5.00	4.30	4.85
February	4.80	5.35	4.97	5.20	4.10	5.15	4.40	5.00
March	5.00	5.65	5.25	5.57	4.15	5.55	4.50	5.25
April	5.25	5.80	5.60	5.70	4.50	5.72½	5.10	5.40
May	5.30	5.60	5.40	5.57	4.60	5.65	5.00	5.37½
June	5.30	5.55	5.42	5.65	4.50	5.65	4.90	5.35
July	5.45	6.20	5.75	6.20	4.80	6.15	5.05	5.70
August	5.90	6.35	6.30	6.35	5.25	6.45	5.50	6.10
September	5.15	6.25	5.60	6.00	4.40	6.20	4.85	5.75
October	4.95	5.70	5.15	5.55	4.40	5.80	4.75	5.37½
November	4.80	5.15	4.95	5.12½	4.20	5.25	4.50	5.00
December	4.80	5.45	5.00	5.30	4.50	5.35	4.65	5.00

EGGS.

Wholesale prices of eggs per dozen in leading cities of the United States, 1901–1905.

Date.	New York. Average best fresh.		Cincinnati.		Chicago. Fresh.		St. Louis. Average best fresh.	
	Low.	High.	Low.	High.	Low.	High.	Low.	High.
1901.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	19½	27	16	20	17	23	15½	18½
February	17	21½	15	17½	14	19½	14½	17½
March	13	17½	11	15	11½	17	10¼	13
April	13½	14	11	12	12	12¾	10½	12
May	13½	14½	11	11	10½	12¼	10	10¾
June	13	14½	11	11	10	12	8½	10
July	14	18	9	10	10	13	6	9
August	16	20	9	13	12½	14½	9	11½
September	18	22	13½	17	13	17	12	16½
October	20	23	17	17	16½	19	16	18
November	22	29	17	23	19	23½	18	22
December	23	31	23	25	23	28	22	25
1902.								
January	26	34	22	30	18	28	22	26
February	27	37	21	32	23½	33½	21	32
March	15½	30	13½	23	13¾	26½	13½	26½
April	15½	18	14	15	14	16	13½	15½
May	16	17½	14	15	14½	15½	13½	15
June	17	20	14	14½	14¾	17	13	15½
July	18	20½	14	14½	17	18	11¼	14½
August	18	21	14	16	16	18	13	16
September	20	24	16½	18½	17	20½	15	20
October	21	25	18	21	20	22	17	18½
November	22	26	19	23	21½	24	19½	22½
December	24	29	21	23	20	25	20½	22½
1903.								
January	24	28	20	26	21	26½	17½	22½
February	16	25	12	20	14	20	12½	18
March	14½	21	12	16½	12½	20	11	16½
April	15	17½	12	14	12½	15½	11	14¼
May	16	19	13½	14	13	15	12¼	14
June	17½	19½	13½	14	12½	15½	12½	15
July	18½	23	12	14	11	16	11	12½
August	15½	26	12½	18	10	19	14	19
September	19	28	18	19	16	20	18½	19
October	21	33	19	22	17	23	19	21½
November	22	45	20	28	18	28	21½	26
December	28	45	20	26	22	30	24	28½
1904.								
January	27	47	23	32	22	34½	28	29
February	20	40	19	29	18	33½	17¾	29
March	16	25	14½	20	14¾	20	13¼	16
April	17	21	15½	17	15½	18½	14½	15½
May	17	21	15	17	14	18	13	15½
June	17½	21	15½	16	13	17½	14½	15½
July	17½	24	15½	16	11	20	13	17½
August	19	26	15	18	11	20½	16	19½
September	20	30	16	19	13	22	17½	20½
October	20	30	18	20	13	23½	19	20½
November	21	38	21	26	17	28	21½	27
December	20	40	22	27	16	30	24	27
1905.								
January	22	40	22	27	18	31	22	29
February	24	40	24	30	20	36	28	34
March	17	40	14½	23	14½	31	14	22½
April	17½	21	15	16	14½	19	14½	15½
May	17½	21	15	16	14	18½	12½	16½
June	16½	22	14½	15	12	17½	14	15½
July	16½	25	14	14½	12	20½	10½	14
August	18	28	14	17	12½	22	14	16½
September	20	30	17	19	13	22½	16½	16½
October	21	35	18½	23	15	25	16½	19
November	25	40	23	28	16	30	19	24
December	26	40	24	27	18	31	22½	24

TRANSPORTATION RATES.

Mean freight rates on grain, in cents, from St. Louis to Liverpool, via river to New Orleans, and via rail to New York.

Year.	To New Orleans by river.		On wheat to New York, by rail, per 100 pounds.	To Liverpool.	
	On grain in sacks, per 100 pounds.	On wheat in bulk, per bushel.		Via New Orleans, on wheat, per bushel.	Via New York on wheat, per bushel.
1881	20	6	32		
1882	20	6 5/12	29½	22⅔	23[illegible]
1883	17¾	5½	33	19 7/12	27
1884	14	6⅝	26	14 7/12	21¼
1885	15	6⅖	22 1/7	15¼	20¼
1886	16	6½	29	16⅙	21
1887	18¼	6	32 2/15	15	24[illegible]
1888	15	6½	29½	15⅙	22.95
1889	17.93	5.95	28½	17⅓	24.97
1890	15.66	6.58	27⅚	14½	21.48
1891	16.28	6.87½	29	15¾	23.55
1892	16.87	6.50	26.62	14	21
1893	17.54	6.55	28.50	14.71	21.72
1894	17.14	5.89	24.73	11.69	18.71
1895	13	5.95	23.57	12⅛	18.33
1896	14.54	5	23	13.50	19.67½
1897	10.83	4.88	23.64	12.89	20.33
1898	10	4.50	22.25	14.24	20.32
1899	10	4.50	21.95	12.33	17.88
1900	10	a4.25	19.38	14.64	18.41
1901	10	a4.25	19.33	9.48	14.03
1902	10	a4.20	20.66	8.53	15.33
1903	10	a5	22.25	10	16.02
1904	(b)	(b)	21.51	(b)	15.25
1905	(b)	(b)	20.50	(b)	15.60

a F. o. b. New Orleans. b No shipment.

Live stock and dressed meats, Chicago to New York by rail; mean rates, in cents, per 100 pounds.

Year.	Cattle.	Hogs.	Sheep.	Horses and mules.	Dressed beef.	Dressed hogs.		Year.	Cattle.	Hogs.	Sheep.	Horses and mules.	Dressed beef.	Dressed hogs.	
						Refrigerator cars.	Common cars.							Refrigerator cars.	Common cars.
1882	36	29	53	60	57			1894	28	30	30	60	45	45	45
1883	40	32	50	60	64			1895	28	30	30	60	45	45	45
1884	31	28	44	60	51			1896	28	30	30	60	45	45	45
1885	31	26	43	60	54			1897	28	30	30	60	45	45	45
1886	33	30	42	60	61	53	48	1898	28	30	30	60	45	45	45
1887	33	32	40	60	62	59	54	1899 a	25	25	25	60	40	40	40
1888	22	26	31	60	46	46	44	1900	28	30	30	60	45	45	45
1889	25	30	30	60	47	47	45	1901	28	30	30	60	42.9	42.9	42.9
1890	23	28	30	60	39	39	39	1902	28	30	30	60	41.2	41.2	41.2
1891	27	30	30	60	45	45	45	1903	28	30	30	60	45	45	45
1892	28	28	30	60	45	45	45	1904	28	30	30	60	45	45	45
1893	28	20	30	60	45	45	45	1905	28	30	30	60	45	45	45

a Rates did not go into effect until February 1, 1899; until that time the 1898 rates governed.

Meats, packed, Cincinnati to New York by rail; mean rates, in cents, per 100 pounds.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	The year.
1880	39	39	39	34.5	30.5	30.5	30.5	30.5	30.5	30.5	31.5	35	33.41
1881	35	35	35	30.5	30.5	25.7	21.5	21.5	21.5	21.5	21.5	21.5	26.73
1882	......	21.5	24.3	26	26	26	26	26	26	26	26	30.5	25.85
1883	30.5	30.5	30.5	29.2	26	26	26	26	26	26	26.7	30.5	27.83
1884	30.5	30.5	23.3	17.5	17.5	18.4	23	26	26	26	26	26	24.22
1885	24.4	21.5	20	20.6	18.5	17.5	17.5	21.5	21.5	21.5	22.8	26	21.10
1886	26	26	26	26	26	26	26	26	26	26	26	27.7	26.14
1887	30.5	30.5	30.5	26	26	26	26	26	26	26	26	26	27.12
1888	28	28.5	26.3	26	26	26	19.9	17.3	15.5	18.8	21.5	23.6	23.11
1889	26	26	26	26	26	26	26	26	26	26	26	26	26
1890	26	26	26	26	26	26	26	24.8	20	20	20	20	23.89
1891	20	24.3	26	26	26	26	26	26	26	26	26	26	25.36
1892	26	26	26	26	26	25.7	21.5	21.5	21.5	21.5	21.5	21.5	23.70
1893	21.5	23.7	26	26	26	26	26	26	26	26	26	26	25.43
1894	26	26	26	26	26	26	26	26	26	26	26	26	26
1895	26	26	26	26	26	26	26	26	26	26	26	26	26
1896	26	26	26	26	26	26	26	26	26	26	26	26	26
1897	26	26	26	26	26	26	26	26	26	26	26	26	26
1898	26	26	26	26	26	26	26	26	26	26	26	26	26
1899	26	26	26	26	26	26	26	26	26	21.5	21.5	21.5	24.83
1900	26	26	26	26	26	26	26	26	26	26	26	26	26
1901	26	26	26	26	26	26	26	26	26	26	26	26	26
1902	26	26	26	26	26	26	26	26	26	26	26	26	26
1903	26	26	26	26	26	26	26	26	26	26	26	26	26
1904	26	26	26	26	26	26	26	26	26	26	26	26	26
1905	26	26	26	26	26	26	26	26	26	23	21.5	21.5	25

Compressed cotton by rail; mean rates, in cents, per 100 pounds.

Year.	From New Orleans to a—				From Memphis to—		Year.	From New Orleans to a—				From Memphis to—	
	Boston.	New York.	Philadelphia.	Baltimore.	New York.	Boston.		Boston.	New York.	Philadelphia.	Baltimore.	New York.	Boston.
1882	53	48	51	51	61	66	1894	51	50	50	50	50.5	55.5
1883	60	55	53	52	72	77	1895	53	48	48	48	50.5	55.5
1884	60	55	53	52	54	59	1896	55	50	50	50	50.5	55.5
1885	60	55	53	52	56	58	1897	55	50	50	50	50	55
1886	52	47	45	44	53	58	1898	55	50	50	50	47	52
1887	50	45	43	42	53	58	1899	52	47	47	47	48	53
1888	50	45	43	42	47	52	1900	55	50	50	50	50.5	55.5
1889	52	47	45	44	50.5	55	1901	55	50	50	50	50.5	55.5
1890	55	50	50	50	50.5	55	1902	55	50	50	50	50.5	55.5
1891	55	50	50	50	50.5	55	1903	55	50	50	50	50.5	55.5
1892	55	50	50	50	50.5	55	1904	55	50	50	50	50.5	50.5
1893	55	50	50	50	47	52	1905	55	50	50	50	40.5	45.5

a These rates are mainly used for basing purposes.

Corn and wheat, proportional export freight rates per 100 pounds from Kansas City and Omaha to New Orleans and Galveston, during 1905.

Date on which effective.	Corn.		Wheat.	
	From Kansas City.	From Omaha.	From Kansas City.	From Omaha.
1905.	Cents.	Cents.	Cents.	Cents.
February 4	10	11	....	....
April 1	17	18	....	....
July 25	17	18	18	19
August 25	15.5	16.5	16.5	17.5
October 1	14.25	15.75	15.25	16.75

Corn and wheat; mean rates, in cents, per bushel, Chicago to New York.

Year.	Corn.			Wheat.		
	By lake and canal.[a]	By lake and rail.	By all rail.	By lake and canal.[a]	By lake and rail.	By all rail.
1875	....	11.34	19.5	....	12.09	20.89
1876	8.75	9.68	14.12	9.82	10.19	15.12
1877	9.59	13.42	18.03	11.09	14.75	19.56
1878	8.83	10.45	16.39	9.96	11.99	17.56
1879	10.49	12.2	14.56	11.87	13.13	17.71
1880	13.41	14.43	17.48	13.13	15.8	19.8
1881	7.77	9.42	13.4	8.67	10.49	14.4
1882	6.72	10.28	13.5	7.23	10.91	14.47
1883	8.03	11	15.12	9.01	11.63	16.2
1884	6.65	8.5	12.32	7	10	13.2
1885	6.3	8.01	12.32	6.54	9.02	13.2
1886	8.45	11.2	14	9.10	12	15
1887	8.5	11.2	14.7	9.5	12	15.75
1888	6.71	10.26	13.54	7.05	11.14	14.5
1889	6.32	8.19	12.6	6.92	8.97	15
1890	5.93	7.32	11.36	6.76	8.52	14.3
1891	6.32	7.53	14	6.95	8.57	15
1892	5.95	7.21	12.96	6.45	7.59	13.8
1893	7.18	7.97	13.65	7.66	8.48	14.63
1894	4.93	6.5	12.32	5.11	7	13.2
1895	4.50	6.4	10.29	4.86	6.96	11.89
1896	5.75	6.15	10.5	6.19	6.61	12
1897	4.53	6.92	11.43	5.22	7.42	12.5
1898	[b]3.81	4.41	9.8	[b]4.45	4.91	12
1899	[b]5.08	5.83	10.08	[b]5.81	6.63	11.6
1900	[b]4.07	4.72	9.19	[b]4.49	5.1	9.96
1901	[b]4.61	5.16	9.21	[b]5.11	5.54	9.88
1902	[b]4.83	5.51	9.94	[b]5.26	5.89	10.62
1903	[b]4.85	5.78	10.54	[b]5.4	6.37	11.29
1904	[b]3.63	4.82	10.38	[b]4.73	5.50	11.12
1905	[b]4.76	5.19	9.40	[b]5.53	6.40	9.90

[a] Including Buffalo charges and tolls. [b] Exclusive of Buffalo charges.

Average freight rates, in cents, per ton per mile.

Year.[a]	Fitchburg R. R.	Boston and Albany R. R.	New York Central and Hudson River R. R.	Erie R. R.	Lake Shore and Michigan Southern Rwy.	Pennsylvania R. R.	Pittsburg, Fort Wayne and Chicago Rwy.	Chesapeake and Ohio Rwy.	Illinois Central R. R.	Chicago, Rock Island and Pacific Rwy.	Chicago, Milwaukee and St. Paul Rwy.	Chicago and Alton Rwy.	Union Pacific Rwy.	Louisville and Nashville R. R.	All railways in the United States.
1875....	3.624	1.346	1.119	1.061	0.887	0.989	0.970	1.299	1.691	1.688	1.833	1.649	2.164	1.687	1.421
1876....	2.218	1.139	.929	.972	.722	.841	.827	1.062	1.587	1.693	1.798	1.438	2.211	1.638	1.217
1877....	1.955	1.136	.954	.898	.813	.954	1.024	1.035	1.719	1.563	1.949	1.361	2.135	1.382	1.286
1878....	1.582	1.113	.919	.960	.724	.914	.867	.985	1.616	1.539	1.762	1.354	2.236	1.635	1.296
1879....	1.299	1.100	.793	.779	.641	.823	.754	.860	1.523	1.429	1.704	1.054	1.991	1.528	1.153
1880....	1.36	1.207	.879	.836	.750	.918	......	.866	1.543	1.209	1.749	1.206	......	1.594	1.232
1881....	1.26	1.038	.783	.805	.617	.857	.745	.892	1.522	1.220	1.702	1.241	2.178	1.503	1.188
1882....	1.17	1.064	.738	.749	.628	.874	.752	.753	1.417	1.281	1.481	1.253	2.102	1.349	1.102
1883....	1.19	1.197	.915	.786	.728	.881	.787	.722	1.433	1.170	1.391	1.128	1.913	1.323	1.205
1884....	1.09	1.093	.834	.719	.652	.804	.673	.672	1.368	1.097	1.293	1.008	1.557	1.344	1.136
1885....	1.06	.944	.688	.656	.553	.695	.577	.550	1.307	1.043	1.278	1.009	1.420	1.159	1.011
1886....	1.07	1.101	.765	.659	.639	.755	.692	.541	1.157	1.071	1.168	.961	1.266	1.079	.999
1887....	1.13	1.107	.782	.687	.670	.730	.717	.537	1.087	1.012	1.089	.946	1.213	1.075	.984
1888....	1.116	1.099	.753	.716	.861	.723	.660	.541	1.068	.964	1.020	.973	1.170	1.049	1.061
1889....	1.015	1.030	.712	.644	.632	.685	.69	.538	.839	.971	1.067	.525	1.166	.998	.922
1890....	.995	1.105	.730	.665	.644	.661	.69	.561	.942	.995	.995	.898	1.138	.972	.941
1891....	.991	1.089	.740	.636	.630	.656	.70	.525	.934	1.039	1.003	.980	1.131	.968	.895
1892....	.925	1.057	.699	.614	.602	.647	.67	.518	.908	1.055	1.026	.973	1.080	.948	.898
1893....	.923	1.006	.701	.631	.599	.620	.68	.511	.845	1.039	1.026	.949	1.033	.917	.878
1894....	.895	.944	.733	.621	.587	.606	.65	.478	.839	.989	1.037	.974	.970	.876	.860
1895....	.878	.969	.726	.604	.567	.565	.64	.425	.808	1.084	1.075	.994	.971	.831	.839
1896....	.864	.942	.668	.606	.551	.563	.66	.425	.745	1.017	1.003	.925	.957	.806	.806
1897....	.870	.918	.679	.610	.538	.561	.60	.419	.671	.958	1.008	.891	.962	.791	.798
1898....	.844	.839	.606	.575	.530	.521	.57	.369	.695	.966	.972	.866	.950	.743	.753
1899....	.771	.778	.586	.539	.481	.469	.50	.362	.688	.996	.937	.800	1.016	.727	.724
1900....	.798	.824	.558	.588	.490	.504	.58	.343	.650	.987	.930	.794	1.050	.752	.729
1901....	(b)	.831	.575	.615	.489	.562	.56	.388	.619	1.000	.861	.723	1.042	.772	.750
1902....	(b)	(c)	.632	.664	.503	.590	.61	.402	.622	1.034	.840	.678	.979	.744	.757
1903....	(b)	(c)	.634	.637	.519	.598	.62	.475	.591	1.013	.865	.599	.973	.781	.763
1904....	(b)	(c)	.664	.652	.523	.606	.60	.470	.607	.944	.891	.677	.982	.791	.780

[a] Beginning with 1888, the years mentioned end on June 30; prior to 1888 they cover different periods for different railways.
[b] Leased by the Boston and Maine Railroad.
[c] Leased by the New York Central and Hudson River Railroad.

Average rates, in cents, per passenger per mile.

Year.[a]	Fitchburg R. R.	Boston and Albany R. R.	New York Central and Hudson River R. R.	Erie R. R.	Lake Shore and Michigan Southern Rwy.	Pennsylvania R. R.[b]	Pittsburg, Fort Wayne and Chicago Rwy.	Chesapeake and Ohio Rwy.	Illinois Central R. R.	Chicago, Rock Island and Pacific Rwy.	Chicago, Milwaukee and St. Paul Rwy.	Chicago and Alton Rwy.	Union Pacific Rwy.	Louisville and Nashville R. R.	All railways in the United States.
1875....	1.910	2.180	1.885	1.955	2.088	2.259	2.407	3.231	2.882	2.687	2.690	2.755	2.878	3.219	2.378
1876....	1.864	2.099	1.693	1.859	1.846	1.819	1.830	3.322	2.804	2.626	2.805	2.614	2.974	3.018	2.183
1877....	1.947	2.174	1.953	1.772	2.182	2.185	2.192	3.786	2.942	2.772	2.994	2.798	3.140	3.167	2.458
1878....	1.969	2.217	1.978	2.158	2.255	2.277	2.258	3.738	3.122	2.933	3.029	2.795	3.226	3.345	2.573
1879....	1.888	2.137	2.044	2.090	2.221	2.253	2.228	3.630	3.066	2.971	2.908	2.417	......	3.444	2.484
1880....	1.885	2.096	1.999	2.041	2.135	2.222	2.156	2.959	2.514	2.806	2.868	2.076	......	3.476	2.442
1881....	1.820	1.970	1.862	2.016	1.988	2.152	1.895	2.989	2.164	2.666	2.856	1.828	3.341	3.168	2.446
1882....	1.715	1.993	1.808	1.948	2.156	2.249	2.024	2.605	2.388	2.505	2.579	1.951	3.300	2.706	2.391
1883....	1.790	2.088	1.986	1.673	2.196	2.297	2.193	2.373	2.424	2.504	2.516	2.141	3.128	2.614	2.402
1884....	1.651	1.908	1.942	2.189	2.170	2.258	2.222	2.379	2.225	2.572	2.553	1.900	2.952	2.342	3.323
1885....	1.833	1.838	1.419	1.756	2.058	1.950	1.569	2.270	2.211	2.466	2.563	2.026	2.749	2.103	2.216
1886....	1.756	1.853	1.845	1.890	2.098	2.114	2.130	2.131	2.208	2.420	2.415	2.023	2.135	2.436	2.142
1887....	1.89	1.880	1.989	2.039	2.260	2.125	2.255	2.074	2.268	2.328	2.538	2.062	2.301	2.394	2.245
1888....	1.978	1.976	1.967	1.851	2.280	2.111	2.10	2.025	2.197	2.312	2.445	2.123	2.248	2.429	2.349
1889....	1.957	1.869	1.932	1.722	2.286	2.076	2.18	1.709	1.927	2.285	2.415	2.128	2.135	2.370	2.165
1890....	1.915	1.858	1.910	1.584	2.254	2.094	2.25	2.056	2.022	2.149	2.359	2.004	2.045	2.403	2.167
1891....	1.869	1.818	1.905	1.601	2.105	2.070	2.23	2.155	2.073	2.322	2.408	2.205	2.059	2.483	2.142
1892....	1.916	1.828	1.887	1.589	2.183	2.028	2.00	2.181	2.101	2.308	2.464	2.013	2.104	2.448	2.126
1893....	1.869	1.835	1.832	1.551	2.195	1.968	1.98	1.989	1.999	2.095	2.414	1.981	1.987	2.432	2.108
1894....	1.851	1.794	1.857	1.509	2.069	1.993	2.00	1.905	1.925	1.891	2.191	1.776	1.758	2.365	1.986
1895....	1.819	1.770	1.837	1.560	2.215	1.971	2.06	1.980	1.995	2.146	2.411	2.119	1.962	2.318	2.040
1896....	1.769	1.752	1.838	1.641	2.148	1.950	1.88	1.952	1.979	2.108	2.375	2.117	2.075	2.187	2.019
1897....	1.811	1.754	1.842	1.543	2.108	1.958	2.02	1.980	1.979	2.153	2.289	2.116	2.101	2.254	2.022
1898....	1.826	1.750	1.806	1.548	2.032	1.953	2.02	1.943	1.938	2.092	2.362	2.058	1.945	2.152	1.973
1899....	1.800	1.744	1.766	1.536	2.074	1.937	2.02	1.860	2.014	2.036	2.337	2.055	1.941	2.243	1.925
1900....	1.805	1.754	1.793	1.540	2.223	1.952	2.05	1.973	2.021	2.064	2.346	1.908	1.968	2.318	2.003
1901....	(c)	1.742	1.799	1.541	1.993	1.992	2.09	1.984	1.960	2.095	2.324	1.936	2.085	2.355	2.013
1902....	(c)	(d)	1.723	1.531	1.828	1.999	2.04	2.023	1.999	2.135	2.317	1.860	2.007	2.319	1.986
1903....	(c)	(d)	1.773	1.500	2.066	2.015	2.05	2.044	1.971	2.157	2.309	1.981	1.941	2.369	2.006
1904....	(c)	(d)	1.761	1.452	2.067	2.020	2.03	2.072	1.970	2.203	2.305	1.948	1.907	2.387	2.006

[a] Beginning with 1888, the years mentioned end on June 30; prior to 1888 they cover different periods for different railways.
[b] Excludes ferry earnings at Jersey City, N. J., at least since 1891.
[c] Leased by the Boston and Maine Railroad.
[d] Leased by the New York Central and Hudson River Railroad.

Mean rates on grain, flour, and provisions, in cents per 100 pounds, through from Chicago to European ports, by all rail to seaboard and thence by steamers, from 1896 to 1905.

Shipped to—	Articles.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.
Liverpool....	Grain.........	33.5	33.6	34.35	29.72	29.48	21.47	20.85	22.68	20.19	19.16
Do........	Sacked flour..	34.3	36.81	37.66	30.12	27.9	23.00	23.5	25.19	21.00	22.40
Do........	Provisions....	44.91	44.4	47.15	40.5	48.84	36.00	36.25	41.9	36.56	38.49
Glasgow......	Grain.........	34.22	35.23	36.00	32.35	30.98	24.1	21.75	24.43	22.38	20.00
Do........	Sacked flour..	36.5	39.06	39.06	31.25	31.56	24.38	22.75	25.38	23.20	22.50
Do........	Provisions....	49.97	52.5	52.5	44.69	55.31	45.16	41.88	46.88	44.06	43.23
London.......	Grain.........	33.48	34.00	35.00	30.6	31.1	23.23	21.75	23.56	21.50	20.23
Do........	Sacked flour..	35.28	36.12	37.25	33.5	35.01	25.5	24.00	25.19	22.25	23.64
Do........	Provisions....	47.15	48.14	49.69	44.14	55.87	44.75	39.06	44.06	44.06	40.88
Antwerp......	.....do........	49.69	51.09	52.5	47.5	51.09	46.25	41.5	49.69	48.28	43.70
Hamburg......	.....do........	51.00	51.00	52.00	46.00	50.00	44.00	39.00	47.00	46.00	45.75
Amsterdam...	.....do........	52.00	52.00	52.5	47.00	51.00	45.00	40.00	42.00	42.00	45.42
Rotterdam ...	.....do........	52.00	52.00	52.5	47.00	51.00	45.00	40.00	42.00	42.00	44.53
Copenhagen..	.....do........	58.12	57.28	58.13	51.72	55.31	47.75	42.00	49.69	46.88	48.66
Stockholm ...	.....do........	69.37	68.53	69.25	62.97	64.5	53.25	45.00	52.5	49.69	51.47
Stettin........	.....do........	58.12	57.28	58.13	51.72	55.31	47.75	42.00	49.69	46.88	48.18
Bordeaux	.....do........	64.13	64.13	65.75	59.12	64.12	54.25	51.25	56.25	56.25	51.45

Quotations of ocean freight rates, in cents, on corn, wheat, cotton, and lard from United States ports to Liverpool, during 1905.

Article and port.	First week of—												Mean for year.
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	
Corn and wheat (per bu.):													
Boston	4.20	3.15	3.15	3.15	3.15	3.15	3.15	2.10	3.68	4.72	5.78	5.78	3.76
New York	3.82	3.15	2.10	2.62	2.62	2.10	2.10	3.15	3.15	4.20	6.30	6.30	3.47
Baltimore	5.51	2.97	2.42	2.62	2.62	2.10	2.45	3.15	3.59	6.30	6.30	6.82	3.90
New Orleans	7.35	7.35	6.30	5.25	4.20	4.20	4.20	6.30	6.83	6.83	8.92	8.66	6.37
Galveston	7.00	7.00	7.00	7.00	6.50	6.25	6.25	6.75	7.00	7.25	7.25	7.25	6.88
Cotton (per 100 lbs.):													
Boston	12.00	11.00	10.00	10.00	10.00	10.00	10.00	10.00	11.00	12.00	16.00	20.00	11.83
New York	20.00	14.00	14.00	14.00	14.00	13.00	13.00	13.00	15.00	15.00	20.00	25.00	15.83
Baltimore	17.00	14.00	14.00	12.00	16.00	14.00	12.00	13.00	18.00	18.00	24.00	25.00	16.42
New Orleans	35.00	33.00	33.00	30.00	30.00	30.00	28.00	28.00	30.00	35.00	44.00	40.00	33.00
Galveston	35.00	33.00	31.00	31.33	30.00	29.50	......	......	31.67	35.00	40.60	43.00	34.31
Lard, small packages (per 100 lbs.):													
Boston	16.88	16.88	16.88	16.88	16.88	16.88	16.88	16.88	16.88	16.88	19.69	19.69	17.35
New York	16.88	16.88	16.88	16.88	16.88	16.88	16.88	16.88	16.88	16.88	16.88	16.88	16.88
Baltimore	19.69	19.69	19.69	19.69	18.28	18.28	18.28	18.28	18.28	18.28	20.94	20.94	19.19
New Orleans	30.00	27.00	25.00	27.00	26.00	24.00	24.00	24.00	27.00	24.00	27.00	27.00	26.00
Galveston	20.00	20.00	20.00	19.50	19.00	18.50	18.50	19.50	20.00	20.00	20.00	20.00	19.58

IMPORTS AND EXPORTS OF AGRICULTURAL PRODUCTS.[a]

[Compiled by the Division of Foreign Markets, Bureau of Statistics, Department of Agriculture.]

Agricultural imports of the United States during the five years ended June 30, 1905.

Article imported.	1901.		1902.		1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
ANIMAL MATTER.										
Animals, live:										
Cattle—										
For breeding purposes, number	1,249	$273,728	1,928	$375,096	1,481	$225,875	684	$79,936	2,314	$93,084
Other .... number	144,773	1,657,705	94,099	1,233,626	64,694	935,673	15,372	230,751	25,541	365,488
Total cattle .... do	146,022	1,931,433	96,027	1,608,722	66,175	1,161,548	16,056	310,737	27,855	458,572
Horses—										
For breeding purposes, number	1,910	714,623	2,944	1,273,607	2,803	1,191,611	2,634	1,090,596	2,853	1,169,011
Other .... number	1,875	271,115	1,888	303,627	2,196	341,685	2,092	369,691	2,327	422,072
Total horses .... do	3,785	985,738	4,832	1,577,234	4,999	1,536,296	4,726	1,460,287	5,180	1,591,083
Sheep—										
For breeding purposes, number	2,032	48,989	2,059	46,663	1,737	38,037	1,253	23,298	2,200	45,319
Other .... number	329,156	1,187,288	264,894	910,047	299,886	998,897	236,841	791,991	184,742	659,402
Total sheep .... do	331,188	1,236,277	266,953	956,710	301,623	1,036,934	238,094	815,289	186,942	704,721
All other, including fowls	....	325,507	....	481,865	....	799,067	....	543,296	....	588,078
Total live animals	....	4,478,955	....	4,624,531	....	4,533,845	....	3,129,609	....	3,342,454
Beeswax .... pounds	213,773	55,884	408,706	115,937	488,576	127,220	425,168	116,878	373,569	101,121
Cochineal[b] .... do	114,414	20,414	138,821	24,865	112,714	24,215	162,362	64,246	84,332	36,876

[a] Forest products come within the scope of the Department of Agriculture and are included, therefore, in alphabetical order in these tables.
[b] Classed as agricultural for the first time in 1902; the statistics for 1901 are not included in the total imports of agricultural products for that year.

Agricultural imports of the United States during the five years ended June 30, 1905—Continued.

Article imported.	1901.		1902.		1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
ANIMAL MATTER—continued.										
Dairy products:										
Butter ....pounds..	93,669	$19,441	453,978	$80,725	207,007	$51,564	154,457	$34,764	593,104	$124,1[illegible]
Cheese ....do....	15,329,099	2,120,293	17,067,714	2,551,366	20,671,381	3,183,224	22,707,103	3,284,811	23,[illegible],716	3,[illegible]
Milk	....	48,062	....	33,457	....	42,696	....	32,931	....	25,0[illegible]
Total........................	....	2,187,796	....	2,665,548	....	3,277,484	....	3,352,506	....	3,526,750
Eggs......................dozens..	126,520	10,515	384,070	37,432	368,482	29,757	496,825	61,458	[illegible]	[illegible]
Egg yolks....................	....	246	....	6,869	....	25,795	....	22,781	....	37,[illegible]
Feathers and downs, crude........	....	1,521,859	....	2,032,566	....	2,476,659	....	2,742,018	....	2,[illegible]
Fibers, animal:										
Silk—										
Cocoons ....pounds..	132	139	4,118	1,695	259	158	29,759	10,697	28,546	7,875
Raw, or as reeled from the cocoon ....pounds..	9,139,617	29,353,777	12,620,682	41,714,331	13,637,206	49,002,597	12,630,888	44,461,564	17,812,1[illegible]	[illegible]
Waste ....do....	1,265,806	697,449	1,610,026	919,325	1,633,394	1,008,295	4,062,067	1,628,239	4,51[illegible],628	1,48[illegible]
Total silk..............do....	10,405,555	30,051,365	14,234,826	42,635,351	15,270,859	50,011,050	16,722,709	46,100,500	22,357,307	61,[illegible]
Wool and hair of the camel, goat, alpaca, and like animals—										
Class 1, clothing.....pounds..	30,681,475	5,025,194	66,131,670	7,927,919	42,202,121	7,488,394	45,575,993	8,573,494	109,888,258	24,762,682
Class 2, combing ....do....	5,484,264	1,074,701	6,091,024	1,071,866	15,233,113	2,833,435	12,934,143	2,819,822	26,651,624	6,521,171
Class 3, carpet..........do....	67,417,766	6,429,986	94,354,272	8,712,003	119,702,562	11,831,132	115,232,698	13,420,275	112,6[illegible],864	14,941,[illegible]
Total wool ....do....	103,583,505	12,529,881	166,576,966	17,711,788	177,137,796	22,152,961	173,742,834	24,813,591	249,185,746	46,225,[illegible]
Total animal fibers...do....	113,989,060	42,581,246	180,811,792	60,347,139	192,408,655	72,164,011	190,465,543	70,914,0[illegible]	271,[illegible],053	107,2[illegible]
Gelatin manufactures	....	23,230	....	(a)	....	(a)	....	(a)	....	(a)
Glue.............................do....	4,540,951	173,341	4,787,762	477,036	5,560,616	602,077	5,798,330	598,546	7,45[illegible]	701,867
Honey.......................gallons..	182,196	83,599	167,301	56,38[illegible]	287,696	115,400	206,292	69,053	198,617	76,719

Packing-house products:										
Bladders, other than fish						34,019		19,578		15,837
Blood, dried								23,671		11,064
Bones, hoofs, and horns		674,368		692,634		619,239		536,366		926,505
Bristles—										
Crude, unsorted.....pounds..	51,539	22,310	40,537	28,446	34,239	13,069	11,241	10,976	8,122	4,054
Sorted, bunched, or prepared, pounds	1,633,036	1,707,887	1,972,572	2,018,885	3,009,806	2,641,535	2,576,615	2,356,325	2,461,464	2,366,444
Total ....pounds..	1,684,575	1,730,197	2,013,109	2,047,331	3,044,045	2,654,604	2,587,856	2,367,301	2,469,586	2,370,498
Grease		756,453		981,494		876,246		1,157,923		1,170,514
Gut		1,826		15,826		101,827		60,351		62,630
Hair		1,611,424		1,980,319		2,702,734		2,639,586		3,328,471
Hide cuttings and other glue stock		1,057,931		696,439		834,421		854,483		1,120,070
Hides and skins, other than furs—										
Cattle hides ....pounds..	129,174,624	14,647,413	148,627,907	17,474,039	131,640,325	16,159,902	85,370,168	10,989,035	118,177,357	14,949,628
Goatskins..............do....	73,745,596	20,577,033	88,038,516	25,478,179	85,114,070	24,928,729	86,338,547	23,971,731	97,803,571	26,945,721
Other..................do....	77,989,617	12,995,567	89,457,680	15,054,400	102,340,303	16,942,982	103,024,752	17,045,304	126,893,934	22,868,797
Total ....do....	280,909,837	48,220,013	326,124,103	58,006,618	319,094,698	58,031,613	274,733,467	52,006,070	337,874,862	64,764,146
Meat—										
Sausages, bologna		80,605		109,791		111,647		121,143		147,119
Other, including meat extracts		407,003		464,745		719,250		814,341		674,441
Total meat		487,608		574,536		830,897		935,484		821,560
Oils.................gallons..	59,131	12,858	161,306	29,060	261,421	50,641	171,544	34,830	175,620	27,559
Rennets		88,744		93,358		76,785		94,439		99,481
Sausage casings		612,212		754,588		963,495		885,645		826,323
Stearin ....pounds..	3,684,720	67,686	7,634,293	492,287	10,481,807	1,097,450	1,492,407	110,606	2,800,540	191,969
Other		54,667		380,403		706,802		30,619		62,923
Total packing-house products		55,405,987		66,744,893		69,580,773		61,756,952		75,798,841
Total animal matter		106,825,658		137,133,199		152,957,236		142,828,168		192,957,587
VEGETABLE MATTER.										
Argols, or wine lees..........pounds..	28,598,781	2,476,482	29,276,148	2,263,588	29,966,557	2,734,027	24,571,730	2,550,223	26,281,931	2,291,951
Breadstuffs. (*See* Grain and grain products.)										
Broom corn...................tons..	6	618	5	553	3	288	6	392	3	918
Cider ....gallons..	4,376	3,496	8,006	7,159	4,871	4,751	5,609	5,941	8,651	8,931

a No longer classed as agricultural.

Agricultural imports of the United States during the five years ended June 30, 1905—Continued.

Article imported.	1901.		1902.		1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Cocoa and chocolate:										
Cocoa—										
Crude, and leaves and shells of ....pounds..	45,924,353	$6,472,829	51,379,396	$6,656,504	63,351,294	$7,820,087	72,277,600	$8,873,709	73,815,895	$8,577,649
Prepared, or manufactured, pounds..........	977,003	288,840	973,970	295,921	1,004,766	292,522	1,009,082	300,409	874,878	259,037
Total cocoa......pounds..	46,901,356	6,761,669	52,353,366	6,952,425	64,356,060	8,112,609	73,286,682	9,174,118	74,690,773	[illegible]
Chocolate ....do....	718,848	141,892	525,221	101,536	690,824	144,832	1,784,064	426,486	2,692,251	647,377
Total cocoa and chocolate, pounds..........	47,620,204	6,903,561	52,878,587	7,053,961	65,046,884	8,257,441	75,070,746	9,600,604	77,383,024	9,484,063
Coffee ....pounds..	854,871,310	62,861,399	1,091,004,252	70,982,155	915,086,380	59,200,749	995,043,284	69,551,799	1,047,792,984	84,654,102
Coffee substitutes:										
Chicory root—										
Raw, unground ....do....	511,693	9,833	238,272	4,687	1,411,202	27,967	4,138,248	68,312	3,340,913	[illegible]
Roasted, ground, or otherwise prepared.....pounds..	348,597	11,098	298,671	10,451	442,311	17,493	534,267	20,175	596,095	[illegible]
Total chicory root..do....	860,290	20,931	536,943	15,138	1,853,513	45,460	4,672,515	88,487	3,937,008	81,984
Other.................do....	875,420	38,354	400,527	20,499	450,643	23,613	462,378	26,486	244,327	15,407
Total coffee substitutes, pounds..........	1,735,710	59,285	937,470	35,637	2,304,156	69,073	5,134,893	114,970	4,181,335	97,391
Curry and curry powder..........	....	7,497	....	9,010	....	9,112	....	9,955	....	8,827
Fibers, vegetable:										
Cotton..............pounds..	46,631,283	6,787,828	98,715,680	11,712,170	74,874,426	10,892,591	48,840,590	8,541,510	60,508,548	9,434,720
Flax..................tons..	6,878	1,880,717	7,772	2,094,915	8,155	2,028,012	10,123	2,541,874	8,089	2,260,421
Hemp ....do....	4,057	622,814	6,054	1,013,911	4,919	821,261	5,871	869,260	3,987	[illegible]
Istle, or Tampico fiber......do....	2,334	163,566	7,819	495,254	14,670	1,086,682	13,622	1,199,014	15,697	[illegible]

Jute and jute butts.........do....	103,140	4,412,482	128,963	4,447,987	79,703	3,358,825	96,735	4,104,870	98,215	4,500,623
Manila hemp...............do....	43,735	7,115,446	56,453	10,555,272	61,648	11,885,510	65,666	11,423,395	61,662	12,065,270
Sisal grass..................do....	70,076	7,972,561	89,583	11,961,213	87,025	13,289,444	109,214	15,935,555	100,301	15,256,859
Other.........................do....	8,013	764,917	9,083	977,410	16,075	1,992,779	14,428	1,740,317	17,149	1,901,989
Total...........................	....	29,720,334	....	43,258,132	....	45,355,104	....	46,355,795	....	47,532,821
Flowers, natural........................	....	21,268	....	30,382	....	31,577	....	42,612	....	29,080
Forest products:										
Charcoal..............................	....	....	....	....	....	....	231,302	14,844	5,643	478
Chinchona bark.........pounds..	4,858,904	1,025,546	3,723,303	649,764	3,978,850	519,758	3,605,131	591,375	4,251,869	570,725
Cork wood or cork bark..........	....	1,729,912	....	1,816,107	....	1,737,366	....	1,484,405	....	1,729,143
Dyewoods, and extracts of—										
Dyewoods—										
Logwood............tons..	54,793	864,986	52,657	774,380	51,008	748,550	48,491	663,572	85,514	444,824
Other......................	....	213,812	....	171,120	....	401,849	....	588,934	....	77,751
Total dyewoods.........	....	1,078,798	....	945,500	....	1,150,899	....	1,252,506	....	522,575
Extracts and decoctions of, pounds.....................	2,922,141	195,647	2,991,631	213,404	3,723,133	267,371	3,145,770	269,777	8,496,642	290,066
Total dyewoods and extracts of................	....	1,274,445	....	1,158,904	....	1,417,770	....	1,522,283	....	821,611
Gums, not elsewhere specified—										
Arabic...................pounds..	2,315,679	241,660	4,269,251	341,714	3,905,053	265,386	2,890,051	186,623	3,651,544	190,182
Camphor, crude.........do....	2,175,784	738,875	1,831,058	576,405	2,472,440	764,403	2,819,673	874,665	1,904,062	628,744
Chicle...................do....	3,140,768	753,696	4,574,605	936,065	4,282,247	954,389	5,084,580	1,308,540	5,060,166	1,357,458
Copal, cowrie, and dammar, pounds.....................	18,166,296	1,923,251	20,523,109	2,261,206	27,653,928	2,938,754	20,565,507	2,127,228	25,687,702	2,493,428
Gambier, or terra japonica, pounds.....................	26,813,587	821,539	28,453,802	1,162,233	42,537,348	2,034,511	27,857,055	1,251,782	32,192,781	1,112,060
Shellac..............pounds..	9,608,745	1,277,128	9,064,789	1,605,068	11,590,725	2,713,687	10,988,413	3,505,229	10,706,817	3,748,180
Other........................	....	879,990	....	861,492	....	923,517	....	917,815	....	1,004,859
Total........................	....	6,639,139	....	7,744,183	....	10,594,647	....	10,171,882	....	10,630,481
Hemlock bark.............cords..	16,794	65,418	21,971	103,930	17,040	75,283	14,111	63,460	13,511	64,181

Agricultural imports of the United States during the five years ended June 30, 1905—Continued.

Article imported.	1901.		1902.		1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Forest products—Continued.										
India rubber, gutta-percha, etc.—										
Gutta-joolatong, or East Indian gum ....pounds..	9,371,087	$248,838	16,850,821	$501,418	13,984,817	$345,431	14,887,416	$430,231	19,104,911	$641,819
Gutta-percha ....do....	280,560	130,957	525,767	252,329	316,290	222,400	424,617	174,953	665,217	212,188
India rubber ....do....	55,275,529	28,455,383	50,413,481	24,899,230	55,010,571	30,436,710	59,015,551	40,444,250	67,234,256	49,875,866
Total ....do....	64,927,176	28,835,178	67,790,069	25,652,977	69,311,678	31,004,541	74,327,584	41,049,434	87,004,384	50,729,873
Ivory, vegetable..........do....	13,461,461	179,735	14,699,215	165,489	17,194,434	192,093	15,740,792	229,944	19,688,913	416,883
Naval stores—										
Tar and pitch (of wood), barrels	2,107	11,520	1,660	8,796	1,242	6,004	1,063	6,643	574	3,206
Turpentine, spirits of, gallons..........	13,630	4,441	8,457	2,814	16,705	6,020	19,751	6,224	43,063	13,546
Total..........	....	15,961	....	11,610	....	12,024	....	12,867	....	16,752
Palm leaf, natural	....	7,085	....	10,905	....	5,339	....	5,010	....	8,434
Sumac, ground..........pounds..	7,339,606	133,303	9,182,917	145,776	12,858,547	187,186	18,604,644	276,891	15,588,868	225,056
Tanning materials, n. e. s	....	46,477	....	47,500	....	56,401	....	194,201	....	922,949
Wood, not elsewhere specified—										
Cabinet woods, unsawed—										
Mahogany..........M feet..	32,281	1,752,612	44,795	2,361,483	48,387	2,783,679	50,870	2,690,382	81,844	1,977,894
Other	....	1,240,737	....	999,792	....	1,251,621	....	1,434,229	....	1,077,723
Total cabinet woods	....	2,993,349	....	3,361,275	....	4,035,300	....	4,124,611	....	3,055,617
Timber—										
Round, including logs, M feet..........	82,985	804,188	106,171	907,168	73,836	637,881	66,033	552,504	97,306	722,693
Hewn, squared, or sided, cubic feet..........	112,653	18,810	129,183	18,027	207,554	41,131	139,180	33,357	184,742	28,912
Total timber	....	822,998	....	925,195	....	679,012	....	585,861	....	751,605

Lumber—										
Boards, deals, planks, and other sawed lumber, M feet	490,820	6,361,423	665,603	9,271,090	720,937	10,673,317	589,232	8,878,474	710,538	10,906,661
Shingles ... M	555,853	1,028,184	707,614	1,362,821	724,131	1,494,906	770,373	1,602,999	758,725	1,581,421
Other	....	1,246,509	....	1,380,973	....	1,753,532	....	1,545,384	....	1,649,314
Total lumber	....	8,636,116	....	12,014,884	....	13,921,755	....	12,026,857	....	14,137,396
All other	....	3,152,586	....	3,319,458	....	3,621,782	....	3,752,103	....	4,102,436
Total wood, n. e. s.	....	15,605,049	....	19,620,812	....	22,257,849	....	20,489,432	....	22,047,054
Wood pulp ... tons	46,757	1,586,402	67,416	2,059,092	116,881	3,387,770	144,796	3,602,668	167,504	4,500,955
Total forest products	....	57,143,650	....	59,187,049	....	71,478,022	....	79,619,296	....	92,680,555
Fruit juices, n. e. s.:										
Prune juice, or prune wine, gallons	37,686	26,885	42,817	32,925	53,135	40,435	70,521	38,227	52,765	37,118
Other, including cherry juice, gallons	42,152	20,989	29,108	15,114	32,810	16,709	62,988	27,731	23,574	14,130
Total ... gallons	79,838	47,874	71,925	48,039	85,945	57,144	133,509	65,958	76,339	51,248
Fruits:										
Fresh or dried—										
Bananas	....	6,550,186	....	7,307,437	....	8,541,156	....	7,709,976	....	9,897,821
Currants ... pounds	16,019,198	916,994	36,238,976	1,238,756	33,878,209	743,644	38,347,649	997,430	31,742,919	704,289
Dates ... do	18,434,917	372,400	20,013,681	344,833	21,681,159	486,151	21,058,164	463,459	19,257,250	360,483
Figs ... do	9,933,871	458,513	11,087,131	487,733	16,482,142	775,917	13,178,061	660,360	13,364,107	617,027
Lemons ... do	148,514,614	3,516,856	164,075,309	3,320,359	152,004,213	3,079,221	171,923,221	3,659,598	139,084,321	2,905,082
Oranges ... do	50,332,914	716,457	52,742,476	784,640	56,872,070	818,780	35,893,260	525,468	28,880,575	374,088
Plums and prunes ... do	745,974	62,880	522,478	44,077	633,819	63,218	494,105	46,976	671,604	63,617
Raisins ... do	3,860,836	297,631	6,683,545	399,973	6,715,675	476,844	6,867,617	355,542	4,041,689	278,031
Other	....	2,059,130	....	2,053,588	....	2,353,864	....	2,749,670	....	2,924,187
Total fresh or dried	....	14,951,047	....	15,981,396	....	17,338,795	....	17,168,479	....	18,179,625
Prepared or preserved	....	1,366,801	....	1,454,788	....	1,521,443	....	1,796,209	....	1,599,488
Total fruits	....	16,317,848	....	17,436,184	....	18,860,238	....	18,964,688	....	19,779,113
Ginger, preserved or pickled, pounds	340,690	17,306	660,494	28,194	569,292	23,810	230,890	13,502	436,061	24,874

Agricultural imports of the United States during the five years ended June 30, 1905—Continued.

Article imported.	1901.		1902.		1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Grain and grain products:										
Grain—										
Barley .... bushels..	171,004	$84,073	57,406	$33,221	56,462	$30,201	90,708	$45,245	81,020	$39,546
Corn (maize) .... do....	5,169	3,418	18,278	13,418	40,919	29,966	16,633	10,837	15,443	10,623
Oats .... do....	20,735	8,995	25,812	12,085	137,416	45,899	170,882	57,802	38,773	18,626
Rye .... do....	46	33	88	97	838	430	32,512	20,329	20,551	13,576
Wheat .... do....	600,212	418,327	118,612	78,640	1,077,424	669,419	6,852	7,517	3,102,585	2,769,317
Total grain .... do....	797,166	514,846	220,196	137,461	1,313,059	775,915	317,587	141,730	3,258,372	2,851,688
Grain products—										
Macaroni, vermicelli, etc., pounds	(a)	(a)	(a)	(a)	28,787,821	1,171,887	40,224,202	1,617,634	53,441,080	2,083,833
Malt .... bushels..	4,580	4,635	3,019	2,929	2,468	3,029	3,465	3,250	3,298	3,580
Meal and flour—										
Oatmeal .... pounds..	204,694	11,667	236,981	13,628	227,681	13,685	235,819	14,201	304,668	16,361
Wheat flour ...... barrels..	642	3,430	420	2,610	601	4,489	46,851	164,100	40,801	176,513
Total meal and flour....	....	15,097	....	16,238	....	18,174	....	178,301	....	192,874
Other	....	1,078,995	....	1,380,658	....	438,963	....	613,916	....	667,427
Total grain products......	....	1,098,727	....	1,399,825	....	1,632,053	....	2,413,101	....	2,947,714
Total grain and grain products	....	1,613,573	....	1,537,286	....	2,407,968	....	2,554,831	....	5,799,402
Hay .... tons..	142,620	1,128,610	48,415	381,417	293,112	2,238,109	114,388	914,842	46,214	359,515
Hops .... pounds..	2,606,708	851,008	2,805,293	833,702	6,012,510	1,808,491	2,758,163	1,374,327	4,339,379	1,980,804
Indigo .... do....	3,139,063	1,402,894	3,057,673	1,035,980	4,532,458	1,202,451	5,046,614	1,282,497	4,830,930	873,781
Licorice root b .... do....	100,105,654	1,737,097	109,077,323	1,926,903	88,580,611	1,545,167	89,463,182	1,472,323	108,443,893	1,780,109
Liquors, alcoholic:										
Distilled spirits—										
Of domestic manufacture, returned .... proof gallons..	875,099	794,594	805,212	749,687	819,591	846,404	471,596	539,362	316,469	326,885
Brandy .... do....	290,301	843,318	316,222	911,419	348,878	1,000,997	390,988	1,104,410	403,386	1,139,129

Other............do....	1,712,156	2,521,237	1,909,887	2,781,048	2,061,057	2,987,179	2,228,842	3,313,795	[illegible]	3,539,044
Total distilled spirits, proof gallons........	2,877,556	4,162,149	3,031,321	4,415,154	3,229,526	4,834,580	3,101,426	4,557,507	[illegible]	[illegible]
Malt liquors—										
Unbottled ....gallons..	2,447,555	719,092	2,553,165	718,383	2,966,343	885,694	3,197,955	[illegible]	[illegible]	1,119,768
Bottled ....do....	1,151,891	1,166,123	1,198,406	1,161,965	1,292,475	1,252,047	1,467,756	[illegible]	[illegible]	[illegible]
Total malt liquors....do....	3,599,446	1,885,215	3,751,511	1,880,348	4,258,818	2,087,711	4,665,711	[illegible]	[illegible]	[illegible]
Wines—										
Champagne and other sparkling..........dozen quarts..	311,078	4,589,494	335,256	4,930,768	407,941	5,861,639	336,245	[illegible]	[illegible]	[illegible]
Still wines—										
Unbottled ....gallons..	2,785,850	1,942,322	3,300,026	2,143,433	3,753,211	2,292,297	4,007,691	2,387,018	3,973,919	[illegible]
Bottled ....dozen quarts..	373,832	1,687,420	397,818	1,846,937	410,869	2,095,360	471,153	2,035,217	[illegible]	[illegible]
Total still wines	....	3,629,742	....	3,990,370	....	4,387,657	....	4,422,235	....	[illegible]
Total wines..............	....	8,219,236	....	8,921,138	....	10,249,296	....	9,391,870	....	10,241,021
Total alcoholic liquors......	....	14,265,600	....	15,246,640	....	17,171,617	....	16,062,702	....	[illegible]
Malt, barley. (*See* Grain and grain products.)										
Malt extract, fluid or solid............	....	4,863	....	3,683	....	3,008	....	2,924	....	[illegible]
Malt liquors (*See* Liquors, alcoholic.)										
Nursery stock:										
Plants, trees, shrubs, vines, etc...	....	1,098,469	....	1,172,023	....	1,871,588	....	1,493,789	....	[illegible]
Subtropical plants, etc., for propagation	....	463	....	547	....	1,610	....	[illegible]	....	[illegible]
Total nursery stock	....	1,098,932	....	1,172,570	....	1,873,198	....	[illegible]	....	[illegible]
Nuts:										
Almonds ....pounds..	5,140,232	946,138	9,868,982	1,240,886	8,142,161	1,387,717	[illegible]	1,246,474	11,745,081	[illegible]
Cocoanuts	....	801,233	....	832,383	....	908,242	....	971,852	....	[illegible]
Walnuts...............pounds..	(a)	(a)	(a)	(a)	12,362,567	1,106,033	23,670,761	[illegible]	[illegible]	[illegible]
Other	....	1,518,484	....	1,971,072	....	1,514,406	....	[illegible]	....	[illegible]
Total nuts	....	3,268,855	....	4,044,341	....	4,866,398	....	5,471,166	....	[illegible]

a Not stated.

b Classed as agricultural for the first time in 1902; the statistics for 1901 are not included in the total agricultural imports for that year.

Agricultural imports of the United States during the five years ended June 30, 1905—Continued.

Article imported.	1901.		1902.		1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Oil cake .... pounds..	448	$64	2,614,059	$20,740	3,827,011	$30,286	1,791,973	$18,592	1,129,013	[illegible]
Oils, vegetable:										
Fixed or expressed—										
Olive, salad .... gallons..	983,059	1,266,293	1,339,097	1,579,409	1,494,132	1,736,648	1,713,500	1,875,825	1,923,174	[illegible]
Other	....	3,422,170	....	5,046,811	....	7,750,712	....	5,952,702	....	[illegible]
Total fixed or expressed	....	4,688,463	....	6,626,220	....	9,487,360	....	7,828,527	....	8,119,325
Volatile, or essential	....	1,959,395	....	2,092,371	....	2,156,331	....	2,396,748	....	2,504,723
Total vegetable oils	....	6,647,858	....	8,718,591	....	11,643,691	....	10,225,275	....	10,624,048
Opium, crude .... pounds..	583,208	1,259,726	531,189	1,216,202	516,570	1,019,909	573,055	1,255,115	564,880	1,102,401
Opium, prepared .... do....	117,581	972,582	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
Rice, rice meal, etc.:										
Rice .... do....	74,598,061	1,588,044	75,674,776	1,596,210	78,317,310	1,732,238	75,323,157	1,869,338	43,408,100	1,097,099
Rice flour, rice meal, and broken rice .... pounds..	42,601,649	736,854	81,984,118	1,330,711	91,338,974	1,329,235	78,898,615	1,204,092	63,075,066	918,867
Total .... do....	117,199,710	2,324,898	157,658,894	2,926,921	169,656,284	3,061,473	154,221,772	3,073,430	106,483,516	2,015,966
Sago, tapioca, etc	....	443,333	....	545,938	....	618,221	....	695,922	....	761,525
Seeds:										
Flaxseed, or linseed .... bushels..	1,681,726	2,098,207	477,157	724,082	129,089	194,024	213,270	201,224	206,184	318,637
Other	....	1,940,987	....	2,528,070	....	2,637,255	....	3,386,245	....	8,158,982
Total	....	4,039,194	....	3,252,152	....	2,831,279	....	3,587,469	....	8,477,619

Spices:										
Unground—										
Nutmegs ....pounds..	1,836,417	360,889	1,841,614	339,685	2,365,624	444,643	1,498,600	288,348	2,324,961	347,721
Pepper, black or white, pounds..................	16,081,849	1,806,167	16,046,179	1,752,345	21,832,675	2,296,221	18,615,186	2,059,051	19,413,357	1,909,521
Other...............pounds..	13,506,848	1,001,482	15,134,481	1,146,246	22,464,192	1,590,778	17,745,806	1,469,587	28,113,130	1,751,895
Total unground ......do....	31,425,114	3,168,538	33,022,274	3,238,276	46,662,491	4,331,642	37,859,592	3,827,026	47,922,578	4,049,137
Ground....................do....	3,786,623	394,571	4,460,841	446,966	4,538,688	483,483	5,414,804	508,982	5,106,179	534,219
Total spices ....do....	35,211,737	3,563,109	37,483,115	3,685,242	51,201,179	4,815,125	43,274,396	4,336,008	53,028,757	4,583,356
Spirits distilled. (See Liquors, alcoholic.)										
Starch.......................pounds..	7,302,501	179,340	11,714,931	235,645	10,540,905	205,949	7,430,383	191,450	6,140,758	180,465
Straw..........................tons..	9,633	35,816	2,986	11,723	3,303	12,832	10,828	81,754	2,825	12,790
Sugar and molasses:										
Molasses.....................gallons..	11,453,156	1,123,923	14,391,215	1,037,696	17,240,399	1,121,710	18,828,530	1,018,198	19,477,885	1,137,844
Sugar—										
Raw—										
Beet..............pounds..	908,683,078	20,028,575	255,030,219	4,202,044	87,130,805	1,223,023	2,414,454	50,525	223,944,976	4,797,278
Cane ....do....	2,956,586,102	67,507,439	2,685,792,937	48,684,775	4,075,635,121	69,740,051	3,681,904,214	71,359,114	3,434,186,471	91,943,398
Total raw.........do....	3,865,269,180	87,536,014	2,940,823,156	52,886,819	4,162,765,926	70,963,074	3,684,318,668	71,409,639	3,658,131,447	96,740,676
Refined..................do....	109,736,660	2,951,786	91,092,719	2,174,278	53,342,180	1,125,899	16,304,945	506,114	22,801,551	904,773
Total sugar...........do....	3,975,005,840	90,487,800	3,031,915,875	55,061,097	4,216,108,106	72,088,973	3,700,623,613	71,915,753	3,680,932,998	97,645,449
Total sugar and molasses ...	....	91,611,723	....	56,098,793	....	73,210,683	....	72,933,951	....	98,783,293
Tea...........................pounds..	89,806,453	11,017,876	75,579,125	9,390,128	108,574,905	15,659,229	112,906,541	18,229,310	102,706,599	16,256,858
Tobacco:										
Wrapper....................do....	6,574,586	5,940,857	5,729,879	5,084,606	6,314,359	4,669,932	7,387,390	5,641,124	7,110,093	5,274,032
Filler and other leaf........do....	20,276,667	10,349,530	23,698,958	10,127,065	27,702,597	12,564,983	23,775,246	11,298,363	26,178,784	12,708,645
Total ....do....	26,851,253	16,290,387	29,428,837	15,211,671	34,016,956	17,234,915	31,162,636	16,939,487	33,288,878	18,078,677

a No longer classed as agricultural.

Agricultural imports of the United States during the five years ended June 30, 1905—Continued.

Article imported.	1901.		1902.		1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Vanilla beans ....pounds..	218,988	$875,229	361,739	$859,399	521,689	$1,032,654	550,328	$1,424,047	[illegible]	[illegible]
Vegetables:										
Fresh or dried—										
Beans and dried pease, bushels	1,099,640	1,306,405	881,966	1,152,177	1,088,665	1,420,384	978,187	1,223,509	472,672	[illegible]
Onions ....bushels..	774,042	509,552	796,316	608,673	925,599	699,657	1,171,242	914,413	[illegible]	[illegible]
Potatoes............do....	371,911	221,759	7,656,162	3,160,801	358,505	238,445	3,166,581	1,870,904	181,170	[illegible]
Other	....	356,971	....	536,581	....	497,666	....	789,761	....	[illegible]
Total fresh or dried	....	2,407,687	....	5,458,232	....	2,856,102	....	4,788,487	....	[illegible]
Prepared or preserved—										
Pickles and sauces..........	....	388,486	....	480,342	....	537,356	....	646,858	....	[illegible]
Other	....	923,506	....	1,101,261	....	1,187,897	....	1,573,257	....	[illegible]
Total prepared or preserved.	....	1,311,992	....	1,581,603	....	1,725,253	....	2,220,115	....	[illegible]
Total vegetables	....	3,719,679	....	7,039,835	....	4,581,355	....	7,008,602	....	[illegible]
Vinegar ....gallons..	135,883	34,222	168,195	45,751	152,524	42,656	181,294	46,856	[illegible]	[illegible]
Wafers, unmedicated	....	18,054	....	17,108	....	19,111	....	20,327	....	[illegible]
Wines. (*See* Liquors, alcoholic.)										
Total vegetable matter, including forest products	....	342,249,043	....	335,798,407	....	374,720,111	....	398,226,029	....	[illegible]
Total vegetable matter, excluding forest products	....	285,105,393	....	276,611,358	....	303,242,089	....	318,666,713	....	[illegible]
Total agricultural imports, including forest products	....	419,071,701	....	472,931,696	....	527,677,347	....	541,051,117	....	[illegible]
Total agricultural imports, excluding forest products	....	391,932,051	....	413,744,557	....	456,199,325	....	461,434,871	....	[illegible]

Agricultural exports (domestic) of the United States during the five years ended June 30, 1905.

Article exported.	1901. Quantity.	1901. Value.	1902. Quantity.	1902. Value.	1903. Quantity.	1903. Value.	1904. Quantity.	1904. Value.	1905. Quantity.	1905. Value.
ANIMAL MATTER.										
Animals, alive:										
Cattle .... number..	459,218	$37,566,980	392,884	$29,902,212	402,178	$29,848,936	593,409	$42,256,291	567,806	$40,598,048
Hogs .... do....	22,318	238,465	8,368	88,330	4,031	40,923	6,345	53,780	44,496	416,692
Horses .... do....	82,250	8,873,845	103,020	10,048,046	34,007	3,152,159	42,001	3,189,100	34,822	3,175,259
Mules .... do....	34,405	3,210,267	27,586	2,692,298	4,294	521,725	3,658	412,971	5,826	645,464
Sheep .... do....	297,925	1,933,000	358,720	1,940,060	176,961	1,067,860	301,313	1,954,604	268,365	1,687,321
Other, including fowls	....	236,319	....	200,738	....	149,590	....	111,129	....	209,497
Total	....	52,058,876	....	44,871,684	....	34,781,193	....	47,977,875	....	46,728,281
Beeswax .... pounds..	140,276	39,461	125,283	36,541	70,811	21,337	55,631	16,545	85,406	24,966
Dairy products:										
Butter .... do....	23,213,526	4,014,905	16,002,169	2,885,609	8,896,166	1,604,327	10,717,824	1,768,184	10,071,487	1,648,281
Cheese .... do....	39,813,517	3,950,999	27,203,184	2,745,597	18,987,178	2,250,229	23,335,172	2,452,239	10,134,424	1,084,044
Milk	....	1,437,818	....	1,473,564	....	921,026	....	1,367,794	....	2,156,016
Total	....	9,403,722	....	7,104,770	....	4,775,582	....	5,588,217	....	4,888,041
Eggs .... dozens..	3,692,875	676,232	2,717,990	528,679	1,517,189	325,571	1,776,632	336,408	2,471,881	543,580
Egg yolks	....	1,610	....	14,700	....	48,108	....	28,294	....	217
Feathers	....	327,966	....	239,756	....	141,257	....	157,035	....	280,256
Fibers, animal:										
Silk waste .... pounds..	53,398	9,138	81,477	9,759	149,400	19,968	227,139	30,814	72,451	9,806
Wool .... do....	199,565	26,017	123,278	13,369	518,919	71,818	319,750	37,171	126,051	15,068
Total .... do....	252,963	35,155	204,755	23,128	668,319	91,786	546,889	67,985	198,502	24,874
Glue .... do....	2,703,400	251,447	2,907,632	284,413	2,569,164	253,768	2,656,057	258,311	2,824,202	279,554
Honey	....	55,571	....	106,112	....	64,220	....	69,317	....	66,307
Packing-house products:										
Bones, hoofs, horns, and horn tips, strips, and waste	....	218,680	....	163,180	....	193,817	....	208,523	....	181,203
Bristles	....	3,968	....	17	....	515	....	1,888	....	1,197
Grease, grease scraps, and other soap stock	....	3,339,948	....	2,610,925	....	2,926,565	....	3,311,777	....	3,716,907

Agricultural exports (domestic) of the United States during the five years ended June 30, 1905—Continued.

Article exported.	1901.		1902.		1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
ANIMAL MATTER—continued.										
Packing-house products—Continued.										
Hair	....	$674,881	....	$633,337	....	$616,133	....	$724,514	....	$778,471
Hides and skins, other than furs, pounds	11,161,749	1,064,952	9,372,747	906,504	12,859,549	1,224,409	62,727,648	[illegible]	[illegible]	[illegible]
Lard ..... pounds	611,357,514	46,560,148	556,840,222	52,375,864	490,755,821	50,854,504	501,302,643	[illegible]	[illegible]	[illegible]
Lard compounds ..... do	23,359,966	1,419,878	36,201,744	2,687,653	46,130,004	3,607,542	[illegible]	[illegible]	61,215,187	[illegible]
Meat—										
Beef—										
Fresh ..... do	351,748,333	31,851,361	301,824,473	29,045,056	254,795,963	25,013,323	299,579,671	26,841,586	236,486,568	[illegible]
Cured—										
Salted or pickled ..... do	55,312,632	3,145,219	48,632,727	3,031,027	52,801,220	3,814,671	57,584,710	3,260,475	55,934,705	[illegible]
Other ..... do	789,285	72,677	818,382	72,836	1,126,032	102,184	269,112	20,542	136,476	14,057
Total cured ..... do	56,101,917	3,217,896	49,451,109	3,103,863	53,927,252	3,916,855	57,853,822	3,281,017	56,071,181	[illegible]
Canned ..... do	53,445,521	5,307,501	66,645,838	6,646,130	76,307,114	7,916,928	57,468,338	5,882,888	66,688,568	[illegible]
Total beef ..... do	461,295,771	40,376,758	417,921,420	38,795,049	385,030,329	36,847,106	414,901,831	36,005,491	359,246,317	[illegible]
Canned meat, n. e. s.	....	1,556,671	....	1,801,385	....	1,831,940	....	2,254,235	....	[illegible]
Mutton ..... pounds	691,121	46,643	430,351	37,067	6,144,020	532,476	465,255	40,618	640,897	[illegible]
Pork—										
Fresh ..... do	30,728,586	2,424,537	44,171,674	3,652,464	20,966,113	2,035,491	18,638,820	1,669,818	[illegible]	[illegible]
Cured—										
Bacon ..... do	456,122,741	37,499,026	383,150,624	35,449,797	207,336,000	22,178,525	249,665,941	24,446,752	[illegible]	[illegible]
Hams ..... do	216,571,803	22,842,778	227,653,232	25,222,744	214,183,365	25,712,633	194,948,864	22,293,867	[illegible]	[illegible]
Salted or pickled, pounds	138,643,611	9,926,633	115,896,275	10,117,562	95,287,374	9,959,762	112,224,861	9,527,388	[illegible]	[illegible]
Total cured, pounds	811,338,155	70,268,437	726,700,131	70,790,103	516,806,739	57,850,920	556,839,666	56,268,007	[illegible]	[illegible]

Canned..........pounds..	8,945,594	708,381	9,603,882	832,910	13,590,897	1,369,657	9,479,312	963,321	10,254,259	993,394
Total pork..........do....	851,012,335	73,401,355	780,175,687	75,275,477	551,363,749	61,256,098	584,952,798	58,901,146	609,794,071	58,088,287
Sausage and sausage meat, pounds....................	9,799,106	923,974	7,137,297	726,437	5,264,648	585,088	5,302,349	492,528	6,061,508	671,211
Total meat................	....	116,305,401	....	116,635,415	....	101,052,708	....	97,824,018	....	93,223,508
Oils—										
Lard oil ....gallons..	766,783	438,645	460,035	327,794	356,658	306,384	376,826	244,499	269,797	154,409
Oleo oil...............pounds..	161,651,413	11,846,373	138,546,088	12,254,969	126,010,339	11,981,888	165,183,829	12,873,658	145,228,245	11,485,145
Other.................gallons..	574,209	258,406	352,201	201,535	221,669	179,505	452,481	273,481	577,777	217,596
Total oils	....	12,543,424	....	12,784,298	....	12,447,727	....	13,391,598	....	11,857,150
Oleomargarin (imitation butter), pounds..........................	4,990,699	484,501	5,721,254	601,521	7,645,652	798,273	6,137,251	695,874	7,961,164	711,078
Sausage casings..................	....	2,778,854	....	1,795,044	....	1,964,524	....	2,358,167	....	2,646,898
Tallow ....pounds..	77,166,889	3,848,561	34,065,758	1,924,577	27,368,924	1,623,852	76,924,174	3,801,302	65,525,992	3,022,173
Other	....	3,212,009	....	3,624,764	....	2,101,785	....	2,032,813	....	2,257,259
Total packing-house products..	....	192,485,205	....	196,743,099	....	179,412,354	....	177,441,654	....	170,208,211
Poultry and game	....	1,070,190	....	856,801	....	1,079,056	....	1,009,234	....	897,425
Quills	....	8,281	....	6,168	....	3,976	....	23,164	....	1,615
Silk waste. (*See* Fibers, animal.)										
Wool. (*See* Fibers, animal.)										
Total animal matter	....	256,416,722	....	250,815,851	....	220,998,208	....	233,034,209	....	221,006,706
VEGETABLE MATTER.										
Breadstuffs. (*See* Grain and grain products.)										
Broom corn.........................	....	237,863	....	244,358	....	211,253	....	226,179	....	227,066
Broom root (rice root).............	....	1,708	....	1,798	....	....	....	....	....	....
Cider ....gallons..	462,018	61,132	121,006	21,869	598,119	84,084	714,476	103,314	394,723	61,204
Cocoa, ground or prepared, and chocolate	....	333,036	....	166,245	....	213,476	....	236,084	....	270,819
Coffee:										
Green or raw ....pounds..	497,559	72,584	27,088,368	3,209,946	29,233,837	3,295,968	32,208,497	3,656,943	15,509,235	1,966,107
Roasted or prepared.........do....	(a)	(a)	443,985	71,152	535,108	89,899	405,893	64,516	590,016	82,401
Total ....do....	....	72,584	27,532,353	3,281,098	29,768,945	3,385,867	32,614,390	3,721,459	16,100,251	2,048,508

a Not stated.

Agricultural exports (domestic) of the United States during the five years ended June 30, 1905—Continued.

Article exported.	1901.		1902.		1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Cotton:										
Sea Island ... bales	29,305	$2,237,758	31,771	$2,186,907	51,688	$4,038,370	34,776	$3,154,376	42,721	$[illegible]
Sea Island ... pounds	11,573,867		12,231,680		20,205,080		13,254,464		16,[illegible],124	
Upland ... bales	6,479,145	311,435,885	6,841,921	288,164,912	6,886,591	312,142,059	5,974,418	367,650,879	[illegible]	[illegible]
Upland ... pounds	3,319,516,581		3,488,547,083		3,522,837,942		3,049,938,376		4,288,[illegible],770	
Linters ... pounds	28,171,912	1,431,604	28,195,873	946,537	26,098,947	884,842	26,663,146	1,238,018	[illegible]	[illegible]
Total ... do	3,359,062,360	315,105,047	3,528,974,636	291,598,356	3,569,141,969	317,065,271	3,089,875,906	372,043,264	[illegible]	[illegible]
Flowers, cut	...	1,787	...	4,788	...	5,290	...	5,676	...	[illegible]
Forest products:										
Bark, and extracts of, for tanning	...	386,238	...	288,012	...	239,786	...	291,783	...	552,909
Charcoal	...	4,161	...	4,929	...	5,118	...	22,646	...	[illegible]
Naval stores—										
Rosin ... barrels	2,820,815	4,742,457	2,535,962	4,202,101	2,396,498	4,817,205	2,585,108	6,621,870	[illegible]	[illegible]
Tar ... do	32,135	77,669	23,236	55,854	18,622	50,802	15,641	44,944	[illegible]	[illegible]
Turpentine and pitch, barrels	18,391	45,795	18,370	44,356	15,972	36,379	13,177	32,253	24,971	74,938
Turpentine, spirits of, gallons	20,240,851	7,715,029	19,177,788	7,431,248	16,378,787	8,014,322	17,202,808	9,446,155	15,894,813	8,922,191
Total	...	12,580,950	...	11,738,562	...	12,918,708	...	16,145,222	...	16,1[illegible]
Wood—										
Timber—										
Round	...	3,608,092	...	3,343,908	...	4,506,728	...	4,473,297	...	3,010,846
Hewn ... cubic feet	4,624,698	802,528	5,388,439	1,030,687	3,291,498	787,082	3,788,740	881,[illegible]	[illegible]	[illegible]
Sawed ... M feet	533,920	6,376,686	412,750	5,225,003	530,659	7,462,111	558,690	8,472,[illegible]	[illegible]	[illegible]
Total timber	...	10,787,306	...	9,599,598	...	12,755,921	...	13,827,[illegible]	...	11,[illegible]
Lumber—										
Boards, deals, and planks, M feet	1,101,815	20,106,242	942,814	16,978,322	1,065,771	20,965,328	1,426,784	[illegible]	[illegible]	[illegible]
Joists and scantling, M feet	41,496	572,704	37,885	472,384	46,894	647,920	60,119	875,062	[illegible]	[illegible]
Shingles ... M	39,255	80,[illegible]	23,224	86,799	38,211	86,245	28,[illegible]	82,377	[illegible]	[illegible]

Shooks—										
Box		590,271		700,035		779,777		869,802		825,145
Other ....number..	714,651	882,438	788,241	798,884	566,205	829,218	533,182	795,595	672,192	1,278,972
Total shooks		1,472,709		1,498,919		1,609,025		1,665,397		2,104,117
Staves and heading—										
Heading		137,961		123,376		134,383		170,874		148,012
Staves ......number..	47,363,262	3,757,018	46,998,512	3,830,432	55,879,010	4,740,680	47,420,095	4,082,344	48,256,285	2,613,[illegible]
Total staves and heading		3,895,009		3,953,808		4,875,063		4,253,218		3,761,677
Other		1,422,384		3,572,328		3,732,782		3,190,687		[illegible],115
Total lumber		20,558,636		26,562,560		31,916,363		38,620,030		34,109,659
Total wood		41,345,942		36,162,158		44,672,284		52,447,305		45,[illegible],347
Wood alcohol [a] ....proof gallons..	919,504	476,582	626,925	338,619	833,629	452,892	1,194,466	585,259	1,097,451	602,285
Wood pulp ....pounds..	61,528,437	1,051,867	38,348,632	740,103	22,464,472	445,228	30,230,820	593,474	25,706,906	473,885
Total forest products		55,369,161		48,928,764		58,281,124		70,085,789		63,109,348
Fruits:										
Fresh or dried—										
Apples, fresh ....barrels..	883,673	2,058,964	459,719	1,628,886	1,656,129	4,381,801	2,018,262	5,446,473	1,499,949	3,859,875
Apples, dried ....pounds..	28,209,023	1,510,581	15,664,468	1,190,593	39,646,297	2,378,635	48,201,665	2,791,421	39,272,800	2,[illegible],414
Apricots, dried ....do....	(b)	(b)	1,928,367	178,143	9,190,081	713,887	7,205,086	608,511	6,854,164	606,777
Oranges		436,560		420,835		465,397		739,593		929,161
Prunes ....pounds..	10,021,554	589,113	23,358,849	1,404,422	66,385,215	3,512,507	73,146,214	3,419,497	54,[illegible],840	2,[illegible]
Raisins ....do....	3,512,164	218,715	2,323,274	149,216	4,280,028	284,550	4,020,418	281,402	7,054,824	552,087
Other		2,716,269		2,153,050		4,215,034		4,317,919		[illegible]
Total fresh or dried		7,530,202		7,125,115		15,951,791		17,505,497		[illegible]
Preserved—										
Canned		3,006,109		1,195,635		1,739,571		2,637,002		2,541,025
Other		71,597		94,323		66,757		115,490		71,[illegible]
Total preserved		3,077,706		1,289,958		1,806,328		2,752,492		2,612,893
Total fruits		10,607,908		8,415,103		17,758,119		20,348,299		15,297,891

a Classed as agricultural for the first time in 1904; the statistics for earlier years are not included in the total domestic exports of forest product, 1901-1903.
b Not stated.

Agricultural exports (domestic) of the United States during the five years ended June 30, 1905—Continued.

Article exported.	1901.		1902.		1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Ginseng .... pounds..	149,069	$801,672	154,063	$856,515	151,985	$796,008	131,882	$851,820	144,[illegible]	$1,0[illegible]
Glucose and grape sugar ...... do....	204,209,974	3,113,828	130,419,611	2,319,286	126,239,981	2,460,022	152,768,716	2,949,[illegible]	175,250,580	[illegible]
Grain and grain products:										
Grain—										
Barley .... bushels..	6,293,207	2,883,565	8,714,268	3,995,303	8,429,141	4,662,544	10,881,627	6,292,914	10,[illegible]	[illegible]
Buckwheat .... do....	123,540	79,120	719,615	449,917	117,953	75,713	31,096	19,827	310,[illegible]	[illegible]
Corn (maize) .... do....	177,817,965	82,527,983	26,636,552	16,185,673	74,833,237	40,540,687	55,858,965	30,071,234	[illegible]	47,[illegible]
Oats .... do....	37,146,812	11,765,330	9,971,139	4,153,258	4,613,809	1,850,728	1,153,711	475,302	5,479,[illegible]	[illegible]
Rye .... do....	2,326,882	1,221,979	2,697,863	1,581,491	5,422,731	3,143,910	765,108	460,980	1,4[illegible]	[illegible]
Wheat .... do....	132,060,667	96,771,743	154,856,102	112,875,222	114,181,420	87,795,104	44,230,169	35,850,318	4,394,402	[illegible]
Total grain .... do....	355,769,073	195,349,720	203,595,539	139,240,844	207,598,291	138,068,656	112,920,589	73,150,735	100,020,410	[illegible]
Grain products—										
Bran, middlings, and mill feed .... tons..	79,358	1,383,246	48,980	962,595	49,513	945,053	19,193	366,213	36,293	722,582
Breadstuff preparations . do....	....	3,439,741	....	2,809,154	....	3,256,945	....	2,807,704	....	2,71[illegible]
Distillers and brewers' grain and malt sprouts ..... tons..	59,136	992,836	66,846	1,157,636	73,104	1,320,065	56,038	1,062,326	75,[illegible]	1,[illegible]
Malt .... bushels..	357,947	250,099	401,375	266,894	347,147	252,801	438,580	315,676	487,168	[illegible]
Meal and flour—										
Corn meal .... barrels..	896,877	2,065,432	348,031	1,046,643	451,506	1,382,127	590,774	1,091,609	671,906	1,[illegible]
Oatmeal .... pounds..	92,198,138	2,308,649	59,516,512	1,617,298	67,823,935	1,839,106	14,526,477	463,062	52,476,917	1,[illegible]
Rye flour .... barrels..	3,165	10,860	2,369	8,403	3,757	12,818	3,160	11,302	4,721	1[illegible]
Wheat flour .... do....	18,650,979	69,459,296	17,759,203	65,661,974	19,716,484	73,756,404	16,999,432	68,894,836	8,826,335	[illegible]
Total meal and flour....	....	73,844,237	....	68,334,318	....	76,990,455	....	71,060,869	....	42,732,791
All other	....	584,838	....	629,797	....	661,131	....	602,521	....	[illegible]
Total grain products	....	80,494,997	....	74,160,394	....	83,426,450	....	76,215,319	....	[illegible]
Total grain and grain products	....	275,844,717	....	213,401,238	....	221,495,086	....	149,366,054	....	108,[illegible]
Grasses, dried	....	18,295	....	18,001	....	15,291	....	8,762	....	11,[illegible]
Hay .... tons..	89,364	1,476,870	153,431	2,580,622	50,974	828,483	60,730	1,052,705	[illegible]	1,[illegible]
Hops .... pounds..	14,963,676	2,466,515	10,715,151	1,550,657	7,794,705	1,909,951	10,985,988	2,116,180	11,878,032	4,480,[illegible]

Lard compounds. (*See* Meat and meat products.)										
Liquors, alcoholic:										
Distilled spirits—										
Alcohol, including cologne spirits........proof gallons.	237,509	97,633	367,538	220,453	120,697	23,510	587,549	112,291	1,081,871	223,664
Brandy..................do....	15,323	28,176	24,077	30,174	18,117	19,213	70,193	44,119	21,171	18,217
Rum......................do....	1,076,711	1,468,110	1,095,401	1,425,920	1,096,719	1,458,393	757,227	994,959	911,371	1,175,887
Whisky—										
Bourbon...............do....	525,372	687,969	611,518	638,061	169,396	203,137	231,540	254,693	212,001	246,115
Rye....................do....	160,357	251,583	155,046	275,717	104,236	223,480	127,535	217,551	106,893	207,606
Total whisky...do....	685,729	939,552	766,564	913,778	273,632	426,617	359,075	472,241	318,894	453,721
Other.....................do....	23,562	44,670	76,384	82,950	48,014	62,358	47,402	67,851	86,771	97,328
Total distilled spirits...do....	2,038,834	2,578,141	2,329,964	2,673,275	1,557,179	1,990,091	1,821,446	1,691,467	2,417,078	1,968,767
Malt liquors—										
Unbottled ....gallons..	333,666	79,508	417,025	90,769	400,072	95,758	382,346	81,687	354,097	80,436
Bottled ....dozen quarts..	1,351,779	1,643,517	822,899	1,199,293	759,027	1,082,982	540,301	769,432	626,400	932,372
Total malt liquors	....	1,723,025	....	1,290,062	....	1,178,740	....	851,119	....	1,012,808
Wines—										
Unbottled ....gallons..	1,117,858	461,560	929,900	407,345	678,150	290,552	896,643	403,557	839,386	355,215
Bottled ....dozen quarts..	9,901	43,013	10,952	42,980	5,232	24,624	6,066	33,136	5,800	28,242
Total wines................	....	504,573	....	450,325	....	315,176	....	436,693	....	383,457
Total alcoholic liquors......	....	4,805,739	....	4,413,662	....	3,484,007	....	2,982,279	....	3,365,032
Malt. (*See* Grain and grain products.)										
Malt liquors. (*See* Liquors, alcoholic.)										
Malt sprouts. (*See* Grain and grain products.)										
Nursery stock........................	....	134,961	....	132,027	....	158,959	....	287,880	....	219,223
Nuts	....	218,743	....	304,241	....	299,558	....	330,366	....	309,195
Oil cake and oil-cake meal:										
Corn.........................pounds..	12,703,209	131,774	14,740,498	161,056	8,093,222	95,568	14,014,885	169,921	24,171,127	278,526
Cotton-seed ....do....	1,258,687,317	13,119,968	1,050,466,246	12,271,009	1,100,392,988	12,732,497	820,319,073	9,134,088	1,251,907,996	13,897,178
Flaxseed, or linseed........do....	455,154,860	5,471,930	582,886,875	7,508,133	570,908,149	7,011,214	668,868,722	7,765,169	618,498,525	7,600,907
Total ....do....	1,726,515,386	18,723,672	1,648,093,619	19,943,198	1,679,394,359	19,839,279	1,593,232,680	17,069,178	1,894,577,648	21,776,611

Agricultural exports (domestic) of the United States during the five years ended June 30, 1905—Continued.

Article exported.	1901. Quantity.	1901. Value.	1902. Quantity.	1902. Value.	1903. Quantity.	1903. Value.	1904. Quantity.	1904. Value.	1905. Quantity.	1905. Value.
VEGETABLE MATTER—continued.										
Oils, vegetable:										
Fixed or expressed—										
Corn .... gallons..	4,808,545	$1,831,980	4,266,398	$1,769,370	3,788,035	$1,467,493	3,222,875	$998,613	3,109,017	[illegible]
Cotton-seed .... do....	49,356,741	16,541,321	33,042,848	12,992,393	35,642,994	14,211,244	29,010,743	10,717,280	51,[illegible]	[illegible]
Linseed .... do....	99,919	66,653	102,116	68,617	182,330	98,116	236,419	147,721	[illegible]	[illegible]
Other	....	363,056	....	220,372	....	169,796	....	189,451	....	139,219
Total fixed or expressed	....	18,803,010	....	15,050,752	....	15,946,649	....	12,053,065	....	[illegible]
Volatile, or essential—										
Peppermint .... pounds..	60,166	63,672	36,301	54,898	13,033	34,943	42,939	124,728	36,973	[illegible]
Other	....	169,004	....	202,983	....	252,770	....	440,588	....	[illegible]
Total volatile, or essential ..	....	232,676	....	257,881	....	287,713	....	565,316	....	[illegible]
Total vegetable oils........	....	19,035,686	....	15,308,633	....	16,234,362	....	12,618,381	....	[illegible]
Rice, rice meal, etc.:										
Rice .... pounds..	1,078,958	42,807	615,036	29,707	532,092	27,048	2,380,418	88,465	74,866,965	2,234,400
Rice bran, meal, and polish, pounds........	24,448,888	143,922	28,976,238	228,010	19,218,356	122,589	26,741,345	200,263	38,415,795	[illegible]
Total .... pounds..	25,527,846	186,729	29,591,274	257,717	19,750,448	149,637	29,121,763	288,728	113,282,760	[illegible]
Rice root. (*See* Broom root.)										
Root beer........ dozen quarts..	1,751	2,018	712	1,014	949	834	456	455	332	358
Roots, herbs, and barks, n. e. s	....	275,150	....	290,692	....	320,122	....	266,809	....	[illegible]
Seeds:										
Cotton........ pounds..	43,329,257	366,953	56,403,344	509,627	51,622,370	532,732	12,859,756	111,174	21,101,[illegible]	[illegible]
Flaxseed, or linseed..... bushels..	2,755,683	4,319,102	3,874,033	6,031,887	4,128,130	5,698,492	758,579	820,068	[illegible]	1,728
Grass seed—										
Clover........ pounds..	11,998,674	1,063,506	7,256,573	594,723	15,522,527	1,549,687	6,440,618	900,626	[illegible]	1,114,075
Timothy........ do....	7,275,806	296,640	5,966,986	373,046	18,289,917	853,829	12,672,676	180,946	16,141,209	[illegible]
Other	....	144,948	....	315,556	....	581,773	....	299,649	....	[illegible]
Total grass seed........	....	1,505,094	....	1,283,325	....	2,985,289	....	1,381,221	....	[illegible]

All other seeds	....	193,666	....	202,975	....	238,770	....	240,262	....	317,554
Total seeds	....	6,381,815	....	8,027,824	....	9,456,233	....	2,[illegible]	....	2,507,747
Spices	....	20,204	....	23,471	....	36,787	....	28,521	....	32,272
Spirits, distilled. (See Liquors, alcoholic.)										
Starch .... pounds	102,800,725	2,005,865	28,183,967	656,705	27,759,599	832,943	57,185,739	1,340,282	61,460,441	1,420,572
Straw	....	5,328	....	5,092	....	1,747	....	4,007	....	7,112
Sugar, molasses, and sirup:										
Molasses .... gallons	2,495,638	291,063	2,911,509	416,470	3,413,387	492,260	3,819,109	592,288	4,784,807	591,872
Sirup .... do	15,092,321	2,235,014	14,865,744	2,018,761	12,265,295	1,714,899	12,991,957	1,840,[illegible]	[illegible]	2,056,[illegible]
Sugar—										
Raw .... pounds	147,221	6,056	359,402	14,089	99,101	3,545	112,977	3,427	25,090	909
Refined .... do	8,727,639	437,523	7,213,050	292,715	10,421,055	358,537	15,304,[illegible]	528,616	18,322,978	745,[illegible]
Total sugar .... do	8,874,860	443,579	7,572,452	306,804	10,520,156	362,082	15,418,537	532,[illegible]	18,348,077	746,[illegible]
Total sugar, molasses, and sirup	....	2,969,656	....	2,771,835	....	2,569,241	....	2,970,894	....	3,414,[illegible]
Teasels	....	25,079	....	23,161	....	34,258	....	23,479	....	[illegible]
Tobacco:										
Leaf .... pounds	306,900,934	27,175,466	291,369,700	26,881,641	357,496,342	31,972,023	305,382,128	29,464,792	[illegible]	[illegible]
Stems and trimmings .... do	8,886,848	181,009	9,637,665	222,355	10,687,742	278,860	6,589,703	176,[illegible]	6,070,[illegible]	[illegible]
Total .... do	315,787,782	27,656,475	301,007,365	27,103,996	368,184,084	35,250,893	311,971,831	29,640,812	[illegible]	[illegible]
Vegetables:										
Fresh or dried—										
Beans and peas .... bushels	468,670	862,088	324,481	636,345	232,841	530,875	248,805	546,479	290,321	[illegible]
Onions .... do	165,391	144,030	113,531	117,019	145,509	116,624	144,764	116,104	254,048	[illegible]
Potatoes .... do	741,483	518,621	528,484	564,550	843,075	552,533	484,042	436,135	1,[illegible],270	[illegible],210
Total fresh or dried, bushels	1,375,544	1,524,739	966,496	1,317,914	1,221,425	1,200,032	877,611	1,098,718	1,727,[illegible]	[illegible]
Prepared or preserved—										
Canned	....	528,914	....	560,612	....	597,759	....	719,580	....	580,048
Other	....	544,764	....	667,761	....	745,697	....	785,070	....	[illegible]
Total prepared or preserved	....	1,073,678	....	1,228,373	....	1,343,456	....	1,504,650	....	1,[illegible]
Total vegetables	....	2,598,417	....	2,546,287	....	2,543,488	....	2,603,374	....	3,[illegible]

Agricultural exports (domestic) of the United States during the five years ended June 30, 1905—Continued.

Article exported.	1901.		1902.		1903.		1904.		1905.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
VEGETABLE MATTER—continued.										
Vinegar ....gallons..	83,780	$13,231	95,675	$19,754	103,417	$18,072	132,450	$19,192	111,994	$17,158
Wines. (*See* Liquors, alcoholic.)										
Yeast..................................	....	6,809	....	8,439	....	24,675	....	18,772	....	[illegible]
Total vegetable matter, including forest products..........	....	750,580,770	....	655,226,446	....	715,763,473	....	[illegible]	....	[illegible]
Total vegetable matter, excluding forest products..........	....	695,211,609	....	606,297,682	....	657,482,849	....	[illegible]	....	[illegible]
Total agricultural exports, including forest products	....	1,006,997,492	....	906,042,297	....	936,761,681	....	929,246,053	....	890,104,125
Total agricultural exports, excluding forest products	....	951,628,331	....	857,113,533	....	878,480,557	....	859,160,264	....	826,904,777

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