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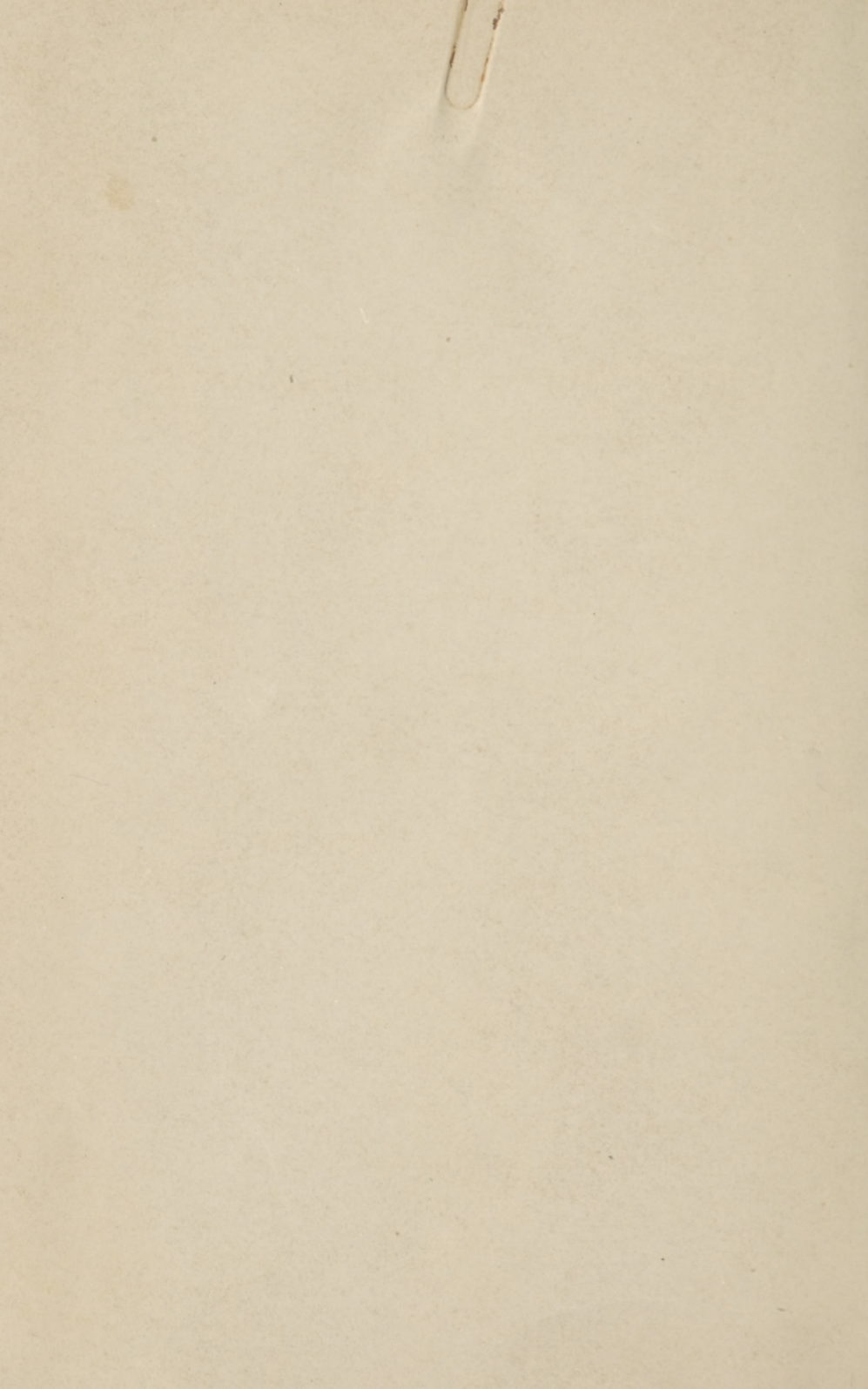


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The

Bureau of Animal Industry

of the

United States Department of Agriculture

ITS ESTABLISHMENT, ACHIEVEMENTS
AND CURRENT ACTIVITIES

By

U. G. HOUCK, B.S., V.M.D.

with the collaboration of other members of the Bureau Staff

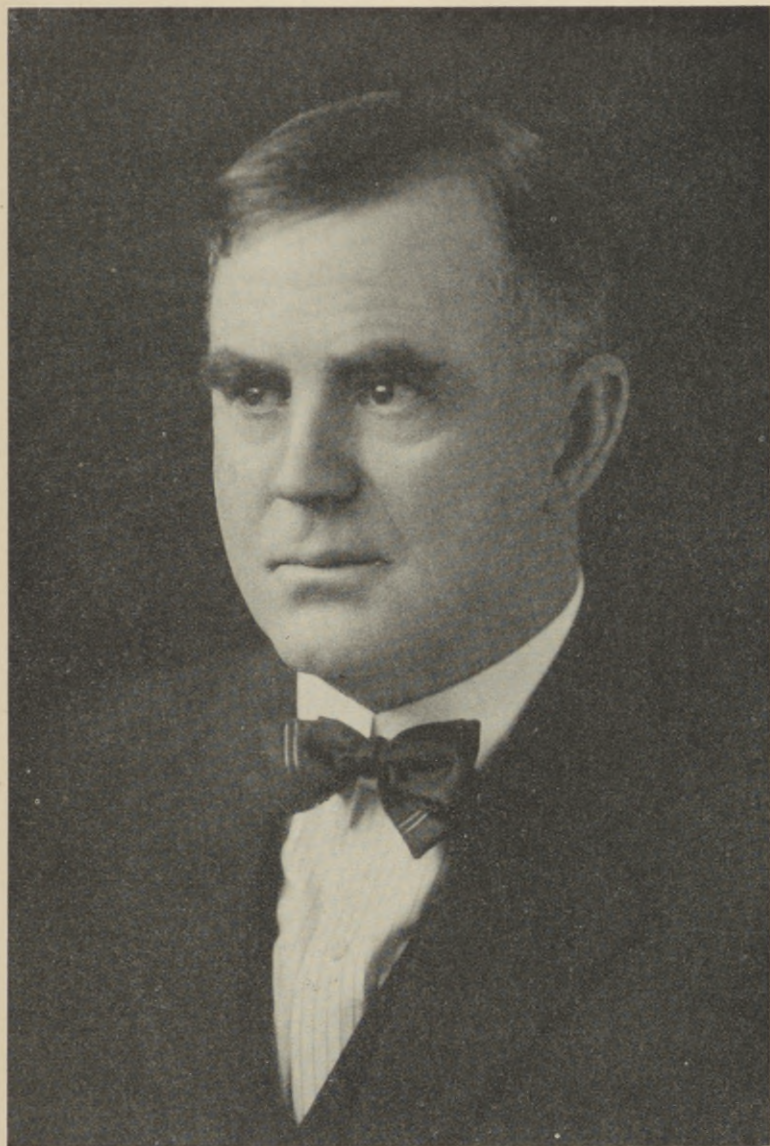
PUBLISHED BY THE AUTHOR
WASHINGTON, D. C.

1924

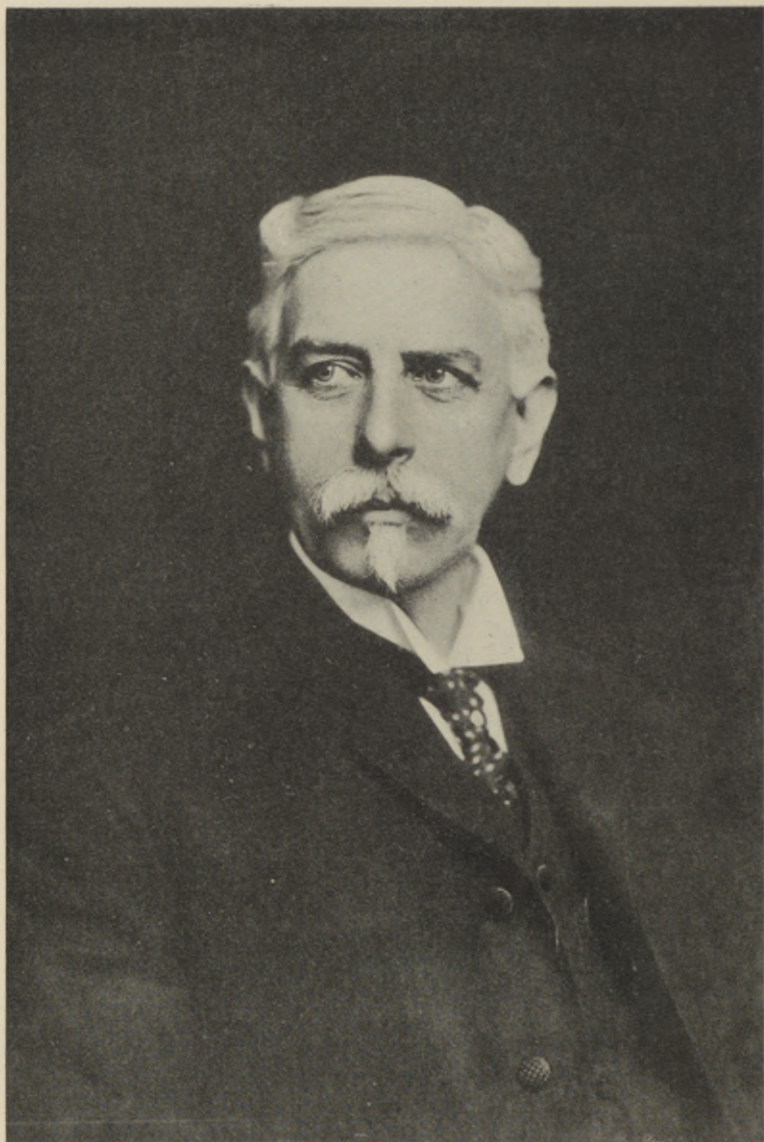
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Hon. HENRY C. WALLACE
Secretary of Agriculture
Appointed March 5, 1921



DR. D. E. SALMON

First Chief of the Bureau

Appointed Chief May 31, 1884. Resigned November 1, 1905



DR. A. D. MELVIN

Second Chief of the Bureau

Appointed Chief December 1, 1905. Died December 7, 1917



DR. JOHN R. MOHLER
Third and Present Chief of the Bureau
Appointed Chief December 11, 1917

PREFACE

In preparing this brief sketch of the establishment, growth and work of the Bureau of Animal Industry I have assembled only the more important facts, events and accomplishments in handy form for reference by those who have helped to make Bureau history and those who are interested in the activities of the organization.

Bureau and other publications have been quoted freely, and I am indebted to the chiefs and members of the staffs of the different divisions and offices of the Bureau for collaborating in preparing the sketches of their respective operations and to the Editorial Office for editorial assistance.

It is hoped that this publication will fulfill its purpose by placing on record the more important activities of the Bureau which has done so much to assist in promoting the livestock industry, advancing agriculture and guarding the public health.

U. G. HOUCK, B. S., V. M. D.

May, 1924.

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INTRODUCTION

Today the Bureau of Animal Industry completes its fortieth year of service. It began with a small staff consisting of a chief, one clerk, and a force limited to 20 persons. With no ambition as to size, but seeking only to render efficient public service, it has grown steadily. By the will of the people as expressed through Congress, it has undertaken one activity after another. The first work was almost entirely that of controlling and eradicating animal diseases. Later, Congress assigned to it the responsibilities of protecting the public health through meat inspection and other regulatory measures. Other steps in its development have related to investigating and promoting dairying, better methods of breeding, feeding and managing livestock, and the care and handling of their products.

The duties of the Bureau now include scientific research, education, relieving animal suffering, guarding the public health, promoting the livestock industry, protecting property, stimulating domestic commerce in animals and their products, and preserving and extending export trade. To conduct all this work properly requires a personnel which averages close to 4,500 employees. These workers are distributed among 19 divisions and offices of the Bureau. Less than 10 per cent are stationed in Washington; the nature of the work calls for the principal distribution of employees among all the States of the Union and several foreign countries.

The first big task of the Bureau was the eradication of contagious pleuropneumonia from the cattle of this country, and its conquest was the first great achievement of the Bureau of Animal Industry. The last big task in the 40-year period of the Bureau is the 1924 campaign against foot-and-mouth disease in California which is taxing our energies as this is written. In all our outbreaks there has been a vexatious and inexplicable lapse of valuable time between the appearance of this infection upon our soil and its definite recognition. Fortunately in this outbreak that period was relatively short. This permitted the inauguration of the campaign of eradication before the infection had become so widespread as to defy control. The largest and best trained force ever assembled in one State for foot-and-mouth disease eradication was placed in the field, but notwithstanding the strenuous efforts made the disease spread to 16 counties. This shows the persistent and treacherous nature of this intensely infectious animal plague.

Many obstacles not encountered in previous outbreaks have had to be overcome in this one. Among them has been the spread of the disease to large range herds and flocks in a rough, inaccessible, and

poorly fenced country, suffering from the worst drought experienced in thirty years. Progress is being made, however, and at this writing the disease is believed to have been stamped out in all but 4 counties, and in these control is being rapidly established. The magnitude of this outbreak is shown by the fact that in only 3 months approximately 95,000 animals have been involved. In the 1914 outbreak, which was the largest ever experienced in this country and which lasted for a period of 18 months, 172,000 animals were affected.

The success of the work conducted by the Bureau of Animal Industry depends on the interest and efficiency of its individual employees. Because of such responsibility, and because many of our employees have an incomplete knowledge of the purpose, scope and policies of the Bureau, I commend the action of Dr. Houck and his colleagues in preparing this interesting and instructive book. The information contained should prove to be beneficial both to the employees of the Bureau and to the general public. Without a publication of this kind it is scarcely possible for persons within the Bureau, or others dealing with it, to grasp the spirit of public service which caused its organization and has guided its development. We find that the public knows little of some of the most important branches of Bureau work, due perhaps to the fact that the Bureau has conducted its operations quietly and without ostentation, although it has been suggested repeatedly that more publicity be given to its achievements. As Chief of the Bureau, I am pleased to know that such a feeling prevails—that we have much more of interest to say than has been said.

Records of the research, experimental work, and the regulatory activities of the Bureau in cooperation with the States, that have been conducted during the 40 years of its existence, are scattered through numerous volumes, reports and articles. In this brief historical sketch the most important facts, events and accomplishments have been assembled, with their dates, in order to have them handy for reference by those who are interested in the Bureau's activities.

This book may be considered as a souvenir of the fortieth anniversary of the birth of the Bureau as well as a tribute to each of its workers, past and present, who by their creative and constructive minds, their enterprise and perseverance, have made such splendid contributions to science and have done so much to elevate the Bureau to the position of respect, confidence and usefulness that it now occupies.

JOHN R. MOHLER, A. M., V. M. D., D. Sc.

May 29, 1924.

Outline of Organization of the Bureau of Animal Industry

Early progress made by the Bureau in behalf of the livestock industry increased the popularity of its work and also the demands for assistance. In order to meet the demands most effectually, it became necessary in 1891 to organize the Bureau into four divisions, each under a chief, and assign specific duties to each division. In order to trace its development through the following pages of this historical sketch, the organization of the Bureau from its beginning to the present time is outlined as follows:

- 1883, May 1. Veterinary Division established in the Department of Agriculture by Dr. D. E. Salmon, who was called to Washington for that purpose.
1883. A pathological laboratory was established by Dr. D. E. Salmon. April 1, 1891, the name was changed to Division of Animal Pathology.
1883. An experiment station was established on leased property in the suburbs of Washington, on Benning Road. July 1, 1897, the station was transferred to its present location, about five miles north of Washington, D. C., on the Rockville road, at Bethesda, Md.
- 1884, May 29. The U. S. Bureau of Animal Industry established by Act of Congress.

Zoological Division.

- 1886, Aug. 1. Zoological Laboratory established.
1901. Zoological Laboratory changed to Zoological Division.

Biochemic Division

- 1890, Jan. 1. Biochemic Laboratory established.
- 1896, July 1. Biochemic Laboratory changed to Biochemic Division.

Reorganization of the Bureau

1891, April 1. Bureau organized in four divisions, as follows:

1. Inspection Division.—To the Inspection Division was assigned all work of an executive nature, including the eradication of contagious diseases, the inspection of export and import animals, meat inspection, vessel inspection, and the regulation of the movement of southern cattle.
2. Division of Animal Pathology.—To this Division was assigned all scientific investigations in regard to the nature, cause, prevention and treatment of animal diseases. The name of this Division was changed to Division of Pathology, and later, to Pathological Division.
3. Division of Field Investigations and Miscellaneous Work.—To this Division was assigned various duties, principal among which were investigations in the field of the location, character and prevalence of outbreaks of the various diseases reported. It maintained a corps of field correspondents from whom informa-

tion was collected as to the condition of livestock, outbreaks of disease, and other conditions in regard to which the farmers needed information. It also was charged with the supervision of the expenditures and accounts of the whole Bureau. It looked after poultry diseases, the animals in the District of Columbia, and answered inquiries made by letter. To some extent this Division was intended as a bureau of information.

4. Division of Quarantine.—To this Division was assigned the duties of issuing permits for the importation of animals, the supervision of importations of livestock on arrival at the port of entry, their removal from the ship to the quarantine station, and also their supervision while being held in quarantine.

Quarantine Division

- 1891, April 1. Division of Quarantine established.
1896, July 1. Division of Quarantine changed to Miscellaneous Division.
1903, July 1. Miscellaneous Division changed to Quarantine Division.
1922, May 1. Quarantine Division combined with Field Inspection Division under the title of Field Inspection Division.

Dairy Division

- 1895, July 1. Dairy Division established.
1902, July 1. Dairy research laboratories established.

Animal Husbandry Division

- 1901, July 1. George M. Rommel appointed expert in animal husbandry, and work in animal husbandry begun. This work grew in a few years into the Animal Husbandry Office.
1910, Jan. 1. Animal Husbandry Office changed to Animal Husbandry Division.

Meat Inspection Division

- 1890, Aug. 30. Federal meat-inspection service first established and placed under the administration of the Bureau.
1891, April 1. Meat inspection placed under newly organized Inspection Division.
1912, July 1. Meat Inspection Division established as a separate division through the separation of the meat-inspection work from the Inspection Division.

Field Inspection Division

- 1912, July 1. Field Inspection Division established as a separate division through separation from the Inspection Division.
1922, May 1. Field Inspection Division and Quarantine Division combined under the title of Field Inspection Division.

Division of Hog Cholera Control

- 1913, July 1. Field investigations and demonstrations begun on a wide scale under direction of the Biochemic Division. (The investigation of hog cholera was commenced by Dr. D. E. Salmon in 1883 and was continued by the Biochemic Division.)
1916, Jan. 1. Office of Hog Cholera Control established through the separation of the hog-cholera field work from the Biochemic Division.

1919, April 16. Office of Hog Cholera Control changed to Division of Hog Cholera Control.

Tick Eradication Division

1917, May 1. Tick Eradication Division established as a separate division through the separation of the tick eradication work from the Field Inspection Division. (The investigation of Texas fever was begun by Dr. D. E. Salmon soon after July 1, 1881, when he was appointed special agent in the Department of Agriculture. On July 1, 1906, tick eradication was begun by the Bureau under the direction of the Inspection Division in cooperation with the States.)

Division of Virus-Serum Control

1917, Feb. 17. Office of Virus-Serum Control established. (Work was begun July 1, 1913, under the Biochemic Division.)

1920, July 1. Office of Virus-Serum Control changed to Division of Virus-Serum Control.

Tuberculosis Eradication Division

1917, May 1. Tuberculosis Eradication Division established through separation from the Quarantine Division, which had been conducting the tuberculosis eradication work in the District of Columbia and in many herds outside of the District since May 27, 1907.

Office of Personnel

1903, July 1. Appointment Section was established in the Quarantine Division, when the name of the Miscellaneous Division was changed to Quarantine Division.

1906, Sept. 1. The Appointment Section became a separate section through separation from the Quarantine Division.

1914, July 1. Appointment Section included in Miscellaneous Division.

1921, May 1. Appointment Section changed to Office of Personnel, on abolition of Miscellaneous Division.

Office of Accounts

1906, Sept. 1. Office of Accounts established as a separate office through separation from the Quarantine Division.

Editorial Office

1898, Mar. 1. George F. Thompson transferred from the Division of Publications to the Bureau to do editorial work.

1903, Mar. 20. Editorial Office established when Mr. Thompson was appointed editor.

Office of Legal Adviser

1916, Feb. 1. Office of Legal Adviser established in the Bureau. Previous to this date the Bureau obtained all legal advice direct from the Solicitor of the Department.

Miscellaneous Division

1914, July 1. Miscellaneous Division organized. Charged with work relating to personnel, supervision of veterinary colleges, keeping records and data relating to projects of work, and other matters not handled by other divisions and offices. (For earlier outline, see Quarantine Division.)

1921, May 1. Miscellaneous Division abolished. Duties continued by Office of Personnel.

Chiefs of the Bureau of Animal Industry

Dr. D. E. SALMON, May 31, 1884, to Oct. 31, 1905.

Dr. A. D. MELVIN, Dec. 1, 1905, to Dec. 7, 1917.

Dr. J. R. MOHLER, Dec. 11, 1917, to the present.

Assistant Chiefs of the Bureau of Animal Industry

Dr. A. M. FARRINGTON, Oct. 8, 1887, to April 1, 1891.

Mr. WILLIAM DICKSON, April 1, 1891, to May 12, 1891.

Dr. CHARLES B. MICHENER, May 12, 1891, to Sept. 15, 1893.

Mr. DANIEL G. HATCH (Acting), Sept. 15, 1893, to Jan. 16, 1896.

Dr. G. M. BRUMBAUGH, Jan. 16, 1896, to Jan. 1, 1899.

Dr. A. D. MELVIN, Jan. 1, 1899, to Dec. 1, 1905.

Dr. A. M. FARRINGTON, Dec. 1, 1905, to June 30, 1914.

Dr. J. R. MOHLER, June 30, 1914, to Dec. 11, 1917.

Mr. B. H. RAWL, Oct. 1, 1918, to June 6, 1921. *

Administrative Assistant

Mr. CHARLES C. CARROLL, April 1, 1920, to the present.

Chief Clerks of Bureau

Mr. MILES FULLER, July 1, 1884, to Nov. 15, 1889.

Mr. WILLIAM J. COWING, Nov. 15, 1889, to June 1, 1893.

Mr. P. L. LYLES, June 1, 1893, to April 20, 1896.

Mr. HERMAN H. GERDES (Acting), April 20, 1896, to Jan. 1, 1897.

Col. S. R. BURCH, Jan. 1, 1897, to Sept. 1, 1903.

Mr. EDWIN B. JONES, Oct. 1, 1903, to Aug. 1, 1908.

Mr. CHARLES C. CARROLL, Aug. 1, 1908, to March 31, 1920.

Mr. J. R. COHRAN, April 1, 1920, to the present.

PRESENT ORGANIZATION

The present organization of the Bureau of Animal Industry is as follows:

Chief: JOHN R. MOHLER.

Administrative Assistant: CHARLES C. CARROLL.

Chief Clerk: J. R. COHRAN.

Editor: D. S. BURCH.

Legal Adviser, HARRY GODING.

Animal Husbandry Division: L. J. COLE, Chief.

Biochemic Division: M. DORSET, chief.

Dairy Division: C. W. LARSON, chief.

Division of Hog Cholera Control: U. G. HOUCK, chief.

Division of Virus-Serum Control: D. I. SKIDMORE, chief.

Field Inspection Division: A. W. MILLER, chief.

Meat Inspection Division: R. P. STEDDOM, chief.

Pathological Division: JOHN S. BUCKLEY, chief.

Tick Eradication Division: R. A. RAMSAY, chief.

Tuberculosis Eradication Division: J. A. KIERNAN, chief.

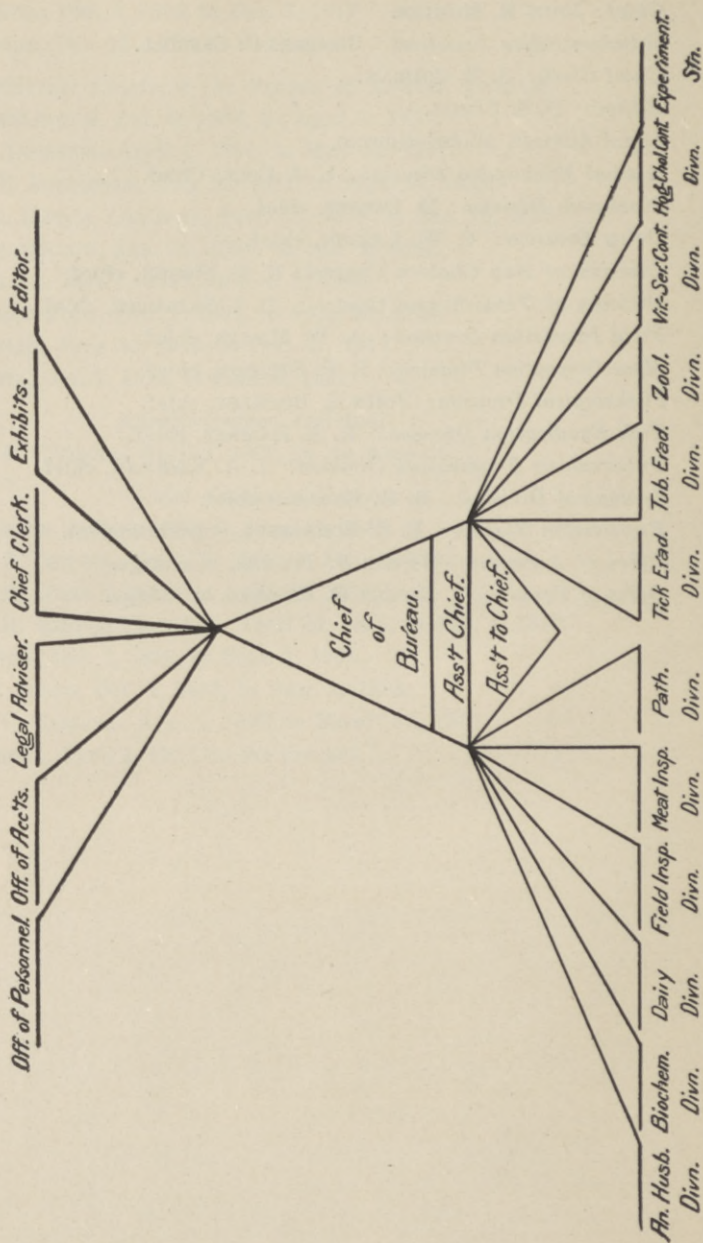
Zoological Division: B. H. RANSOM, chief.

Experiment Station: E. C. SCHROEDER, superintendent.

Office of Accounts: GEORGE F. TUCKER, in charge.

Office of Personnel: GEORGE H. RUSSELL, in charge.

*Organization
of
U. S. Bureau of Animal Industry.*



Commissioners and Secretaries of Agriculture

Hon. Henry L. Ellsworth, of Connecticut, Commissioner of Patents from 1836 to 1845, was the first official of the National Government who gave active attention to agricultural matters. During the time that he was Commissioner of Patents he received from Government representatives abroad and from other sources quantities of choice seeds and many plants which he distributed to enterprising farmers in different parts of the country.

Largely as a result of his efforts, in 1839 Congress appropriated \$1,000 for the purpose of collecting and distributing seeds and procuring agricultural statistics. This money was to be taken from the Patent Office fund and the work was to be done under the direction of the Commissioner of Patents, who at that time was an official of the Department of State. The distribution of seeds and the collection and publication of agricultural information continued under succeeding Commissioners of Patents.

When the Department of the Interior was established in 1849 the Patent Office, including the work relating to agriculture, became a part of it. In 1857 the staff of the Section of Agriculture of the Patent Office consisted of eight members.

David P. Holloway, of Indiana, who became Commissioner of Patents in 1861, made an earnest plea to Congress for the establishment of a separate department of the Government to handle agricultural matters. Mr. Holloway's arguments were supported by agricultural societies and prominent individuals throughout the country. Congress passed the law approved May 15, 1862, establishing the Department of Agriculture, effective July 1, 1862. The heads of this Department from the beginning to the present time are shown in the following list:

Commissioners of Agriculture

ISAAC NEWTON, of Pennsylvania, Commissioner of Agriculture, 1862-1867, Formerly Chief of the Section of Agriculture in the Patent Office. Appointed by President Lincoln and took charge July 1, 1862. On June 19, 1867, Commissioner Newton died as the result of heat stroke.

JOHN W. STOKES, Acting Commissioner of Agriculture, 1867. Mr. Stokes, Chief Clerk of the Department, was appointed Acting Commissioner following Commissioner Newton's death, and served until December 4, 1867.

Gen. HORACE CAPRON, born in New York, appointed from Illinois. Commissioner of Agriculture, 1867-1871. Appointed by President Johnson November 29, 1867, and took charge December 4, 1867. Resigned June 27, 1871, to accept the position of Advisor to the Commission which had been appointed by the Japanese Government to develop agriculture in that country.

Judge FREDERICK WATTS, of Pennsylvania, Commissioner of Agriculture,

1871-1877. Appointed by President Grant to fill the vacancy caused by the resignation of Commissioner Capron.

WILLIAM G. LE DUC, of Minnesota, Commissioner of Agriculture, 1877-1881. Appointed by President Hayes and assumed control July 1, 1877.

Dr. GEORGE B. LORING, of Massachusetts, Commissioner of Agriculture, 1881-1885. Appointed by President Garfield and took charge July 1, 1881.

NORMAN J. COLMAN. Born in New York, appointed from Missouri. Commissioner of Agriculture, March 4, 1885, to February 9, 1889. Appointed by President Cleveland and took charge April 3, 1885.

Secretaries of Agriculture

NORMAN J. COLMAN, Secretary of Agriculture, 1889. On February 9, 1889, the U. S. Department of Agriculture, which had been established by the Act of Congress approved May 15, 1862, was raised to the first rank in the executive branch of the Government, when Commissioner Colman was appointed by the President the first Secretary of Agriculture.

JEREMIAH M. RUSK. Born in Ohio, appointed from Wisconsin. Secretary of Agriculture, 1889-1893. Appointed by President Harrison and took charge March 7, 1889.

J. STERLING MORTON. Born in New York, appointed from Nebraska. Secretary of Agriculture, 1893-1897. Appointed by President Cleveland and took charge March 7, 1893.

JAMES WILSON. Born in Scotland, appointed from Iowa. Secretary of Agriculture, 1897-1913. Appointed by President McKinley and took charge March 5, 1897. Secretary Wilson enjoyed the distinction of serving continuously longer than any other Cabinet officer in the history of our Government.

DAVID F. HOUSTON. Born in North Carolina, appointed from Missouri. Secretary of Agriculture, 1913-1920. Appointed by President Wilson and took charge March 6, 1913. Resigned February 1, 1920, to become Secretary of the Treasury.

EDWIN T. MEREDITH. Born in Iowa and appointed from Iowa. Secretary of Agriculture, February 2, 1920, to March 4, 1921. Appointed by President Wilson to fill the vacancy created through the resignation of Secretary Houston.

HENRY C. WALLACE. Born in Illinois, appointed from Iowa. Secretary of Agriculture, 1921 to the present time. Appointed by President Harding and took charge March 5, 1921.

PART I.

Conditions Leading Up to the Creation of the Bureau

There were so many important conditions and events prior to the existence of the Bureau of Animal Industry that indicated the need for a strong, efficient veterinary organization operated under the patronage of the National Government, that it seems proper to review them briefly before discussing the establishment, growth and achievements of this important branch of the Department of Agriculture.

The success of diversified agriculture throughout the world depends largely upon the production of livestock, and success in livestock production depends largely upon the control of destructive animal diseases.

In his report for the year 1837, Henry L. Ellsworth, Commissioner of Patents, called attention to the rapid improvements that were being made in the implements of agriculture and labor-saving machines, and suggested the desirability of extending assistance to farmers through a regular system for the selection and distribution of seeds of the choicest varieties for agricultural purposes. In the performance of his official duties the Commissioner of Patents was brought into close personal contact with the inventors of agricultural implements. In discussing agricultural subjects with the inventors and other persons interested in farming in different sections of the country he was frequently requested to furnish information and advice. In this way the Patent Office gradually assumed the duty of looking after agricultural interests and became the chief source of official information on agriculture and livestock matters.

In a letter of January 22, 1839, to the chairman of the Commission on Patents, Mr. Ellsworth said :

In the discharge of official duties I could not fail to notice facts deeply connected with the subject of agriculture, and, so far as I was able, without the neglect of primary obligations, to give all the advantageous aid in my power to this important branch of national industry.

The Commissioner of Patents continued to give considerable attention to agricultural matters, including those relating to livestock, and in 1860 the Agricultural Division of the United States Patent Office was established and Thomas G. Clemson was made Superintendent of the new-division.

The Department of Agriculture was established by Act of Congress of May 15, 1862, and entered into operation July 1 of that year.

In the report of the Agricultural Division of the Patent Office for the year 1860 attention was called to the prevalence of hog cholera. This was the first report of the National Government calling attention to the prevalence of animal diseases in this country.

By 1869 the losses from animal diseases were attracting much attention, but up to that time no action had been taken by the National Government to give any assistance to livestock raisers further than to publish in the yearly reports some articles on livestock production and the care of animals. In his report to Congress in 1869 recommending the establishment of a Division of Veterinary Surgery in the Department of Agriculture, Horace Capron, Commissioner of Agriculture, said:

The numerous epizootic and zymotic diseases by which our cattle are infected demand the intelligent consideration of the general Government and of the several States. The experiences of the past few years have demonstrated the necessity of such facilities and I therefore strongly recommend the establishment of a Division of Veterinary Surgery in connection with this Department.

In 1870 Commissioner Capron repeated his recommendation. Finally on May 1, 1883, Dr. D. E. Salmon, who had been in the service of the Department since July 1, 1881, was called to Washington to establish a Veterinary Division of the Department of Agriculture. Dr. Salmon was an investigator of animal diseases, and the Veterinary Division was established immediately with the view of providing facilities for the investigation of such diseases. Hog cholera, contagious pleuropneumonia, sheep scab, Texas fever, anthrax, black-leg, contagious abortion, fowl cholera and other animal diseases had existed in this country for years. There had been outbreaks of foot-and-mouth disease and equine influenza. Heavy losses were reported each year from various sporadic diseases, and unfavorable conditions had arisen in connection with our export trade. Therefore, in connection with the investigation of animal diseases there was urgent need for the establishment of a veterinary organization in the Department of Agriculture, provided with funds and authority to prevent and control communicable diseases, to prevent the importation of foreign plagues, to collect information that would be valuable to the stock grower and necessary to the profitable development of our animal industries, and to enable us to secure free entrance of our products into the markets of the world.

CONTAGIOUS PLEUROPNEUMONIA

The presence of contagious pleuropneumonia in some of our Eastern States, and the necessity of eradicating it in order to prevent its spread to the herds on the open plains of the West and to protect our export cattle trade, was the most important factor leading to the action of Congress in establishing the Bureau of Animal Industry as a permanent organization in the Department of Agriculture.*

Although contagious pleuropneumonia had existed in this country since 1843, the importance of eradicating it while it was yet possible to do so was not fully appreciated until 1879. The disease was first introduced in the United States from England in 1843, one year after its appearance in that country. Peter Dunn, a milkman located near South Ferry, New York City, purchased a ship cow from the captain of the English S. S. *Washington*. This cow carried the infection to Mr. Dunn's herd, and from there it spread to many others in the vicinity of New York City and Brooklyn. The character of the disease did not seem to be recognized, or if it was the owners of the infected herds endured their losses without complaint and kept their opinions to themselves.

Contagious pleuropneumonia prevailed uninterruptedly in some of the dairy herds in the vicinity of New York City from the beginning in 1843 and did not attract public attention until 1862, when a commission from the State of Massachusetts, where efforts were then being made to eradicate the disease, visited New York and Brooklyn for the purpose of learning the reason for the losses reported in the dairy herds of that section. The commission reported that they found some cows sick with the disease in the acute form, and having conducted a post-mortem on one animal in the last stages of the disease, stated that it showed a typical case of the same malady which existed in Massachusetts.

The plague had been introduced into Massachusetts on July 23, 1859, in the bodies of four Dutch cows imported by Winthrop W. Chenery, of Belmont, near Boston. These cows had been shipped from Rotterdam, Holland, an infected city. They were all so sick when they arrived at Boston that only two were able to walk from the boat to Mr. Chenery's farm. The character of the disease in this instance was soon recognized, but, unfortunately, not until after the infection had escaped to other herds in the vicinity, and within the next four years the disease had appeared in twenty towns or town-

* See "The Eradication of Contagious Pleuropneumonia," page 38.

ships in Massachusetts. By the following spring the State had been roused to its danger and on April 4, 1860, the State Legislature passed an act providing for the appointment of three commissioners who were required to take measures for the extirpation of this new invader. The commissioners were authorized and instructed to visit the places where the disease was known or supposed to exist, and were empowered to quarantine and appraise all diseased and exposed cattle and to cause them to be killed and buried, and the premises where they were kept to be cleaned and disinfected.

The commissioners promptly entered upon their duties, and it was soon found that the disease had spread over a larger area than it was at first supposed to have reached. The appropriation of \$10,000 placed at their disposal by the legislature was soon exhausted, along with a like amount contributed from the State Agricultural Society and liberal public-spirited individuals.

More funds were required, and the Governor summoned an extra session of the legislature. After the report of the commissioners had been received and considered, they were released from the necessity of slaughtering all diseased and exposed stock and at their option they were empowered to carry out a system of isolation and quarantine. With various intervals this and succeeding commissions were kept in existence for six years, sufficient funds were provided, and finally the last remnants of the plague were extinguished in 1864, and it did not reappear in that State. Dr. E. P. Thayer, of Newton, Mass., was the veterinary commissioner who brought this work to a successful end.

The infection was carried from Massachusetts into Connecticut during the early part of the outbreak and reached Pennsylvania in 1860, Delaware in 1861, and Maryland, Virginia and the District of Columbia in 1868.

The disease reached New Jersey first in 1847 in an importation made by a Mr. Richardson, who slaughtered his whole herd, valued at \$10,000, to prevent the spread of the disease. Other affected cattle were later brought into the State from New York and from there the infection spread to Pennsylvania and Delaware, and thence to Maryland, Virginia and the District of Columbia.

Connecticut, profiting by the experience of her neighbor State, followed the example of Massachusetts and was successful in eradicating the outbreak, but her proximity to New York City and Long Island brought upon her a series of invasions, which she combated

vigorously and successfully. Massachusetts and Connecticut were the only ones of the infected States that by their own efforts alone succeeded in eradicating contagious pleuropneumonia.

From time to time during the years succeeding the successful efforts of Massachusetts to eradicate the plague, the attention of Congress and of the public was called to the desirability of a combined effort by all the infected States to exterminate this insidious and destructive disease while it was yet confined to narrow limits along the Atlantic coast, but no such action was taken. In his report to Congress in 1878, William G. Le Duc, Commissioner of Agriculture, stated in referring to the prevalence of contagious pleuropneumonia:

The interests involved in this case are of so vast a character, and of such overshadowing importance both to the farming and commercial interests of the country, as to require the active intervention of the Federal Government for their protection, and for this reason the considerate attention of Congress is respectfully asked to this important matter.

It was not until 1879 that the livestock men and the State and National authorities became aroused to the serious situation that confronted the country. It was recognized that if the infection could be carried from the plague-stricken States to adjacent States it could be carried farther, even to the unfenced plains of the West. The terrible consequences of such a contingency were apparent. It would mean the general infection of eastern herds, the permanent establishment of the disease on our great plains, the extinction of our foreign livestock traffic, and finally the imposition of a tax on the country which would necessarily increase with coming years in ratio with the increase in animal population.

An outbreak in New Jersey caused by a cow brought from Ohio in the early part of 1879, suggested the possibility of the disease having already reached the latter State, an occurrence which was inevitable sooner or later, but the actual existence of which would enormously increase the dangers.

An article appeared in the *New York Weekly Tribune* on November 27, 1878, calling attention to the necessity for concerted action in connection with the prevalence of the disease around Washington, D. C., and its gradual spread from one State to another. This article was immediately quoted by various English papers and a demand was made for an embargo on American cattle. This demand was soon followed by the condemnation at Liverpool of a cargo of beef cattle shipped in January, 1879, on the S. S. *Ontario* from Portland,

Maine, also by the institution of special inquiries by representatives of the English Government in this country and by the action of the Privy Council in promulgating an order dated February 6, 1879, effective March 3, that all American cattle arriving at English ports should be slaughtered within a limited time on the docks at the port where they were landed.

The order of the Privy Council caused much excitement in the United States and had more effect than all that had been done in arousing the States to take action to eradicate the disease. The restriction imposed by order of the Privy Council upon our export cattle trade resulted in lowering the price of our steers in the English market on an average of \$10 each below the price paid for similar animals shipped from Canada. As we were at that time shipping at least 100,000 beef cattle abroad each year, it meant a loss to our cattle industry of at least \$1,000,000 annually, or enough to clear our country of the disease.

These conditions resulted in stimulating the States to take action immediately with a view of eradicating the plague. On April 15, 1878, the New York Protective Bill became law, but no practical application of it was made until February 6, 1879, when Governor Robinson appointed Dr. James Law to head a commission for the suppression of the disease in the State of New York. A corps of able veterinarians were employed to assist Dr. Law and the work was commenced with an energy that gave promise of a speedy suppression of the disease by the safest and only effectual method, that is, by the condemnation and immediate slaughter of all infected animals and the segregation and quarantining of all exposed herds. A large number of animals were condemned and slaughtered, but it was soon found that the appropriation made for this purpose was insufficient and the work had eventually to be suspended in the fall of that year for the want of means to carry it forward.

Partial efforts for the suppression of the malady were also made by the States of New Jersey and Pennsylvania soon after New York inaugurated operations, but these efforts were not prosecuted with sufficient energy and determination to inspire much hope of their success, while Maryland and Virginia made no efforts to combat it.

It soon became apparent that where the work of suppressing disease of this character was undertaken by the States separately and individually, many difficulties were encountered and some of them were found to be almost impossible to surmount. There was not the essential perfect concert of action and harmony of purpose on the part of

all the States interested. In some sections the cattle owners opposed the methods of eradication that were employed and persisted in hiding the disease and trafficking in affected animals. Frequently the inspectors were refused admittance to premises suspected of harboring the infection. The work was not thoroughly done, and the stables in infected districts were never under complete supervision. In some States the assertion was made again and again that they were entirely free from pleuropneumonia, and yet it was known that a thorough inspection by competent veterinarians could not fail to reveal a considerable number of cases, especially chronic cases. At best the attempts of the States were spasmodic. While one State was earnestly striving to accomplish something, an adjacent one would allow the shipment of diseased cattle and thus counteract what had been accomplished in the former. Quarantines were opposed by annoying and burdensome retaliations which caused the work of eradication to drag and little was being accomplished in eliminating the disease.

It was generally felt that under existing conditions the efforts to expel the invader would not be successful and the livestock industry must continue indefinitely to endure the losses and to be harassed by the rigid quarantine restrictions imposed by various States for their protection or as retaliation.

The best-informed livestock owners and veterinary authorities came to realize that a national direction of the activities for the extermination of the malady would overcome the worst and most discouraging features which prevented the efforts of the individual States from being effective. The traffic in affected cattle would cease, the work would be more thorough and energetic, because the inspectors would not be directly or indirectly dependent upon the good will of the interested cattle owners for their positions, and the excuse so often presented of the inability of the States to pay for the diseased cattle would also be overcome.

In an article published early in 1879 Dr. Law said:

It matters little whether controlled by State or National Government, if vigor and uniformity of action can be secured; but, as much combined and unflagging work is necessary, it could be best controlled by an intelligent central authority. The United States Government is as much called upon to defend her possessions against an enemy like this—so implacable, so relentless, and so certain, if not repelled, to lay us under an incubus which will increase with the coming centuries, and dwarf the prosperity to which we are entitled,—as against the less insidious one who attacks us openly with fire and sword. Let the National Congress consider this well. Let every stockholder press it upon his Representatives as a matter that cannot be safely ignored even for a single day.

Public sentiment grew rapidly in favor of prompt eradication of the disease, and earnest appeals were made to the National Government to take charge of the work in all the infected States, but at this time there was no National organization that was prepared to handle the situation.

Before the National Government could take charge of this work it would be necessary for Congress to provide funds, enact appropriate laws, and establish an organization with authority to carry into effect measures to cope with the disease and the situation as it existed. As the English agricultural press made it a point of keeping representations before the public intended to create further prejudice and continue the opposition of the authorities to our invasion of foreign markets, it was apparent that to protect our export cattle trade measures must be inaugurated at once to satisfy the English that we were determined to stamp out and keep out all contagious and infectious diseases. Thus, the necessity for establishing an organization to stamp out contagious pleuropneumonia in order to protect our export cattle trade was the most important factor leading to the organization of the Bureau of Animal Industry.

EXPORT TRADE IN CATTLE AND MEATS

Certain conditions developed in connection with our export cattle and meat trades prior to 1884 that required the attention of the National Government to protect these industries.

By 1870 our livestock industry had grown to such an extent that it seemed exceedingly desirable to find an outlet in foreign markets for the surplus livestock and meat products. The month of October, 1875, records an important era in the development of the resources of this country. It was then that the export shipment of fresh meat as a business was begun by Timothy Eastman of New York. A few live cattle had been sent to foreign markets before this period, but a regular trade in either cattle or dressed meats had not yet been established. Timothy Eastman may be properly considered the pioneer in this enterprise, being the first to establish a paying trade in fresh-meat exportation; but the fact should be recorded that John J. Bates of New York made several experiments in this direction before Mr. Eastman commenced to ship. Mr. Bates tells the story of his experimental operations as follows:

On the 11th of February, 1875, I shipped by the Steamer *Baltic*, in refrigerator, twelve quarters of beef, twelve sheep and six hogs. The managers of the White Star Line thought so little of the enterprise that they refused me the use of steam to run the fan-

blower. The meat reached Liverpool in good condition by the use of hand-power to operate the fan. On June 6 following I shipped on the Steamer *Wisconsin* ten carcasses of beef, thirty sheep, and twelve hogs. The meat reached Liverpool in good condition. On August 10, following, I shipped on the Steamer *Britannic* twelve carcasses of beef and one hundred and forty sheep in refrigerator. The meat arrived in Liverpool in good condition. Used steam. In October following Mr. T. C. Eastman made the next and all succeeding shipments.

During the year 1876 Mr. Eastman forwarded to Liverpool 26,333 carcasses of cattle, 14,929 of mutton, 200 hogs and 45 veal; to Glasgow, Scotland, 13,666 carcasses of beef, 5,567 of mutton, and 13 veal; to Le Havre, France, 261 carcasses of beef.

By 1877 the shipments of dressed beef had increased to about 600 tons weekly. The success of the experiments caused a sensation in England among producers and consumers. Although the quality of our meat was indorsed by the best English authorities, the English livestock growers and others immediately endeavored to discourage its extensive consumption by attempting to create prejudice against the American product.

The *Agricultural Gazette* of London of January 29, 1877, contained the following item:

On Wednesday last the S. S. *City of Richmond* arrived at Liverpool with 808 quarters of American beef, consigned to Messrs. Archer and Malthouse, of the Central Meat-Market, London; 650 quarters were sold in the large towns in the north of England and 158 in the London market. The prices realized for the whole, by the carcass, was 6½d per pound.

The sale of American beef in Dublin on Saturday was very considerable. The butchers' shops in which it was sold in different parts of the city were regularly besieged by purchasers. The beef was sold 8d and 10d per pound. A panic had almost been caused by the sale of the beef, which is pronounced better than home produce.

The following extract from the *London Mark Lane Express* of January 15, 1877, is also of interest to show the growing fears from the American invasion of the English market:

The excitement upon the subject of the importation of meat from America increases as the news of large freights received circulates through the country; losing nothing, we may depend, in its course. There is no doubt that the large supplies recently sent to London and Liverpool have had a considerable effect upon the trade of those important meat markets although up to the present, prices in the country have not been appreciably affected. . . . But there are those who tell us that the trade is only in its infancy, and as we know but little of the resources of America for meat-producing, we cannot disprove the prediction. Only last week one large importer stated that he had a thousand carcasses of beef, and as many of both mutton and pork as well, on the sea between New York and Liverpool. Such little recitals as that are calculated to cause alarm; but until we know more about American resources it will be foolish

to gladden the hearts of consumers and cause producers to tremble with visions of cheap meat.

Our export trade continued to grow. American meats were becoming more and more popular in foreign markets, and the trade was carried on without interruption until 1879, when it was alleged that the English veterinarians had found on postmortem examination lesions of contagious pleuropneumonia in a cargo of cattle that had been shipped from Portland, Maine, to Liverpool in January of that year.* As a result of these claims by the English veterinarians and the demand from English livestock producers and others for an embargo against American cattle, the Privy Council issued its order of February 6, 1879, effective March 3, 1879, requiring that all American cattle arriving at English ports must be slaughtered within ten days on the docks where landed. The reason given by the English authorities for issuing the cattle order was the discovery of contagious pleuropneumonia in cattle from the United States.

In the same year restrictions on the importation of sheep into Great Britain were based upon alleged importation of foot-and-mouth disease from this country. As this disease had never existed in the United States except in two or three instances when cattle landed from England were found to be affected with it, and had never been allowed to spread here, it seems evident that the sheep in question must have contracted the disease on vessels that had previously been infected by English cattle.

The records also show that German regulations followed a shipment of American cattle to that country in 1880 which prevented the development of a profitable trade with Germany, as further American cattle shipments were thereby prohibited.

The reports continued to arrive that American cattle affected with pleuropneumonia were being landed in England. An investigation was made in the United States which demonstrated clearly that the animals in question originated in western States where there was no infection. The existence of the disease in these animals was held in doubt and it was decided to carry the investigation to the other side.

Dr. C. P. Lyman, a graduate of the Edinburgh Veterinary College, and held in high esteem as a veterinary surgeon in the State of Massachusetts, was selected to perform this delicate and important task. Dr. Lyman spent July and August, 1880, in England. Out of nearly 1,100 cattle landed and examined during his stay in Liverpool in no case could pleuropneumonia be detected in the living animal, and the

* See Pathological Division, page 58.

inspectors of the veterinary department of the Privy Council condemned after post-mortem examination only six pairs of lungs from animals shipped from Boston to Liverpool on four different steamers. In all thirteen pairs of lungs were condemned from July 7 to November 21, 1880. All of the steers in question were from the States of Missouri, Iowa, Illinois and Ohio—States in which there was no infection known; they were transported to the port of export over railroad lines located away from the areas of infection and they did not pass through any market centers that were even suspected of harboring the infection.

From the results of his macroscopic examinations, Dr. Lyman did not regard the pathological conditions observed in the lungs as contagious pleuropneumonia. However, samples were taken and turned over to Dr. Whitney, an eminent microscopist of Harvard College, for further examination with the aid of the microscope. In his report referring to the results of Dr. Whitney's examination, Dr. Lyman said:

Therefore, if we may place any value upon facts as evidenced by the microscope—and who will say we cannot?—the absolute fact is well shown that not only were the lungs condemned in my presence as being affected with pleuropneumonia contagiosa not affected with that disease; but that the changes noticed in them, in all but one case, were due to a chronic interstitial pneumonia with peribronchitis, with necrosis and the formation of small cavities at and within the lung tissue proper; and further there are evidences amounting to a certainty in one case at least that the disease known as tuberculosis probably plays a more or less important part in the etiology of these changes.

Prof. Williams of Edinburgh was called to Liverpool to see the lesions in question. When he was asked for an opinion he replied: "I have as yet no opinion to give, and shall have none until I have been able to make a more thorough examination of the lungs." He took specimens back with him to Edinburgh and during the next six months received various fresh specimens and finally he reported that he had "not the slightest hesitation in saying that in no case has he found them to exhibit the characteristic lesions of contagious pleuropneumonia." The opinion of Prof. Williams was supported by the conclusions of other experts who had examined specimens of the lungs in question.

It was hoped that Dr. Lyman's visit to England would result in a modification or withdrawal of the order of the Privy Council of February 6, 1879. But as reports continued to arrive of the condemnation of American cattle at English ports on account of pleuropneumonia, and as it was feared that American pork would be excluded from the English market on account of trichinosis, it was decided that

Dr. Lyman should return to England in the summer of 1881, accompanied by Dr. Whitney, the microscopist, to continue the investigations inaugurated the previous year of the diseases found in American animals on arrival at foreign ports.

This investigation was made possible through an Act of the Congress passed at the preceding session, appropriating \$15,000 for the purpose of enabling the Department of Agriculture to ascertain as accurately as possible all facts in relation to the existence of disease among cattle of the United States. At the same time investigations were being pursued in the United States by several experienced veterinarians who were appointed for that purpose in March, 1881.

Accordingly, Dr. Lyman sailed for England in June, 1881, under a letter of instructions from Hon. George B. Loring, Commissioner of Agriculture, as follows:

You will on or about the 10th day of June, proximo, take passage for Great Britain, and having arrived there you will continue your investigations undertaken for the Department of Agriculture in England, last season. These examinations may be pursued by you during the summer months or such a part thereof as may be found necessary, at such port or ports of Great Britain as the circumstances existing from time to time may seem to demand.

It will be well if you can persuade the veterinarians employed by the Government of Great Britain to join you in making a thorough examination of any animals, or lungs thereof, arriving from the United States that may appear to them to show symptoms or lesions of contagious pleuropneumonia, with a view to the settlement, if possible, of the present contested question as to whether the animals now so freely condemned by them as showing the presence of this disease really do have it, or if the lesions of some other disease have been mistaken for it, as is shown by the result of your own examination of the lungs of animals that were pronounced by the British authorities to be unmistakably affected by pleuropneumonia contagiosa.

As a part also of your duties you will, so far as possible, examine in a proper manner the hogs arriving in Great Britain from the United States during your stay there, with a view of ascertaining to how great an extent they are diseased or are infected with trichinæ.

You will also investigate, so far as possible and as circumstances may seem to demand, the question of the existence of any other contagious disease that may be present or alleged to be present among any animals arriving in Great Britain from this country.

Dr. Lyman arrived in London June 24 and the next day called upon the Right Hon. Mr. Mundella, vice-president of the Privy Council, to whom he presented his credentials and stated the objects of his mission.

During the whole of Dr. Lyman's stay in England, which was until August 16, no cattle from the United States were condemned for contagious pleuropneumonia, and before he left England to return to the

United States the veterinarian in chief, Prof. Brown, assured Dr. Lyman that he did not think there need be any occasion for alarm in the future; that if our country was entirely free from pleuropneumonia no condemnations would be made upon lungs presenting the appearances only of those that were condemned in Dr. Lyman's presence during his visit in 1880.

From January 1 to August 16, 1881, thirty-seven pairs of lungs from American cattle were condemned for contagious pleuropneumonia.

The predominating evidence indicates that the lesions found in the lungs of cattle from the United States on arrival at English ports were not those of contagious pleuropneumonia. It was not asserted by the United States authorities that the English veterinarians willfully made diagnoses which they knew to be incorrect or false, but it seemed quite evident that the English authorities as well as the veterinarians were eager to take advantage of every opportunity to handicap our export cattle and meat trade which was developing so rapidly in Great Britain to the great disadvantage of the livestock growers of that country.

As a further illustration of the attitude of some of the British people toward our invasion of foreign markets, in two cases of meat poisoning which occurred in England in 1881 a bacillus was found in the meat by Dr. Edward E. Klein of the Medical Department of the Local Government Board and the suggestion soon followed from other persons that this might be the bacillus of swine plague, or if not, that it was probably equally dangerous and hence another reason for prohibiting American pork. In this instance inquiry developed that fortunately the pork in question was from a hog raised and slaughtered in England.

In January, 1881, the United States Department of Agriculture was notified by the veterinary department of the Privy Council that fifty-nine head of cattle affected with foot-and-mouth disease had been landed at Deptford (London) from New York by the S. S. *France*. In a few days it was reported that 267 cattle from the S. S. *City of Liverpool* from New York had been similarly condemned. Other notifications were received and finally on March 23, with the condemnation of 371 cattle from the S. S. *City of Liverpool*, the manifestation of the disease among our animals stopped as suddenly as it had begun. Other condemnations were made at Liverpool and Glasgow in cattle shipped from Boston, Portland and New York.

As there was no foot-and-mouth disease in this country at that time,

and these reports tended further to react unfavorably against our export meat trade, Dr. Lyman was instructed to inquire into the reason for these reports in connection with his investigations in England. He soon discovered that the Deptford and Liverpool lairages were infected from diseased cattle from France in September, 1880, and that it was the habit of cattle shippers to bring back to the United States and use again headropes that had done previous service upon animals in the contaminated lairages at English ports. In this way the infection was conveyed to the cattle aboard ship on their way from American ports to England. It was also revealed that the *S. S. France* sailing from London for New York January 7, 1881, carried in addition to the mixed cargo of wool, hides, etc., two bulls and eight heifers, consigned to the American Horse Exchange, Ltd., in New York, which upon arrival January 21 were found to be affected with foot-and-mouth disease. These animals were quarantined for ninety days and we fortunately escaped an outbreak of the disease in this country.

On March 31, 1874, the canning of beef was commenced in this country by the Wilson Packing Company of Chicago. By 1880 we had developed a paying foreign trade in canned meats and cured pork. This invasion of foreign markets by our enterprising packers also met with opposition. In 1878-79 reports were received from foreign countries that our pork was considered dangerous to human health because it was heavily infested with trichinæ. The finding of trichinæ in these products was seized upon as a pretext for excluding our pork from the principal markets of Europe.

An investigation showed that some sections of this country were entirely free from the affection, and out of 1,889 hog carcasses examined only 2.7 per cent showed trichinosis. On inquiry it was learned that of 103,528 samples examined by the French inspectors only 2 per cent were found infected, and of the 97,750 samples examined by the German inspectors only 2.09 per cent were found affected. Out of a total of 298,782 samples that were inspected at home and abroad in 1880-81 only 2.1 per cent showed infection, which was much less than existed in the countries that placed an embargo upon American pork.

England, however, deferred declaring an embargo against American pork. In the report of the veterinary department of the Privy Council office for the year 1879 the following statements appear:

The inspectors of the Veterinary Department examined 279 separate portions of swine's flesh which were sent from Liverpool and detected living trichinæ in three specimens; . . . but it was not deemed expedient to prohibit the introduction of American pork into

this country, for the reason that such a measure would have damaged the trade without producing any satisfactory results. A large proportion of the objectionable meat would have been sent to this country by a circuitous route, and thus the object of the restriction would have been defeated, besides which, trichinosis among swine is known to exist in Germany, and it probably exists in other exporting countries, so that nothing short of a total prohibition of swine flesh in all forms from all foreign sources would have been effectual.

At this time our export trade was hampered by various impediments. Without good and sufficient reasons our cattle were excluded from European markets except English markets that were provided with facilities for slaughtering the cattle within a limited time at the port where they were landed, our pork products were excluded from the principal markets of Europe on a frail pretext, and we had no veterinary organization prepared to cope with this serious situation. It was apparent, too, that our Government should have veterinary representatives stationed in European countries, especially in England, our greatest foreign market.

TEXAS FEVER

Texas fever is one of the oldest of animal diseases and has been reported in France, Italy, Turkey, West Indies, Mexico, Central America, South America, Australia, Africa, Ireland, Finland, southern Russia, China, Java, Borneo, the Philippine Islands, and also along the Danube River in Rumania.

While our export cattle and meat trade was seriously hampered as a result of the existence of contagious pleuropneumonia in this country, the general livestock industry was being seriously affected by the ravages of Texas fever, hog cholera and other destructive animal diseases.

There appears to be no question that Texas fever was introduced into this country through importations of cattle from the Spanish colonies of the West India islands and Mexico. Although it is recorded that cattle were brought to our mainland from these sources as early as 1610, it is not known definitely when the disease first appeared in our colonies.

It seems that our first accounts of Texas fever did not come from those sections where it was generally supposed to be indigenous, but from localities where it had been carried by the movement of cattle from the South. Probably the earliest published account of the disease is a lecture delivered by Dr. James Mease on November 3, 1814 before the Philadelphia Society for Promoting Agriculture.

In his lecture Dr. Mease called attention to the ability of cattle from a certain district of South Carolina to carry the disease to all others with which they mingled in their progress to the North. As an illustration, Dr. Mease referred to a herd of cattle that was driven in 1796 from South Carolina to Pennsylvania, where the disease broke out in Lancaster County and other places. He had traced the outbreak to the southern herd and stated that the people of Virginia prohibited the passage of North Carolina cattle through that State; that these cattle infected others while they themselves were in perfect health, and that cattle from Europe or the interior taken to the sea-coast section of our country south of Virginia were attacked by the disease and it generally proved fatal. In a paper read before the same society, September 20, 1825, he said: "The circumstances of cattle from a certain district in South Carolina affecting others with this disease has long been known," but the precise locality, or its extent, he was unable to ascertain.

Mr. J. Wilkinson of Athens, Ga., reported to the Department of Agriculture in April, 1867, that cattle seldom contract the disease unless removed from where they were raised; that if they were taken from the mountain country to the low country, they soon took the fever and died without communicating the disease to the native cattle; that cattle taken from the low land into the elevated country continued to improve, while they communicated the infection to the animals with which they came in contact, but after remaining in the colder country for a time they lost the power of communicating the infection.

Little was known of this disease in the Northern States prior to 1866, although as early as 1795 the State Legislature of North Carolina passed a law requiring that—

No person shall hereafter drive any cattle from those parts of this State, where the soil is sandy and the natural production or growth of timber is the long-leaf pine, into or through any of the highland parts of the State where the soil or growth of timber is of a different kind, between the first day of April and the first day November in every year, under the penalty of four dollars for each and every head of cattle so driven, to be recovered and applied as before mentioned.

In 1814 the State of Virginia refused to allow the passage through the State of cattle from certain sections of South Carolina. A law was passed by the North Carolina legislature at its 1836 session to prevent the driving of cattle into the State from either South Carolina or Georgia between April 1 and November 1. Notwithstanding these

laws and their modification from time to time during the next forty-two years, the disease spread to the Blue Ridge Mountains and became planted even beyond this natural barrier. Its progress was likened by Mr. Lenoir, in his letter published in 1879, to the spread of ringworm, slowly advancing, with an angry external border line, and apparently dying away in the district over which it passed.

With the extension of settlements, the growth of the livestock industry and the development of markets and transportation facilities, it gradually spread over the entire South and frequently to different sections of the North, so that by 1877 it was the cause of much alarm throughout the country, and especially along the avenues of transportation and at the centers of the cattle trade. Along the routes where cattle from Texas and other Southern States were driven to northern markets they invariably left disease and death in their paths. By far the greatest losses seem to have been occasioned by driving Texas cattle through Missouri, Kansas, Arkansas, and Indian Territory, for distribution as feeders in various Western States. As far back as 1852 the "murrain" was reported destructive in Missouri, and from 1858 to 1861 it had increased to such an extent along the Texas cattle trails that Missouri in 1861 framed laws to regulate the movement of herds from the South. Other States soon followed the example of Missouri. The people in these States were aroused to great indignation because some Texas cattlemen persisted in driving their herds north, and armed parties confronted and turned back the invading herds. Such vigorous enforcement of the laws had a beneficial effect in preventing further losses.

The disease ceased in all of these border States during the war, but immediately after the close of the war, when the Texans again sought an outlet through Kansas and Missouri for their accumulated livestock, it reappeared. In order to avoid the hostile opposition met in the adjacent States, Texas cattlemen were forced to resort to shipping their livestock up the Mississippi River by boat. By 1867 Cairo, Illinois, had become the chief point of transshipment of cattle from steamboat to railroads. During the Spring of 1867, beginning April 23, about 30,000 cattle were landed at Cairo. Although most of these animals were butcher stock and went direct to the large abattoirs, the disease was spread to many native herds in southern Illinois. The river traffic continued to increase and in 1868 Texas cattle landed at Cairo were shipped eastward by train in large numbers and spread infection and consternation into the heart of the country from Illinois to Massachusetts.

The experiences of 1868 aroused the farmers of the North from their apathy and skepticism to a realization of the increasing dangers from the fever or "murrain" disseminated by southern cattle and the necessity for decisive and energetic action against it. State laws and regulations were enacted and strengthened from time to time, yet the border line of the infected area continued to advance steadily northward and frequent outbreaks occurred in many States, so that by 1879 cattle owners in many parts of the country were in the greatest consternation and alarm. Cattle were dying on every side. Men in the South who had invested their earnings in livestock to improve their herds after the Civil War saw their savings and hopes vanish together with the death of their highly prized animals, and they were powerless to prevent it. No one knew of an efficacious remedy. No one knew why only southern cattle communicated the plague and why it disappeared in the winter time. No one could understand how perfectly healthy southern cattle could convey such a deadly poison to northern cattle, while the northern animal sick with the disease seemed unable to communicate it to others. On every hand was doubt and uncertainty as to the cause of the disease, how it was disseminated, and how its ravages might be prevented. It was evident that medication proved of little benefit, and immunity from its fatal effects seemed to lie only in prevention if the way could be pointed out.

It happened that Dr. John Gamgee, an eminent authority of England, who had investigated animal diseases in various European countries, was in the United States in 1868 when an extensive outbreak occurred in Illinois. He was induced by the Pork Packers' Association of Chicago to head a commission consisting of himself, Dr. Blaney and W. E. Richardson, appointed to visit the localities where the disease had appeared and report on the matter. This investigation was begun on July 29, 1868, and continued until August 4. On August 5 Prof. Gamgee was requested to continue the investigations for the Department of Agriculture in other sections of the country. At the request of the Commissioner of Agriculture the Surgeon General of the Army detailed Doctors J. S. Billings and E. Curtis, Assistant Surgeons, U. S. Army, to assist Prof. Gamgee in his investigations and laboratory experiments. Mr. H. W. Ravenel, an eminent botanist of South Carolina, accompanied Professor Gamgee in the field work. The investigations were continued for ten months, when Professor Gamgee reported his conclusions as follows:

1. That southern cattle, especially from the Gulf Coast, are affected with a latent or an apparent form of the disease.
2. That they become affected in consequence of the nature of the soil and vegetation on which they are fed, and the water which they drink.
3. That their systems are charged with poisonous principles which accumulate in the bodies of acclimatized animals that enjoy immunity.
4. That southern cattle may be driven so as to improve in condition; and yet for some weeks, and probably not less than three months, continue to excrete the deleterious principles which poison the cattle of the States through which the herds are driven on their way north or west.
5. That all breeds of cattle in States north of those on the Gulf Coast, without regard to age or sex, if they feed on grass contaminated by southern droves, are attacked by the splenic fever; that the disease may be, but is very rarely, propagated through the feeding of hay.
6. That the disease occurs mainly during the hot months of summer and autumn, and never after the wild grasses have been killed by frosts, until the mild weather in spring returns; that then the grasses are healthy, and continue healthy, unless fresh droves of Texas or of Florida cattle are driven over the land.
7. That heat and drought aggravate the disease in individual animals.
8. That there is not the slightest foundation for the view that the ticks disseminate the disease.
9. That the splenic fever does not belong to that vast and deadly group of purely contagious and infectious diseases of which the rinderpest, the lung plague, and eruptive fevers are typical.
10. That it is an enzoötic, due to local influences, capable of only a limited spread, and analogous to or identical with the "black water" of various parts of Europe.
11. That, however warm the weather may be, cattle affected with splenic fever have not developed in their systems any poison like the anthrax poison; and that the flesh, blood, and other tissues of animals are incapable of inducing any disease in man or animals.
12. That splenic fever is not malignant typhus or typhoid fever. That it has no analogue among human diseases, but is, however, developed under conditions which prevail where the so-called malaria injuriously affects the human health.

In these conclusions Prof. Gamgee summarized the character and extent of our knowledge and views of Texas fever up to 1870.

In the autumn of 1879 Dr. D. E. Salmon, a promising young veterinary surgeon, was appointed by Commissioner of Agriculture Le Duc to investigate animal diseases in the Southern States with particular reference to Texas cattle fever. Dr. Salmon pursued his investigations in the laboratory and field with characteristic zeal and skill. Much time and effort were devoted to a study of the nature of the disease and the character of the contagion, how the infection is spread and preserved from season to season, how it is taken into the system, why animals though exposed did not sicken usually until after the middle of July, etc. Diligent efforts also were made to

ascertain the boundaries of the permanently infected area, the rate at which the northern boundary line was moving north, and the amount of losses along the slowly advancing line. Although the cause of the disease was not determined, much of practical benefit was learned through these early investigations of Dr. Salmon.

The cattle tick, with which southern cattle were generally infested, had for a number of years been suspected by cattlemen as being intimately connected with the spread of the disease. Prof. Gamgee states in 1868 that "the tick theory has acquired quite a renown during the past summer, but little thought should have satisfied anyone of the absurdity of the idea." In his report to the Secretary of Agriculture in 1869 Mr. J. R. Dodge, the Statistician of the Department of Agriculture, said: "Many believe the ticks which infest the North Carolina cattle and were communicated to the natives attacked, caused the disease. There is no evidence that these parasites have anything to do with its diffusion or virulence."

In his report to the Commissioner of Agriculture in 1880 Dr. Salmon said: "The tick theory scarcely explains a single one of the many peculiar phenomena of the disease." Scientific men generally were inclined to regard the tick theory as absurd. However, Dr. Salmon's observations had satisfied him that infection resulted when susceptible animals were allowed to graze on the trails of cattle from the South or in pastures occupied by them. His field investigations led to the further conclusion that in order to protect the cattle industry of the North from repeated invasions of the disease from the South it would be necessary to establish a quarantine line between the infected and free areas and regulate the movement north of all cattle originating below this line. He directed his work accordingly, and by the end of 1883 had succeeded in locating about 200 miles of this line extending from the Atlantic Coast west through the State of Virginia.

The plan of establishing a quarantine line was heartily approved by those who were engaged in the cattle industry north of the infected area. But in order to carry it into effect funds were needed, laws were necessary that would absolutely prevent the movement of cattle from the infected sections except under safe restrictions, and to carry out the plan successfully would require an efficient national organization. Hence the conditions that confronted the National Government in 1883 in connection with the investigation and control of Texas fever indicated the need of a strong veterinary organization under the

National Government with authority to regulate the interstate movement of southern cattle, and was an important factor leading to the establishment of the Bureau of Animal Industry on May 29, 1884. However, this Act of Congress, which in addition to establishing the Bureau of Animal Industry, provided means for the suppression and extirpation of pleuropneumonia and other contagious diseases among domestic animals, specifically provided—

That the so-called splenic, or Texas, fever shall not be considered a contagious, infectious or communicable disease within the meaning of sections four, five, six, and seven of this Act, as to cattle being transported by rail to market for slaughter, when the same are unloaded only to be fed and watered in lots on the way thereto.

HOG CHOLERA*

In urging his recommendation on Congress in 1868 that a Division of Veterinary Surgery be created in the new Department of Agriculture, which had been established by the Act of Congress of May 15, 1862, and commenced its operations as a separate and independent department July 1, Commissioner Horace Capron said:

The prevalence of fatal maladies among all varieties of farm animals, resulting in the annual loss of not less than \$50,000,000, demands the prompt attention of this Department, the vigilance of the Agricultural Association, and National and State legislation.

Although for several years previous there had been a gradual increase in the losses from various animal diseases, the recommendation of Commissioner Capron was prompted especially on account of the despondency among swine breeders at that time due to the increasing prevalence of hog cholera and their inability to protect themselves against the ravages of this persistent, destructive plague.

This malady is said to have made its first appearance in this country in the State of Ohio in 1833, where it received the name of hog cholera, which is a misnomer. It was not a new disease, as it had long been known in Europe, where it was classed with the malignant anthrax affections of animals. By 1853 no less than 90 separate areas of infection were known to exist and the malady was becoming very much dreaded by the breeders of swine. Dr. George Sutton and Dr. E. M. Snow were prominent among those who from 1858 to 1862 devoted time and study to this disease, but as the real character and cause of the disease were not then known, their work did not result

* See "Biochemie Division," page 158, and Division of Hog-Cholera Control, page 304.

in any great benefit in lessening either the spread of the infection or the losses resulting from it.

In 1867 it was reported that from 15 to 60 per cent of the swine in many of the infected counties had died of the disease, resulting in a monetary loss that year of not less than \$15,000,000. In some sections the mortality was so high that it resulted in practically destroying the swine industry in those sections, and the discouraged swine breeders were not disposed under existing conditions to undertake it again.

In his report to the Commissioner of Agriculture for the year 1875, J. R. Dodge, the Department Statistician, says: "It is very probable that \$100,000,000 represents scarcely more than the annual losses of farm animals from disease and neglect, of which half could undoubtedly be saved by efficient means of cure and prevention." The following year (1876) the total monetary loss from hog cholera and all other swine diseases was estimated to be about \$23,500,000, and hog cholera was responsible for by far the greater part of this loss, probably 90 per cent.

The report of the Statistical Division of the Department showed that in 1879 more than 34,000,000 hogs were produced in this country, which was greatly in excess of the number of any other class of food animals produced that year. The rapidly growing export trade in hog products had a stimulating effect on our swine industry, and there was a general feeling that veterinary science should direct its energies to discover some means for the protection of this important industry against the losses from hog cholera. Appeals were made to the National Government for assistance not only on account of the heavy losses sustained by the farmer but also to protect our export trade.

Reports of the existence of cholera and trichinosis in American hogs purposely spread in European countries had been seized upon in the early part of the year 1879 as pretexts for prohibiting the entry and sale of our salted and smoked meats to markets where the business had been remunerative. Some work of an investigational nature had already been undertaken but not in time to avert the embargoes against our products. Congress had appropriated \$10,000 in 1878 for the investigation of animal diseases. Agents were appointed for a period of two months to make investigations of hog cholera during the fall in New York, Indiana, Iowa, Kansas, Mis-

souri, North Carolina and Virginia, and Dr. Detmers was returned to Illinois to continue the work he had begun in the fall and winter of 1877. The appropriation was renewed each year thereafter and was increased as the exigencies of the work demanded.

The most important results were obtained through the investigations of Dr. James Law in New York, Dr. H. J. Detmers in Illinois, and Dr. D. E. Salmon in North Carolina and Washington, D. C. In 1878 Dr. Detmers announced that he had discovered the micro-organism of hog cholera and named it "bacilli suis." Dr. Detmers's discovery agreed with the findings of Dr. Edward E. Klein, an eminent authority officially connected with the Medical Department of the Local Government Board of England.

The investigations of Dr. Salmon in 1879 and 1880 led him to suspect a "micrococcus" as being the causative agent of the disease, and he stated his reasons for this opinion in his official report covering his research work in 1880. A repetition of his observations and experiments in 1881 corroborated his findings of the previous year, and he was supported in his views by Professor Ménégnin. In 1880 Dr. Detmers expressed the opinion that he probably had given a faulty name to his bacillus and should have called it "swine plague schizosphitæ" instead of "bacilli suis."

The scientific work with this disease was carried on energetically, but up to the close of the year 1883 no additional discoveries of great importance had been made, the cause of the disease was in dispute, and no one had offered a remedy that proved of much value. Our pork had been excluded from important European markets and it was evident that in order to establish confidence abroad it was necessary to inaugurate a national veterinary service in this country comparable to the service that existed in the most progressive foreign countries. Thus hog cholera was another important factor that indicated the need for the establishment of the Bureau of Animal Industry.

ANIMAL TRANSPORTATION*

(Domestic and Foreign)

With the development of railroad and water transportation facilities, trailing gradually gave way to the more modern and rapid methods of moving livestock to market. In some respects this change was an improvement while in others it was not. The cars and yards for

* See "Quarantine Division," page 139.

handling livestock were crude in the early history of the railroads compared with modern equipment, and the cruel practices in handling animals in transit resulted in much criticism and many protests from various sources.

All authorities agreed that the transportation of these animals by rail and boat was attended with great suffering to the animals from want of feed, water and rest; also from overcrowding, and the crowding of smaller animals under the larger in the same cars so that many of them died in transit, many more became diseased, and the loss in weight was heavy. In 1870 a bunch of 194 cattle was shipped from Brigham Young's farm in Utah to Chicago, and it was chronicled in the Chicago papers as a remarkable fact "that in riding 1,500 miles the shrinkage was only 210 pounds a head."

Between Indianola, Texas, and New Orleans, La., cattle were carried on steamers, under deck, in crowded condition, with poor ventilation, four and five days and sometimes more without feed or water. In one instance reported, out of 150 cattle shipped forty died on the short voyage.

Dr. Manheimer, of the Chicago Board of Health, in a letter from Texas in December, 1869, wrote as follows:

I would be astonished to find Texas cattle in good condition upon their arrival at their places of destination. The manner in which they are crowded on ship board and cars, after being exhausted by hurried journeys over the immense prairies of Texas, necessarily develops any latent germs of disease and may cause disease in the healthiest cattle. For instance, thousands are shipped to New Orleans from Indianola and Lavacca, a journey of from three to six days, during which they receive neither food nor water. At New Orleans they are transferred to boats for Cairo, and thence by rail to Tolono, Ill. During the entire trip they have food and water but about three times.

The people of Boston were aroused by criticisms of the cattle transportation and reports of diseased meats found in their markets, and in April, 1871, a joint special committee of the Aldermen and Common Council was appointed to collect information and to ascertain what legislation was necessary to protect the public health. In a communication to this committee the *Chicago Live Stock Reporter* said:

There is great cruelty in transportation. Cars are terribly overcrowded, and animals are carried great distances without food or water. The result is that they are taken out of the cars at Chicago with bruises and sores, and legs and horns are broken; many of them dead and more almost dead; and sometimes cattle and hogs, and sometimes cattle and sheep, are packed in the same car which re-

sults in the smaller animals being trampled upon by the larger. The men employed to drive them into the cars (at Chicago) are armed with saplings weighing often from eight to ten pounds, with sharp spikes or goads at the end. They rush upon the cattle, yelling, swearing, and punching them with these spikes often twenty, thirty, or forty times, taking little care to avoid the eyes. Eighteen to twenty cattle are thus forced into thirty-foot cars, giving less than two feet space to the animal and not unfrequently smaller animals—calves, sheep and swine—are crowded under them. In this way they are often carried for days without food, water or possibility of lying down.

It appeared that this same system of loading and transportation prevailed over the United States, as similar reports were received from many livestock shipping points.

The Massachusetts Railroad Commissioners in their report of January, 1871, said:

The shrinkage between Chicago and Boston is estimated to be from ten to fifteen per cent. Cattle trains yield the road to most others, and pass hours on sidings; the animals are without food or water, and often with insufficient ventilation in summer or shelter in winter; they are jolted off their legs and then goaded till they struggle up, for they cannot be permitted to lie down; they thus arrive at destination trampled upon, torn by each others' horns, bruised, bleeding; having in fact suffered all that animals can suffer and live. The whole system of cattle transportation in the United States as at present conducted is an outrage on the first principles of humanity.

These are examples of the scathing criticisms of the cattle transportation in 1871. Their publication from time to time aroused great indignation and finally resulted in the introduction of a bill in Congress in 1871 to regulate cattle transportation. This bill was finally passed and became a law known as the Twenty-eight Hour Law, March 3, 1873. It provides that livestock while in the course of interstate transportation shall be unloaded for food, water and rest every 28 hours, or every 36 hours when the owner, in writing, authorizes their confinement in the cars for the latter period. It further provides that the unloading shall be performed in a humane manner into properly equipped pens, where the animals must receive proper food, water, and at least 5 consecutive hours of rest before reloading. A penalty of \$100 to \$500 is provided for violations of this law by the carrier.*

The steamship transportation of export cattle was almost as vigorously criticised and condemned as the methods employed in moving animals by rail. Commissioner of Agriculture Le Duc in his report

* See "Field Inspection Division," page 301.

to Congress in 1880 called attention to the heavy losses sustained by export shippers and the discrimination in insurance rates as a result of these losses on cattle exported from the United States as compared with those shipped from Canada. The losses at sea were due to improper care and handling of the animals while in transit from the point of origin to the seaport and the faulty equipment of the steamships engaged in this branch of the export trade.

The following quotation from the report of the Commissioner of Agriculture for 1880 gives an idea of the extent of the losses sustained by cattle exporters:

July, 12,137 cattle shipped to Liverpool, 114 died on the ocean voyage.

August, 9,464 cattle shipped to Liverpool, 272 died on the ocean voyage.

September, 10,826 cattle shipped to Liverpool, 619 died on the ocean voyage.

The insurance rates on cattle from Montreal in August was 2¼ to 2½ per cent and from Boston 3 to 6 per cent.

In September the rates on American cattle from Boston were raised from 5½ to 10 per cent.

The rates of insurance were based on actual experience, and the question suggests itself, What was the difference in the experience of insurance companies between Canadian and United States shipments? This difference was attributed to a proper veterinary inspection at Canadian ports under proper laws, both of which were rigidly maintained by the Canadian Government. The United States insurance companies themselves finally resorted to employing veterinarians to inspect the animals to be insured and would accept no risks on cattle unless they were inspected and passed by their inspectors.

In his recommendation to Congress in 1880 the Commissioner of Agriculture said:

The remedy is plain, and already indicated by the methods of the Canadian Government, viz, proper laws properly executed; which can be made so that while no injustice is done the southern breeder they will protect the interests of the western, northern and eastern breeders, traders and shippers.

It was urged that "laws should be enacted even though we may be unable at first to effectively enforce them," to prevent cruelties to animals in the course of transportation and to protect the interests of those engaged in interstate and export cattle trade.

The twenty-eight hour law was passed March 3, 1873, but as time passed it became more and more evident that a strong national veteri-

nary organization, provided with funds and clothed with authority, was needed to enforce it. The Department of Agriculture had neither the means nor the authority to take charge of the administration of this law.

The losses of American export beef cattle on the ocean voyage was a subject that received a great deal of attention in the public press. The conditions aboard ship and the cruelties perpetrated on those dumb, helpless animals were usually exaggerated in our own papers and were intensified abroad by the evident desire to limit American competition. Here again was the need of laws to regulate and protect the export cattle trade and of a competent veterinary organization to administer the laws.

Thus the demands for regulating and supervising both the interstate and export transportation of livestock to prevent cruel practices and the deterioration or disease of the animals the flesh of which was to be used for food, further indicated the need of a Bureau of Animal Industry.

MEAT INSPECTION*

A Growing Demand

The sufferings and cruelties to which animals were subjected in transportation resulted in deterioration and disease which affected the wholesomeness of the meat for food. This, together with the existence of hog cholera, Texas fever, and other prevalent animal diseases, aroused a sentiment in favor of laws and the adoption of measures in their enforcement looking to the protection of the public health.

As early as 1861 Dr. E. M. Snow, in a report on the prevalence of hog cholera, said:

It is also interesting to all classes of the community on account of the relations of this disease to epidemic diseases which afflict the human race, and on account of its effects upon the supply of animal food for cities.

The Cattle Commissioners of New York in their report for 1869 said:

By the 8th of August, 1868, it became apparent to the Metropolitan Board of Health, in New York City, that the alarming increase of obstinate and fatal diarrhoea in the Metropolitan District was caused by the use of diseased meats. There was revealed to the Commissioners such an amount of reckless barbarity toward animals, and criminal indifference to the public health on the part of many who furnished meat to consumers, that one almost wonders how the city has escaped a pestilence.

* See "Meat Inspection Division," page 255.

The Massachusetts State Board of Health in their report of January, 1871, said that "meat taken from diseased cattle should be condemned, and no meat should be put into the markets without thorough inspection."

Mr. Horace W. Jordan, member of the Brighton Board of Health, testified before a Boston committee in 1871 as follows:

I think it would be an excellent thing if the public could know what comes from Chicago. The public are imposed upon by meat from Chicago, and I think they will be more. At Chicago all the poor cattle, bulls, stags, and everything disagreeable is picked up, etc. This is what you get from Chicago and when the meat is examined here it is almost impossible to tell whether the animal was diseased.

Mr. George T. Angell, President of the Massachusetts Society for the Prevention of Cruelty to Animals, in an essay on Cattle Transportation in 1871, said:

But the question which at once suggests itself is, what security have we that animals slaughtered in Chicago were in good shape there? What security that we may not be eating the meats of diseased animals, which because they could not be brought further alive, were slaughtered there?

Mr. Angell then suggests as a remedy:

First by informing and arousing public opinion, and carrying information upon the subject to the various persons and corporations especially interested; and second, by the enactment and enforcement of stringent laws (upon the necessity of which all will agree), for the careful inspection of all animals slaughtered in the neighborhood of our large cities, and of all meats while being dressed for market, and before they are offered for sale.

The health officer of the Board of Health of Chicago, in February, 1871, reported that "nearly one-half of all the beef, pork and mutton offered for sale in that city was damaged, and poor from disease and unfit for food."

In 1870 Commissioner of Agriculture Horace Capron said, in urging the establishment of a veterinary division in the Department of Agriculture: "The value of stock lost annually from disease is enormous and threatens not only to decimate our animals but to expose the human family to disease from the consumption of unwholesome meats."

Commissioner Le Due in recommending to the Congress the establishment of a Division of Veterinary Science in the Department of Agriculture, said: "The health of the people and the maintenance of their large and valuable foreign trade in cattle now grown into an important factor of commerce, alike call for prompt action in the matter in the direction here indicated."

Dr. D. E. Salmon, in his report to the Commissioner of Agriculture in 1883, said:

Again it is asserted that many cattle affected with Texas fever are killed and their flesh sold as food in the public markets and consequently the local boards of health feel inclined to entirely prohibit the entrance of such cattle within their jurisdiction. Such a restriction necessarily acts as a double hardship. It prevents the people in these cities from obtaining the only really good and well-fatted beef that comes to them and it withdraws the best markets that have heretofore been open to the cattle-raisers of a large section of the country.

The demand for protection of the public health in preventing the sale of unwholesome meats was followed in some of the larger cities by the establishment of a local meat-inspection service under the supervision of boards of health. This service was conducted with varying degrees of success and satisfaction. In addition to the need for a better protection of the public health in our own country, it was becoming apparent that in order to establish confidence abroad in our export meats it would become necessary eventually to be able to certify their wholesomeness and freedom from disease. There was some discussion of this subject when our meats were excluded from foreign markets, but up to 1883 no action had been taken. The need for a national system of meat inspection indicated the necessity of proper laws and a veterinary organization such as our present Bureau of Animal Industry to enforce them.

QUARANTINE AGAINST FOREIGN IMPORTATIONS OF LIVESTOCK

The protection of our rapidly growing livestock industry against invasions of destructive foreign diseases was a duty that devolved upon the National Government. No steps were taken in this direction until 1865, when rinderpest for the second time made its appearance in England.

The first Federal legislation on this subject, entitled "An Act to prevent the spread of foreign diseases among the cattle of the United States," was passed at the first session of the Thirty-ninth Congress, December 18, 1865. Under this law the importation of cattle was prohibited, and the act was amended on March 6, 1866, to prohibit also the importation of the hides of neat cattle. The Secretary of the Treasury was charged with the responsibility of promulgating appropriate regulations to carry the law into full and immediate effect. This law was enacted as a part of the Revised Statutes in 1874. The first prohibition under this law was issued July 31, 1875, by the Secretary of the Treasury against the importation of neat cattle and the hides

of neat cattle from Spain on account of the prevalence of foot-and-mouth disease in that country. This order remained in effect until October of that year. A similar order was issued November 3, 1875, against importations from Great Britain and Ireland on account of another outbreak of foot-and-mouth disease in those countries. This order, however, was modified March 16, 1876, to allow the importation of "blooded stock" from Great Britain and Ireland when accompanied by a certificate issued by a United States consular officer to the effect that such animals were at the date of shipment in a sound and healthy condition.

On receipt of information from authentic sources that contagious pleuropneumonia existed in England the Treasury Department on February 26, 1879, issued an order closing all Atlantic seaports to English cattle until otherwise ordered. This prohibition against England was modified the following July 19 so as to permit importations from English ports, provided all cattle imported were kept in quarantine ninety days on arrival under the supervision of customs officers, "except where State or municipal laws provided for the quarantine of such cattle, and in such cases collectors will permit the proper officers to quarantine them in such manner as the State or municipal authorities require."

Notwithstanding the existing laws administered by the Secretary of the Treasury, foot-and-mouth disease gained entrance to the United States in 1870, and it is surprising that it did not spread itself over a greater area than it did. The disease was brought to this country by cattle shipped from an English port in August, 1870. The cattle showed signs of the disease when two days at sea, passed through the worst stages on the ocean, but conveyed the infection to the stock among which they were placed on their arrival in Canada. Its existence in Oneida County, New York, was reported in September, 1870, about the time of the State agricultural show at Utica, and it was believed to have been brought there by Canadian cattle exhibited at the show. At the time, some were of opinion that it was first brought to the Albany stockyards by Canadian cattle. At different times from November 15 to December 7 it was brought into Dutchess County, New York, by five separate droves from the Albany yards. From Dutchess County, New York, the infection was conveyed into Connecticut and spread to New Milford, Sherman and Kent. Another drove from Albany carried it to the valley of the Connecticut River, where it spread to five townships. Also it was an Albany shipment that infected the stockyards at Brighton, Mass., from where it spread

over a considerable area around Boston and into the State of New Hampshire.

In the early part of 1871 the disease still lingered at several points in New England, but it disappeared before the end of the year. The mild form of the disease, the lack of railroad and steamboat transportation facilities in New England, the drift of the cattle trade toward the Boston market, and the severity of the winter weather that year were favorable conditions that assisted in eliminating this outbreak without the necessity of resorting to slaughter of infected herds.

Again we were very fortunate in escaping an extended outbreak of foot-and-mouth disease from the importation of two bulls and eight heifers that arrived at the port of New York from England on the *S. S. France*, January 21, 1881, and were quarantined in that city for a period of ninety days.

Generally there was a lack of confidence in the ability of the Treasury Department to administer efficiently the quarantine laws. It was felt that the officials of the Treasury Department did not possess a sufficient knowledge of animal diseases and that such matters should be placed under the supervision and direction of competent veterinarians. Some of the orders of the Treasury Department were criticized severely in the public press, as, for instance, the order of July 19, 1879. In referring to this order in the August, 1879, issue of the *National Live Stock Journal*, Dr. James Law said: "On the basis of these facts the Treasury Department should at once exclude all importations, either direct or by way of Canada, not only from England but from France, Belgium, Holland and Germany."

The editor of the *National Live Stock Journal* in the August, 1879, issue said:

The Treasury Department has promulgated orders that have been so silly as to excite the ridicule of the whole country. It has closed our Atlantic ports against importations of cattle from England but has left an open door for such importations by way of Canada; and while this ridiculous show of surveillance has been kept up over importations from one country only, no attempt has been made at supervision over those from other European countries that are known to be the very hot beds of plague and contagion.

Such criticisms, together with the action of the Privy Council of Great Britain in discriminating against American cattle by requiring them to be slaughtered at the port of landing, led to the appointment of the Treasury Cattle Commission, consisting of Prof. James Law, Dr. E. F. Thayer and Mr. J. H. Sanders. Funds were appropriated by the Act of Congress of March 3, 1883, for the purpose of establishing quarantine stations at ports along the Atlantic coast for the de-

tention of imported cattle. The Cattle Commission directed its attention to locating and developing these stations at Portland, Me., Boston, Mass., New York, N. Y., and Baltimore, Md.

An order was issued by the Secretary of the Treasury, July 30, 1883, requiring that all neat cattle from any part of the world except North and South America be held in quarantine at the station at the port of entry for a period of ninety days.

The appointment of the Treasury Cattle Commission was recognized as a step in the right direction, but as the members of the commission acted in an advisory capacity to the Treasury Department in connection with their regular vocations, the conditions were not yet entirely satisfactory. In addition to the inspection immediately on landing of all animals imported, there was evident need for the inauguration of a system of inspection at the port of embarkation of all animals intended for export from this country; also there was need for a close supervision over fitting vessels engaged in the export cattle trade and the care of animals on the sea voyage. In order efficiently to carry out such a system of inspection and supervision, law, funds, and a larger veterinary organization were needed. These conditions also were important factors leading to the establishment of the Bureau of Animal Industry.

OPPOSITION TO THE ESTABLISHMENT OF THE BUREAU

It was estimated that on January 1, 1883, there were on the farms of this country 10,838,111 horses, 1,871,079 mules, 41,171,762 cattle, 49,237,291 sheep and 43,270,086 hogs, or a total of 146,388,329 animals valued at \$2,338,241,519.

The growth of the livestock industry had been rapid and enterprising stockmen were continually improving our breeds through importations of the choicest animals gathered from the best herds and flocks of the Old World. The glowing prospects of an extensive export trade in animals and their products gave an impetus to the livestock industry and brought our people to realize more fully the importance of this profitable phase of agriculture.

But up to 1883 the livestock industry had been left to drift without much beneficial assistance from either State or National Governments. Contagious pleuropneumonia had existed along the Atlantic Coast for fifty years. From 25 to 30 million dollars' worth of hogs were dying each year from hog cholera. Sheep raising had become precarious in many sections because of scab and other parasitic diseases. Tuberculosis and contagious abortion were spreading. Anthrax and

blackleg were on the increase in most of the States. Cattle raisers were in a state of consternation from fear of Texas fever. The causes of the most destructive animal diseases were unknown or in dispute, and livestock owners were defenseless, as veterinary science had not been able to provide effectual prophylactic or medicinal treatment. Vexatious and expensive quarantines were increasing for protection and retaliation. Our system of interstate and export animal transportation was denounced as a disgrace and an outrage on the first principles of humanity. There was a growing demand for protection of the public health in connection with the meat supply. Our export cattle and sheep were denied admission into Great Britain and were condemned to slaughter within a limited time on the docks where they landed, and our pork had been prohibited entrance into most of the markets of continental Europe.

There was urgent need of reliable official information concerning the nature and prevalence of animal diseases and of the means required to control and eradicate them. To meet this need the Veterinary Division of the Department of Agriculture was established in 1883. Dr. D. E. Salmon was appointed chief of the new Veterinary Division, and a farm consisting of seven acres of land was secured at Benning Road, near Washington, D. C., to be used as an experimental station.

It soon became apparent to the livestock men of the country that the necessity of having an efficient executive agency to carry into effect laws and regulations essential to control and eradicate disease and to protect the rapidly developing animal industry at home and abroad had become an even more pressing necessity than the research work. The injurious conditions from the prevalence of animal diseases and the unfavorable status of our export cattle and meat trade became so burdensome and annoying and aroused such grave apprehensions for future contingencies that there were vigorous agitation and insistent demands for governmental assistance which finally culminated in the Act of Congress of May 29, 1884, establishing the United States Bureau of Animal Industry.

Desirable as we now know a central executive veterinary agency to be for the development, protection and extension of the livestock industry, the bill creating the Bureau of Animal Industry did not get through Congress without serious opposition. There were lawmakers jealous for the rights and powers of the States, who feared that a strong Federal bureau would infringe upon the authority of the States. They contended that such matters should be left to State

action, notwithstanding the fact that with the exceptions of Massachusetts and Connecticut no State had been able to cope effectively with contagious pleuropneumonia. The familiar question of constitutionality was raised. There were also those who saw in the proposed organization nothing but an army of jobholders or a political machine, and some objected to the expense. Even the presence of pleuropneumonia in the United States was doubted and questioned. The veterinary profession, then struggling for recognition in America, came in for ridicule, and objection was made to having a "horse doctor" at the head of the proposed bureau.

The bill was championed on the floor of the House of Representatives by Hon. William H. Hatch, of Missouri, then chairman of the Committee on Agriculture. Patiently Mr. Hatch explained the various features and provisions of the bill; skilfully and often with a touch of humor he met objections; forcefully he urged the importance of the measure. Some of his remarks in defense of the veterinary profession deserve to be quoted in this connection. In answering a critic he said:

I desire to present to the House for its consideration a short sketch of a few so-called "horse-doctors." This is not the first time that on this floor, when presenting some bill or resolution from the Committee on Agriculture, I have had to meet sneers and jeers and epithets in place of arguments. I have heard gentlemen apply to this bill the terms "granger," "cow bill" and every other epithet that could be invented to injure it. I do not, however, ask any immunity from such treatment. I stand here ready to properly resent such sneers, and to defend the committee, of which I have the honor to be the chairman, a committee that has entrusted to its charge the interests of that great class who in numbers constitute one-half of the people in this country, and who embrace one-half of its wealth. Let gentlemen who wish to defeat a measure which is designed for the benefit of the great agricultural interests of this country try to sneer it down if they choose by calling it a "horse-doctor bill." Who are the "horse-doctors" of this age? I feel assured that the gentleman, if he had read a little recently upon this subject, would not have started out on that line of argument.

Henri Bouley, a veterinarian, and formerly professor at the Alfort Veterinary School, is today the leading scientific man of France. He has had every honor accorded to him that a scientific man can hope to obtain. He has been president of the Paris Academy of Medicine and of the Academy of Sciences, and is a member of the French Institute. He was the first, the most able, and the most persistent advocate and exponent of the investigations and discoveries of Pasteur. And although he took up the contest in the Academy of Medicine almost singlehanded against the leading scientists of France, he has been uniformly successful, is looked upon as the most powerful debater and writer of the day, and within a few years has produced a revolution in the medical views of his country so far as concerns the subject of contagious diseases. He has lately attracted much attention as the advocate of the free admission of American pork, and is doing more than almost any one else to show

the frivolous character of the objections that have been brought against it.

Professor Chauveau, director of the Veterinary School of Lyons, a life-long veterinarian, is the most accomplished anatomist, physiologist, and investigator of the time. His work on the anatomy of domestic animals is used the world over, not only by veterinarians but by scientific naturalists. He was the first to demonstrate that contagious diseases are caused by living germ; in this he leads Pasteur and Koch by several years. He has made more original investigations and more important discoveries than any man who has ever worked with contagious diseases, and it is conceded by all that he has no peer for the clearness with which he marks out his lines of research and the satisfactory and convincing character of his experiments.

Professor Colin, of the Veterinary School of Alfort, is one of the most eminent physiologists, and is author of a work on animal physiology which is used and quoted wherever science is studied.

Arloing, Cornevin, and Thomas, three young veterinarians, associated themselves together a few years ago to study the disease known in this country as black-quarter, a very destructive malady of young cattle. They discovered the germ which causes the disease, learned the drugs and chemicals most fatal to it, and succeeded in preventing it by a peculiar method of vaccination. Their whole study of the nature and character of the disease is remarkable for its ability and success. Such a thorough and scientific investigation of a contagious disease has never been made in all the history of human medicine.

Professor Toussaint, of Toulouse, has the reputation of being the most brilliant of the young scientific men of France. He discovered the germ of fowl cholera, which enabled Pasteur to make his world-renowned discovery in regard to vaccination for animal diseases. He also originated the method of attenuating or weakening a virus by heat, so that it could be used for preventing the disease by vaccination.

Besides these, the names of Ménégnin, Leblanc, Degive, Trasbot, Magne, Zundel, Lefosse, Delafond, Nocard, and many others are known not only as veterinarians but as scientists and authorities on the great medical questions of the day.

In Germany and Austria the names of Roloff, Spinola, Johne, Franck, Gering, Hertwig, Roll, Feser, Schmidt, Adam, Harms, and Wehenkel are as well known as scientists as they are as veterinarians.

In England, Fleming has made a reputation by his veterinary writings, which makes his name familiar to every student of medical science. It is often remarked by leading physicians that the medical profession has nothing that can be compared to the two volumes of Fleming's on the Origin, History and Prevention of Animal Plagues. His manual of Veterinary Sanitary Science and Police and other special works are equal either from a literary, scientific, or practical standpoint to the best that the members of any profession have ever produced.

Williams, Walley, Robertson, Brown, Steele, and Axe are all acknowledged to be scientific and very able men.

Besides the veterinarians mentioned above, many physicians and scientists have made their reputations by studying the diseases of animals. Among these are Pasteur, Koch, Klebs, Bollinger, Burdon-Sanderson, and Klein.

Coming to America, we find that in spite of the admitted fact that the most destructive diseases of people can never be thoroughly understood until more is known of the diseases of animals; in spite of the annual loss of more than \$50,000,000 from preventable diseases

among animals in the United States, the veterinary profession has been held in the background, discouraged and sneered at by those who should have assisted and defended it. Even in the Congress of the United States, which is supposed to represent the intelligence and the most progressive sentiment of the country, such terms of reproach and scorn as "horse-doctor" and "scientific cranks" are hurled at those who are trying to prevent these enormous losses from falling on the livestock industry and to assist in throwing light on the most destructive plagues of the human race.

A few men have been brave enough to face the sneers and derision and the loss of social position which in the early days of the profession were about the only rewards which they received for a life-long devotion to the interests of their country and to the cause of humanity. The American veterinary profession, though fewer in numbers, begins to rank in ability and scientific attainments with any in the world.

Professor James Law, of Cornell University, a native of Scotland, and educated in the best schools of Europe, was selected because of his great attainments to head the veterinary department of Cornell University, and has been one of the best known professors of that institution since 1868. In 1870, when the dreaded foot-and-mouth disease was introduced into the State of New York, and when the cattle interests of that great State were threatened with the most terrible losses, all were but too glad to seek information from this veterinarian. Again, when in 1878 Congress made its first appropriation for investigating the destructive diseases of swine which were discouraging the farmers over vast sections of the country, Professor Law was called upon to mark out an intelligent line of investigation. In 1879 the veterinary direction of the work for stamping out pleuropneumonia in New York was placed in his hands, and after clearing the greater part of the infected district in that State of the disease he was obliged to stop for want of funds.

Professor A. Lioutard, a native of France, is well known as the head of the American Veterinary College in New York, and is an eminent scientific man.

Dr. Charles P. Lyman, formerly veterinarian of the Department of Agriculture, has been selected by Harvard University as a proper person to organize a veterinary department in that institution.

Dr. R. S. Huidekoper is another well-educated veterinarian selected by the University of Pennsylvania to organize a veterinary department in that institution.

Dr. Salmon, the present veterinarian of the Department of Agriculture, is a graduate of Cornell University. He studied also at the leading veterinary school in France, and has long been widely known in this country as a correspondent of our leading agricultural journals and as one of the very few men in the world who have successfully investigated contagious diseases.

Besides these there are a considerable number of educated and practical veterinarians in this country who have been of great value to the owners of domestic animals.

It is true the profession is still small, but it is rapidly growing; it has fought its way against every obstacle and discouragement; its members have sought education and knowledge in every department of science and in every language where assistance was to be found; and the appreciation of its usefulness, beginning with the masses, has permeated all classes of our society, until praise and favor have taken the place of contumely everywhere with the single exception of the House of Representatives of the United States.

Dr. Salmon, the present veterinarian of the Department of Agriculture, whose exhaustive report is embodied in the report made

by the Committee on Agriculture accompanying this bill, contains the latest information on the subject of pleuropneumonia, its existence and spread in the United States. That paper is published in the *Record*, and as an exhibition of scientific knowledge and research as well as literary composition, will compare favorably with the effort of any gentleman who has spoken for or against this bill.

The strength of the opposition and the closeness of the contest is shown by the vote by which the House of Representatives passed the bill, 155 to 127. The bill also passed the Senate, and on May 29, 1884, it received the approval of the President.

PART II.

Forty Years of the U. S. Bureau of Animal Industry

The U. S. Bureau of Animal Industry came into existence on May 29, 1884, with the approval of the Act of Congress entitled "An Act for the establishment of a Bureau of Animal Industry, to prevent the exportation of diseased cattle, and to provide means for the suppression and extirpation of preuropneumonia and other contagious diseases among domestic animals."

The title of the act indicates the immediate purposes for which the Bureau was established. It is specified in the act that a competent veterinary surgeon should be Chief of the Bureau, that the force should not exceed twenty persons at any one time, that the Commissioner of Agriculture was authorized to appoint two competent agents who should be either practical stock raisers or experienced in livestock business matters, that it should be the duty of the Commissioner to prepare such rules and regulations as he deemed necessary for the speedy and effectual suppression and extirpation of pleuropneumonia and other contagious, infectious and communicable diseases, that the Commissioner of Agriculture should cooperate with the Secretary of the Treasury in establishing regulations governing the transportation and exportation of livestock, that transportation companies were prohibited from accepting for transportation animals affected with any contagious, infectious or communicable disease, and the sum of \$150,000 was appropriated to carry the law into effect.

THE ERADICATION OF CONTAGIOUS PLEUROPNEUMONIA

It is evident from the wording of the act establishing the Bureau that its first duty was to take charge of the eradication of pleuropneumonia in cooperation with the State authorities where the disease existed. The previous efforts of the National Government had not proved effectual on account of the failure of the States to cooperate effectively by passing necessary laws and appropriating sufficient funds to carry on the work successfully. Massachusetts had succeeded in permanently eradicating the disease in October, 1865. Connecticut had repelled repeated invasions from New York, but the other infected States had been spasmodic in their efforts and persisted in applying only temporizing measures in compliance with the demands of cattle dealers and some others. As a consequence, the disease had

spread from the foci of infection on Long Island, where it first appeared in the United States in 1843, until by 1884 it had reached Pennsylvania, New York, New Jersey, Maryland, Virginia, West Virginia, and the District of Columbia, and Connecticut had become re-infected, and, on January 7, 1885, an outbreak was reported in Delaware.*

The first work to be done evidently was to make a preliminary investigation of the prevalence and location of the disease. Steps were taken at once to organize a force to make the investigation, preparatory to the application of eradication measures. Competent veterinarians were scarce in those days, but by July 1, 1885, the Bureau force consisted of the following officers and employees:

Title and Name	Whence Appointed	Compensation†
<i>Chief, Bureau of Animal Industry</i>		
D. E. Salmon.....	North Carolina.....	\$3,000.00
<i>Clerk</i>		
Miles Fuller.....	Illinois.....	1,500.00
<i>Agents</i>		
S. H. Standart.....	Colorado.....	p. d. 10.00
H. M. Taylor.....	Colorado.....	p. d. 10.00
<i>Assistant in Laboratory</i>		
Theobald Smith.....	New York.....	1,600.00
<i>Messenger</i>		
William Alexander.....	Dist. of Columbia.....	720.00
<i>Superintendent, Experimental Station</i>		
William H. Rose.....	.....	1,600.00
<i>Laborer</i>		
B. F. Yates.....	.....	600.00
<i>Assistant Veterinarians</i>		
William B. E. Miller.....	New Jersey.....	p. d. 8.00
H. W. Rowland.....	New Jersey.....	p. d. 8.00
T. J. Herr.....	New York.....	p. d. 8.00
C. B. Michener.....	New York.....	p. d. 8.00
J. W. Hawk.....	New Jersey.....	p. d. 8.00
M. R. Trumbower.....	Missouri.....	p. d. 8.00
L. McLean.....	New York.....	p. d. 8.00
C. K. Dyer.....	New Jersey.....	p. d. 8.00
Lawrence Wilson.....	Kansas.....	p. d. 8.00
E. W. Perry.....	Illinois.....	p. d. 8.00
J. N. Bradley.....	Missouri.....	p. d. 8.00
George Marx.....	Pennsylvania.....	2,000.00
James Harkness.....	.....	p. d. 8.00
H. D. Walker.....	North Carolina.....	p. m. 100.00
J. Gerth, Jr.....	New Jersey.....	p. d. 8.00
S. P. Cunningham.....	Texas.....	p. m. 150.00

* See "Contagious Pleuropneumonia," page 3.

† Compensation per annum unless otherwise indicated (p. d. meaning per day and p. m. per month).

The Chief of the Bureau was handicapped by the restriction imposed by the law in regard to the number of employees that might be appointed, and it was not until the passage of the appropriation act for the fiscal year beginning July 1, 1886, that this restriction was removed.

The governments and local authorities of the infected States were requested to cooperate with the new Bureau and to grant to its inspectors authority to enter upon premises of citizens of those States in order to make the necessary inspections. Some objections were raised against such inspections on the ground that more cases of disease would be found than the States could dispose of with their limited appropriations, and it was argued with much feeling that the publication of the number of cases existing in these States would create unnecessary alarm and interfere greatly with the commerce of the infected sections without accomplishing beneficial results, since sufficient provision had not been made for exterminating the disease. Many stockmen in the United States were skeptical in regard to the contagious nature of contagious pleuropneumonia and were opposed to the drastic measures proposed for its eradication.

As this feeling was reflected in Congress to some extent, it was arranged to slaughter three affected cows at the Experiment Station near Washington, D. C., on January 12, 1884, in order to demonstrate the character of the disease. Hon. James Wilson of Iowa, member of the House Committee on Agriculture, a number of distinguished veterinarians, and delegates from the Chicago convention of stockmen witnessed the demonstration. To prove the contagiousness of the disease that existed in the United States, experiments were conducted at the Experiment Station, Washington, D. C., and on Barren Island in New York Bay. The test was begun on Barren Island September 20, 1884, and by January 3, 1885, 22 out of 31 animals in the test had contracted the disease, and 30 out of 41 animals contracted the disease in the test begun at the Washington Experiment Station on November 1, 1884.

The preliminary investigations were proceeding in the known infected States when the alarming news was received of a malady suspected to be contagious pleuropneumonia which had recently appeared among some breeding herds in the western part of Illinois. Fortunately the trend of the cattle trade had been toward the eastern markets, but those who were most familiar with the situation recognized the increasing danger of a spread westward because of the growing demand since 1880 for purebred and grade Jersey cattle to

improve the dairy herds in the Western States. At first they were taken from the New England States, but as the demand increased and the supply in these sections became exhausted, dealers extended their search even to the infected States and shipped young calves and cows in carload lots to Missouri, Iowa and Illinois.

On July 15, 1884, Dr. M. R. Trumbower was called to examine a cow on the premises of Mr. C. A. Keefer at Sterling, Ill. This cow and others in the vicinity were found to be affected with pleuropneumonia. On August 20, 1884, Hon. George B. Loring, then Commissioner of Agriculture, issued a circular announcing the first outbreak in the West. An investigation revealed that in all probability the infection originated in a shipment of grade Jerseys bought in the vicinity of Baltimore, Md., in November, 1883, and shipped to Mr. C. R. C. Dye, Troy, Ohio, on December 28. Five of Mr. Dye's cattle, including one of the lot from Maryland, were sold at a public sale held at Virginia, Cass County, Ill., on February 21, 1884. Mr. Dye's entries arrived at Virginia January 4, 1884, and it is believed that the Maryland cow carried the infection to Illinois. In tracing the animals sold at the Virginia sale, known as the Epler sale, infected animals were found in valuable herds at Geneva, Sterling, Peoria, Danvers, Springfield, Jacksonville and Rushville, Ill., and Cynthiana, Ky. The disease had existed eight months west of the Allegheny Mountains before it was discovered; it had been carried to three different States, and exposed cattle had gone to seven different States, but fortunately in the majority of cases they did not carry the infection with them. A combination sale at Chicago was advertised for September 1, 1884, into which were entered some 20 animals from two infected herds. If that sale had been allowed to take place the disease would doubtless have been scattered to every part of the West. It was by a succession of the most fortunate coincidences that the contagion had not already spread from Illinois to the herds on the ranges.

On March 5, 1885, the disease was discovered in the dairy herd at the Missouri State Lunatic Asylum, Fulton, Mo. Through the splendid cooperation received from the State authorities and a ruling of the Comptroller of the Treasury on April 21, 1885, allowing expenditures from the regular annual appropriation of the Bureau for the purpose of purchasing and destroying animals found affected, the State was freed of the disease by May 1 of the same year.

The appearance of the malady in the West made it necessary for the new Bureau to divert its attention from the Eastern States to

the outbreaks west of the Allegheny Mountains. It did not have sufficient authority under the law of May 29, 1884, to enforce its regulations within a State and was obliged to operate under existing State laws. Most of the States had neither adequate laws nor funds to cooperate effectively, and some showed a disinclination to enforce existing statutes. For instance, no attempt was made in Kentucky to enforce the State laws. Diseased cattle were handled in that State so recklessly that many others were infected unnecessarily. The plague notoriously existed in the herd of Messrs. Frisbie & Lake, of Cynthiana, who carried the disease into Kentucky from Illinois, but no legal measures were adopted in accordance with the plan so forcibly outlined by the Governor of Kentucky in his communication of September 24, 1884, to county judges and other officers of the law. Frisbie & Lake even succeeded in shipping 125 cattle from their infected premises to Austin, Texas, for public sale, which the Texas authorities allowed to take place on February 12, 1885, in spite of the efforts of the Department of Agriculture to prevent it, and knowing that only 95 of the 125 animals shipped from Kentucky remained alive on the day of the sale. Another shipment of 24 animals from the Frisbie & Lake herd was purchased by Dr. F. B. Hamilton, president of the Tennessee Jersey Breeders' Association and shipped to Jackson, Tenn., early in June, 1885.

The infected premises of Frisbie & Lake finally were quarantined by the authority of the Kentucky State Board of Health on June 15, 1885. Early in March, 1886, the State Legislature enacted a law authorizing the State Board of Health to slaughter infected herds and appropriated money to compensate the owners. The slaughter began on March 15, and on March 27 the last infected animals in the State were destroyed and the disease did not reappear in Kentucky. This was our first demonstration of promptly eradicating a contagious disease by the slaughter and disinfection method.

The State Legislature of Illinois passed an act on May 31, 1884, to suppress and prevent the spread of contagious pleuropneumonia. Good cooperation was received from the State authorities under this law and at the end of the year 1885 it was believed that the State had been freed of the disease. But early in September, 1886, Dr. Caswell, then State Veterinarian of Illinois, made the startling discovery that pleuropneumonia existed among dairy herds in the City of Chicago, not far from the Union Stock Yards, through which cattle were passed to all parts of the country. The infection was found to center in the stables of the Phœnix and the Empire dis-

tilleries and the Shufeldt stables. The milkmen in the vicinity of the distilleries at first denied the existence of any disease among their cattle, but when the evidence became too strong to be longer contested, it was admitted that they had recognized the presence of lung trouble in their cattle since some time in 1884 and they were resorting to inoculation, a practice which originated in Belgium, to lessen the mortality. On November 28, 1886, slaughtering was begun in order to empty the distillery stables as soon as possible.

The Act of Congress appropriating funds for the year ending June 30, 1887, authorized the purchase of diseased animals when necessary to prevent the spread of pleuropneumonia from one State to another, but the statutes then in force in Illinois required the slaughter of affected animals without compensation, which prevented rapid progress in getting rid of the disease. In the act of March 3, 1887, appropriating funds for the fiscal year 1888, Congress modified the law to give authority to the Department of Agriculture to purchase and destroy both diseased and exposed cattle and increased the appropriation from \$100,000 to \$500,000, making \$100,000 of this sum immediately available to meet the emergency in the West and to facilitate the eradication in the East. Arrangements were made with the Illinois authorities to cooperate under this law, and on April 20, 1887, Dr. James Law was placed in charge of the eradication work in Illinois on behalf of the Bureau.

On May 24, 1887, Cook County in Illinois, with the exception of the Union Stock Yards, and Westchester, Kings, Queens, Suffolk, Richmond and New York Counties in the State of New York, and Baltimore, Howard, Carroll and Prince Georges counties in the State of Maryland were placed in quarantine.

In the latter part of July, 1886, a conference was held in Philadelphia at which representatives of the States of New Jersey, Pennsylvania, Delaware and Maryland were present. As a result of this conference the first rules and regulations for combating the disease were issued by the Secretary of Agriculture August 2, 1886, and they were sent to the Governors of the interested States for their acceptance. Maryland was the first State to accept the regulations of the Department for cooperation. The Governors of New Jersey, Pennsylvania and Virginia failed to accept them and the authorities of New York decided that it would be unwise to attempt to control the plague in that State with the small appropriation they had, in view of the large number of infected herds known to exist on Long Island and in the vicinity of New York City. After the passage by Congress

of the act of March 3, 1887, revised rules and regulations were issued April 15, 1887, and sent to all of the States and Territories in the Union. The Governors of 34 States and Territories at once accepted these regulations and agreed to cooperate with the Bureau. As a result of the thorough measures employed under the new regulations, the progress of the disease in Illinois was promptly checked. The last acute case in that State was destroyed on July 28, 1887, and the quarantine was raised on April 1, 1888. It cost the National Government \$79,938.65 to eradicate the disease in Illinois. Ohio had been free of contagious pleuropneumonia since September, 1884. By the end of the year 1885 Missouri was free, and no cases appeared in Kentucky after March, 1886.

There are few if any cases on record where the dairies of a city of the size of Chicago, when once infected with pleuropneumonia, have been cleared of this contagious plague without years of constant effort and the expenditure of vast sums of money. The prompt eradication of pleuropneumonia from the herds of Chicago and the State of Illinois within a few months at so little expense and with so little inconvenience to commerce and without permitting the escape of the infection through the Union Stock Yards and other channels of the cattle trade was a sufficient achievement to establish confidence in the efficiency of the new Bureau of Animal Industry. The continued existence of the disease in the vicinity of the Union Stock Yards, the largest livestock center in the country, would certainly have led to the infection of the whole country within a few years with disastrous results to a profitable cattle industry.

The success attained in eradicating the outbreaks in the West had a beneficial effect in stimulating a desire for a more vigorous prosecution of the work in the East. On November 10, 1887, the State Live Stock Sanitary Board of Maryland issued an order quarantining all bovine animals within six miles of the City Hall of Baltimore and prohibiting any movement of cattle within the quarantined district without permit. On April 5, 1888, the Maryland Legislature passed a law recognizing the work of the Bureau in that State and providing for cooperation. About the same time arrangements were made for more effective cooperation with the New Jersey, New York and Pennsylvania State authorities. Up to this time the work had not progressed satisfactorily in any of these States, especially in Pennsylvania, where the State officers had opinions as to the measures necessary to eradicate the disease which were not shared by the authorities of other States or by the majority of the members of the

veterinary profession. They not only practiced inoculation, but they spared those animals which were mildly affected and after the ordinary period of quarantine allowed them to mingle again with other cattle and to be sent to the public markets of Pennsylvania and other States. The eradication in Pennsylvania progressed rapidly after the State authorities agreed to the proposition of the Department in April, 1888, to purchase and slaughter without cost to the State all exposed cattle which the local authorities were unwilling to destroy at State expense. It was further agreed that the Governor of Pennsylvania would issue a proclamation placing in quarantine all cattle which were on any premises situated within eight miles of the City Hall of Philadelphia. The proclamation was issued to take effect upon April 9, 1888, and remained in effect until December 15, 1888, when it was believed that the State of Pennsylvania was entirely free from the disease.

A satisfactory understanding in regard to cooperation to rid the District of Columbia of pleuropneumonia had not yet been reached, but on July 18, 1887, by request of the Commissioner of Agriculture the Commissioners of the District of Columbia issued an order authorizing the Chief of the Bureau of Animal Industry to act as veterinarian for the District, and that order has never been revoked.

On December 1, 1887, Dr. James Law was withdrawn from Illinois and placed in charge of the work of the Bureau in the whole State of New York. Steps were taken immediately by him to tag and register all bovine animals in the quarantined counties of Westchester, New York, Richmond, Kings and Queens, as had been done so successfully in Cook County, Illinois.

In order to hasten the eradication work on Long Island more radical measures were adopted early in the year 1889. In cases where the disease had reappeared several times on the same premises, the dilapidated stables that could not be properly cleaned and disinfected were torn down and burned. There appeared to be a widespread opinion among the cattle dealers in the vicinity of New York City that the Department of Agriculture had no power to enforce its regulations in preventing cattle in the infected districts from pasturing in common and mingling together on the pastures and highways. It was determined to put a stop to this practice by seizing and slaughtering all cattle found off their owners' premises without a permit from the chief inspector. The first seizure included over 100 head of cows, and this was followed immediately by others. This procedure had the desired effect and from that time the disease

rapidly disappeared. Dr. R. W. Hickman, who remained with the Bureau until March 31, 1922, is credited with making the first seizure on Long Island.

The great obstacle to the speedy conclusion of the eradication of the plague was not in any inherent difficulties in the work itself, but in the impossibility of securing under the State statutes a strict enforcement of the necessary regulations, apparently because the sympathy of the local officers was with the offenders in their districts rather than with those who were trying to eradicate the disease. It was often found difficult or impossible to secure the prosecution and conviction of persons who violated the State laws under which the regulations were made. Some who wilfully violated the regulations and even assaulted the officers of the Department had their cases dismissed by justices of the peace or by the grand juries before which the matter was brought, with the intimation that prosecution for such offenses would not be countenanced by them. Then, too, as eradication progressed and success seemed assured, the State officials manifested an increasing disposition to relax their regulations, to allow violations to go unpunished, to remove restrictions before safety was certain, and the Bureau authorities had no power under National law to curb them.

To overcome the most embarrassing difficulties in the prosecution of the work, the Chief of the Bureau in his report to the Secretary for the year 1888 recommended that the law establishing the Bureau be amended to impose a penalty upon any person who removed or caused to be removed any bovine animal from a section declared by the Secretary of Agriculture to be an infected district to any other State or Territory, or who transported or caused to be transported any such animal upon any railroad or vessel which formed part of a transportation line from one State or Territory into another, but this change in the law was not made until the passage of the act of March 3, 1895.

By the end of 1890 the disease was confined to areas around New York City and Jersey City, and by the end of 1891 Hudson and Essex Counties, New Jersey, were the only areas that had not been declared free of the plague. The last case of contagious pleuropneumonia in the United States was traced and found in the suburbs of Newark, N. J., on March 25, 1892, by Dr. W. S. Devoe and Dr. J. W. Hawk, and on September 26, 1892, the following proclamation was issued:

PROCLAMATION—ERADICATION OF PLEUROPNEUMONIA

U. S. DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY

To all whom it may concern:

Notice is hereby given that the quarantines heretofore existing in the counties of Kings and Queens, State of New York, and the counties of Essex and Hudson, State of New Jersey, for the suppression of contagious pleuropneumonia among cattle, are this day removed.

The removal of the aforesaid quarantines completes the dissolving of all quarantines established by this Department in the several sections of the United States for the suppression of the above-named disease.

No case of this disease has occurred in the State of Illinois since December 29, 1887, a period of more than four years and eight months.

No case has occurred in the State of Pennsylvania since September 29, 1888, a period of four years within a few days.

No case has occurred in the State of Maryland since September 18, 1889, a period of three years.

No case has occurred in the State of New York since April 30, 1891, a period of more than one year and four months.

No case has occurred in the State of New Jersey since March 25, 1892, a period of six months, and no case has occurred in any other portion of the United States within the past five years.

I do therefore hereby officially declare that the United States is free from the disease known as contagious pleuropneumonia.

J. M. RUSK, *Secretary*.

Done at the City of Washington, D. C., this 26th day of September, A. D. 1892.

It cost the National Government \$1,509,100.72 to eradicate the disease in the United States and required about five years. If the States had been prepared with laws and funds as they are now prepared, probably it could have been accomplished within one year.

The United States was the first of the large nations of the world up to that time which, having been once extensively infected with contagious pleuropneumonia, was able to extirpate it completely. When it is considered that there were grave doubts entertained of the possibility of eradicating pleuropneumonia, that the States were not prepared to cooperate effectively, that serious opposition was met on almost every hand, and that other countries had labored a much longer time and made greater expenditures of money without success, the favorable outcome must be regarded as a great achievement for the new Bureau of Animal Industry. It accomplished the first great thing it undertook, the paramount purpose for which it was created.

The Experiment Station

The Experiment Station of the Bureau of Animal Industry is important not only on account of the original research work performed by its scientific staff, but also because it is an ally of the other scientific branches of the Bureau; they either refer their problems to it for solution, or use its facilities to carry on their investigations and experiments. Owing to the fact that the history of the Experiment Station is so intimately interwoven with that of the various research divisions of the Bureau, it is practically impossible to write a history of the Station without duplicating a great deal of the history of the divisions of the Bureau. Therefore, but a brief reference will be made to the Experiment Station of the Bureau of Animal Industry, although it is a very important branch of a Bureau that has numbered among its workers men of the highest rank because of their creative, constructive, analytical minds and to whom lasting honor is due for the splendid contributions they have made to the advancement of human knowledge, the protection of public health, and the development and prosperity of our great livestock industry.

Before the Bureau of Animal Industry was created by Act of Congress, the research work of the Veterinary Division of the Department of Agriculture, under the guidance of Dr. D. E. Salmon, had developed to a stage that made it urgently desirable to secure facilities to maintain domestic animals, affected with infectious and contagious diseases, under closely guarded, experimental, but otherwise customary farm and field conditions. Consequently, at the direction of the Honorable George B. Loring, Commissioner of Agriculture, early in the year 1883, a small tract of land, located in the suburbs of Washington, D. C., on Benning Road, about a quarter of a mile from what was at that time looked upon as the northeast boundary of the city, was leased for the purpose.

The tract of land, with an area of between six and seven acres, improved by a brick dwelling, three small stables, several hog pens and one or two minor structures, to which a small frame building for use as a laboratory and autopsy room was soon added, served as the Experiment Station for a period of fourteen years, or until the year 1897.

The first superintendent of the Station was Dr. W. H. Rose, who served in this capacity from July 1, 1884, to August 15, 1885, when he was succeeded by Dr. F. L. Kilborne, who served until June 30,

1894, and who was in turn succeeded on July 1, 1894, by the present superintendent, Dr. E. C. Schroeder.

In the year 1897 (effective July 1) the Station was moved from Benning Road to its present location, about five miles north of Washington, D. C., on the Rockville Road at Bethesda, Md. At Bethesda a tract of 18 acres of land, on which a frame dwelling was located, was leased with a three-year purchase option. A small, one-story, frame laboratory, a breeding house for small experiment animals, a tool and carriage house and four stables were at once erected at the expense of the Bureau of Animal Industry. The stables provided thirty box and twenty open stalls for horses and cattle.

The leased land, with the improvements on it, and an adjacent two acres, were purchased by the Government in the year 1899 (July 8) for \$20,000, thus giving the Experiment Station a permanent home. Three years later, in the year 1902 (July 15) a second purchase of land adjoining the first was made, of 30 acres, for which \$10,000 was paid, increasing the area of the Station to 50 acres. A detailed account of the various buildings erected from time to time on this land, its division into experiment lots, fencing, drilling wells, the erection of water tanks, the laying of water and gas pipes, etc., would be unprofitable and tedious, as an active experiment station is an establishment that is continuously undergoing alterations to meet the requirements of its ever-changing work; but several buildings merit a little separate attention.

As the needs of the Station outgrew the original small frame laboratory building, the construction of a larger two-story, fire-proof laboratory was undertaken. The first story and basement were completed in the year 1906, but the upper story and permanent roof, owing to lack of money, were not completed until three years later. This building, the cost of which was upwards of \$25,000, is fairly well equipped for the study of the infectious diseases of the lower animals, and moreover, supplies a reasonably safe place for housing the records of the Station's investigations and those conducted by it for and in cooperation with the other scientific divisions of the Bureau.

The original breeding house for small experiment animals was replaced in the year 1910, at an expenditure of about \$5,000, by a larger and better house, which, owing to the difference between the prices for which small experiment animals required in biological investigations and tests can be bred and raised and for which they can be purchased, to say nothing of the better quality of animals pro-

duced under proper supervision and known conditions, nets an annual saving in expenditures fully equal to its cost.

Experience has shown that the more desirable kind of stable at an experiment station for the study of the infectious diseases of animals is a small structure which can accommodate from three to four horses or cattle, and the internal equipment of which is so arranged that it can be changed quickly at little expense in a way that will make it serviceable for animals of any species, either large or small. In addition to a number of larger stables, the Experiment Station now has more than a score of the smaller kind.

The 50 acres of land purchased for and owned by the Station became so crowded in the year 1907, largely owing to space needed for work in the line of animal husbandry as distinct from the study of animal diseases, that it was necessary to secure the use of additional land, and this was provided by leasing an adjacent farm of a little more than 60 acres, and in the year 1909 Congress appropriated \$25,000 to purchase either this farm or other desirable land.

As all land adjacent to and near the Station at that time was held at what seemed to be unreasonably high prices, the appropriation was used to purchase a farm at Beltsville, Maryland, which is now known as the Experiment Farm of the Dairy and Animal Husbandry Divisions of the Bureau of Animal Industry. This relieved the Experiment Station from the need to provide facilities for studies in animal husbandry and dairying, and made a clear and desirable distinction between the investigation of animal diseases and other conditions that affect the value and productivity of animals.

The investigational work of the Experiment Station, beginning in the year 1883 with tests relative to the contagiousness of pleuropneumonia of cattle, which was at that time prevalent in the United States, has been continuously in progress more than 40 years. What the state of our knowledge regarding the infectious diseases was 40 years ago, or in the year 1883, may be judged by the following quotations from one of the text-books of the time on pathology available in the English language:

Some of these diseases, especially the epidemic pestilences or plagues, have from ancient times been suspected to be due to organized poisons. The suspicion has now and again been re-expressed; but is only within the last twenty years that, in a few instances at least, the fact has been demonstrated.

The researches of the last ten years have shown that there are bacterial fungi which are able, by virtue of their specific properties, to affect the animal body and generate disease in it. On the other hand, we find such fungi in the blood and tissues of persons affected with infective disease. We must admit beforehand that the available

observations on this head have not the extent or exactness which we could desire. Only in the case of a few diseases is the bacterial nature of the virus demonstrated by indefeasible histological and experimental investigation. In others the presence of bacteria has been demonstrated in single cases, but their causal relation to the disease has not been proved. In many others, neither the one point nor the other has hitherto been made out. As the question at present stands then, we can only say—that among the infective diseases there are certainly some which are due to the invasion of a microphyte, and that it is highly probable the others have a like origin.

The part played by these micrococci (which are not found in every case) is by no means certainly determined. Of some we can only say that they are frequently or always found in connection with the corresponding disease (small-pox, scarlatina, measles, haemophilia neonatorum). Of others (as in wound-infections) we know, by experimental investigations, that they are only able to attack the tissues when they find in the system poisonous products of tissue-necrosis, or of fermentive decomposition set up by bacteria like themselves. Of many (such as those found in simple and phlegmonous erysipelas) we have every ground for believing that they can develop in the system without any special auxiliary conditions (other than slight traumatic injury).*

In the above quotation it is peculiarly striking that the names of the four diseases, virtually inferred to be due to micrococci, are evils of which the prime etiological factors have evaded isolation even down to our time. The author was notably unfortunate in his selection of examples. A better selection would have been anthrax, tuberculosis, glanders and rouget as diseases caused by specific microparasites. However, although the etiology of anthrax was well known at the time, the work of Koch, Löffler and Schutz, and Pasteur, respectively, on the bacilli of tuberculosis, glanders, and rouget, was not published until 1882, and we must expect that text-books on a rapidly developing science will be a little out of date before they leave the press. Our knowledge of the nature of the infectious diseases two-score years ago certainly was in its infancy; it was like a child beginning to prattle and take a few steps on its own feet.

In an important work on the Principles and Practice of Veterinary Medicine, published in the same year, the statement is made that "sometimes, however, contagious diseases originate spontaneously," and it is pointed out that anthrax, rabies and glanders are maladies that belong in this category.†

Though Koch had announced the discovery of the tubercle bacillus, and the specific organisms of several other infectious diseases had been correctly defined, pathologists of the highest rank continued to talk about the microparasitic theory of infectious diseases, and the fact

* Text Book on Pathological Anatomy and Pathogenesis, by Ernest Ziegler, translated and edited for English students by Donald MacAlister, M. A., M. B., London, 1883, pp. 290, 292.

† Williams, Principles and Practice of Veterinary Medicine, first American edition, New York, 1883, p. 82.

that such diseases are the product of specifically stable microparasites was by no means generally or even commonly accepted by members of the medical and veterinary professions. If we bear in mind the enormously rapid progress our knowledge has made since that time, and that the Bureau of Animal Industry not only kept pace with this progress but, in many instances, proved itself a great pioneer leader, and that the work of the Experiment Station and that of the other scientific divisions of the Bureau are so interwoven that the history of one can not well be written without that of the others, it will be apparent at once that a detailed account of the Station's work would fill several large volumes.

In the year 1884 the study of swine diseases was undertaken at the Station and it was proved by inoculation tests that swine plague in America, and rouget or swine erysipelas in Europe, on which Pasteur had published his investigations two years earlier, are separate and distinct affections. In 1885 and 1886 the distinction between swine plague and hog cholera was made and investigations were undertaken regarding the life histories of the larger parasites of domestic animals. Investigations were also made on the immunization of hogs against swine plague and hog cholera. During the years 1887 and 1888 these investigations were continued and the brilliant work of Doctors Theobald Smith and F. L. Kilborne which solved the mysteries of Texas or southern cattle fever was begun. For the first time in history it was proved conclusively that the essential etiological factor of an infectious disease may be a microparasite that reaches its victims only through an intermediate host, and this revealed why a truly infectious disease may in no respect be contagious.

The Texas fever investigations of the Bureau; the discovery of the microorganism of the disease, an animal and not a vegetable microparasite; the discovery that this microzoön attacks cattle in nature only through the progeny of cattle ticks that have lived on infected cattle, and the discovery that infected immune cattle may carry the parasite in their blood long periods of time without showing the remotest symptoms of disease, but in a way that leads to the infection of the ticks that grow on their bodies and the transmission of the disease through the progeny of such ticks to susceptible cattle, may reasonably be characterized as epochal in the history of our knowledge concerning infectious diseases.

In 1889 hog cholera, swine plague, Texas fever, glanders, tuberculosis, poultry diseases, etc., received consideration at the Station, and

during the following three or four years much work was done to determine the diagnostic value of tuberculin and mallein.

On the subject of tuberculosis the work from the year 1885 to the present time would easily fill a good-sized volume.* It includes studies on the mode of infection with tubercle bacilli; the mode of elimination; the latency of tubercle bacilli in animal bodies; the source of tuberculosis among hogs; the relation between human and animal tuberculosis; the treatment of tuberculous subjects with tuberculin and other products of the tubercle bacillus; treatment with serum obtained from animals injected with tubercle bacilli and their products; the occurrence of tubercle bacilli in other animals than cattle and hogs; the kind of exposure required for the transmission of tuberculosis from diseased to healthy animals; methods of deriving healthy from tuberculous herds of cattle; the occurrence, persistence and significance of tubercle bacilli in dairy products; the efficiency of pasteurization to secure protection against tubercle bacilli in such products; the relation between the location of tuberculous lesions in the body and the portal of infection; immunization against tuberculosis; the conditions and the subjects on which the perpetuation of the different types of tubercle bacilli depend; the occurrence of tubercle bacilli in the circulating blood; the diagnosis of tuberculosis among hogs, cattle and other animals; modes of disinfection against tuberculosis; the standardization of tuberculin; the supervision of commercially prepared tuberculin relative to its purity and potency, etc., etc.

Such diseases as anthrax, blackleg, septicemia, sheep scab, forage and botulinus poisoning, and others have not been neglected, to which must be added numerous tests of alleged cures for various infectious diseases of animals; tests of material suspected to be infected with foot-and-mouth disease and other viruses; special investigations regarding unusual outbreaks of disease among animals; tests of numerous dips and other preparations for the destruction of cattle ticks, sheep scab, etc., etc.

During recent years the two major projects dealt with at the Station have been tuberculosis and infectious abortion disease of cattle,† and the study of these evils and various other diseases will be continued until their mysteries have been revealed and methods for their control and eradication discovered.

* See "Pathological Division," page 68; "Quarantine Division," page 146; "Tuberculosis Eradication Division," page 350.

† See "Pathological Division," page 64.

PERSONNEL OF THE B. A. I. EXPERIMENT STATION

Directors of the B. A. I. Experiment Station:

DR. W. H. ROSE.....	1883 to 1885
DR. F. L. KILBORNE.....	1885 to 1894

Superintendent of the Station:

DR. E. C. SCHROEDER.....	1894 to date
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Assistant Superintendent of the Station:

DR. W. E. COTTON.....	1917 to date
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Veterinary Inspectors and Scientific Assistants:

DR. W. E. COTTON.....	1893 to 1917
DR. G. W. BRETT.....	1911 to 1919
DR. ARTHUR B. CRAWFORD.....	1919 to date

Pathological Division

Reports of losses among livestock in various sections of the country caused the Commissioner of Agriculture to engage Dr. D. E. Salmon on July 1, 1881, to investigate certain diseases that were becoming more prevalent and destructive each succeeding year. Most of Dr. Salmon's time from the date of his appointment to early in 1883, when he was called to Washington to establish a Veterinary Division in the Department of Agriculture, was occupied in investigating Texas fever in the Southern States. But before the Bureau of Animal Industry was created he had fitted up a laboratory in Washington and had also established an experiment station on the outskirts of the city. This laboratory was the beginning not only of the present Pathological Division but also of the Bureau of Animal Industry.

Dr. Salmon was appointed Chief of the Bureau immediately when it was established. As much of the Chief's time was occupied with administrative matters, additional help was sought to carry on and extend the scientific investigations. It was important that the investigation of Texas fever be diligently continued and that a careful study be made of hog cholera and also a number of other prevalent contagious diseases.

Dr. Theobald Smith was appointed an inspector in the Bureau, effective July 1, 1884, and placed in charge of "Investigations of Infectious Animal Diseases." Dr. W. H. Rose was appointed on the same date and assigned as Superintendent of the Experiment Station, which was intended as a place to conduct experiments in connection with the laboratory work. Dr. F. L. Kilborne was added to the force on August 15, 1885, and Dr. Cooper Curtice accepted an appointment on August 1, 1886. These men were the first selected to assist the Chief in developing and extending the Bureau's activities in the field of research in pathology, and they, with others who entered the service later, helped to make Bureau history.

The pathological laboratories and executive office of the Bureau were located on the upper floor of the main building of the Department of Agriculture at Thirteenth and B Streets Southwest. Dr. Salmon was deeply interested in all the work that was being carried on and spent much time in personally conducting laboratory investigations.

The Annual Report of the Bureau covering its activities for the year 1884 shows that considerable progress had been made during the first year of its existence in the study of animal diseases. This

report gives good descriptions by laymen of the symptoms and post-mortem lesions of blackleg, but the remedies advised seem very empiric in these days of effective vaccines and filtrates.

Considerable loss was reported on western ranges during the spring months of 1884 from livestock eating poisonous plants. Those who reported the losses were very anxious that the species of the injurious plants be determined and the name published to assist livestock owners in taking measures to prevent losses.

An outbreak of ergotism in Kansas in 1884 caused considerable excitement among livestock men in the central West, as the disease was reported to be foot-and-mouth disease.* The study which the Bureau made of ergotism during this outbreak resulted in the valuable addition to veterinary literature of a treatise on the growth of ergot and the pathological lesions which result from the ingestion by cattle of forage contaminated with fungus.

Texas fever presented many perplexing problems to be solved. Some progress had been made in determining the northern boundary of the permanently infected area, and an order issued by the Commissioner of Agriculture requiring the isolation of southern cattle in separate pens at public stockyards and railroad feeding stations was the first step in controlling the spread of Texas fever among northern cattle. Outbreaks of glanders were very serious at that time, while tuberculosis apparently was attracting very little attention.

A study of verminous bronchitis of calves and gape disease of fowls was begun by the Bureau in 1885. The most serious infectious disease which confronted the new Bureau was pleuropneumonia. This disease had spread from the original foci of infection in the vicinity of New York City to the herds of Connecticut, New York State, New Jersey, Pennsylvania, Maryland, Virginia, the District of Columbia and, later, it appeared in Missouri, Kentucky and Illinois. The record of the activities of the Bureau in eradicating this disease is given in a separate chapter under the heading "Contagious Pleuropneumonia."

Extensive experiments were performed with Texas fever of cattle in efforts to determine the cause of the disease and to devise additional means for controlling its spread to cattle in the North. Dr. Smith, in the course of experiments ranging from 1886 to 1891, discovered and proved that the causative agent of Texas fever is a microscopic protozoan parasite which attacks the red blood corpuscles. In 1889 Dr. F. L. Kilborne obtained the first evidence by

* See "Field Inspection Division," page 282.

experiment that the disease was carried from animal to animal by cattle ticks, and furthermore, that southern cattle from which the ticks had all been removed were quite harmless if placed in contact with susceptible northern cattle.*

It is interesting to note that discoveries made by the Bureau at the Experiment Station furnished the first experimental proof that some infectious diseases are carried from victim to victim only through the activities of an intermediate host of their causative microparasites. This mode of spreading protozoan infections has since become quite familiar to the public by the discovery that certain species of mosquitoes spread malaria and yellow fever to man and that the tsetse fly may transmit to man the infection of sleeping sickness.

The first outbreak of disease among swine in this country reported to be hog cholera occurred in Ohio in 1833. From its original center the infection spread until it had become a serious menace by the time the Bureau was established. There were many affected herds of swine near Washington, and the Bureau inaugurated extensive investigations both in the laboratory and in the field, in the endeavor to find some means of checking the spread of the disease. At first no distinction was recognized between hog cholera and swine plague, but by 1886 it was found that two separate diseases existed, although both were frequently encountered in a single animal. Tests for the prevention of hog cholera were attempted by recovering bacteria from the bodies of hogs that had died of cholera, attenuating these microorganisms with heat and then using them on susceptible hogs for immunizing purposes. This was the first attempt made to immunize animals with killed bacterial cultures.

The amount of work required of the Bureau laboratory constantly increased. Problems connected with investigations of remedies for hog cholera and swine plague, derived from biological products, had become urgent, and on January 1, 1890, Dr. E. C. Schroeder, who had been engaged in the eradication of pleuropneumonia, was selected to assist in the investigations that were being made. Dr. Schroeder served in that capacity until July 1, 1894, when he was appointed Superintendent of the Experiment Station of the Bureau. On the same day that Dr. Schroeder joined the Bureau forces, Dr. E. A. de Schweinitz was engaged as chemist, and he at once began a chemical study of bacterial products, of which high hopes were entertained by the scientific world. Dr. de Schweinitz was appointed Chief of the Biochemic Division on July 1, 1896.

* See "Texas Fever," page 15, and "Tick Eradication Division," page 318.

Some attention was given to the laboratory study of parasitic diseases of livestock in the early days of the Bureau, but investigations seem to have been chiefly centered upon pleuropneumonia, swine diseases, and Texas fever. A careful microscopic survey of pork products for trichinæ was made in Chicago for the Bureau by Dr. H. J. Detmers, and numerous samples of pork were examined in Washington by Dr. Smith, in addition to which similar inspections were conducted by Dr. F. S. Billings in Boston, Dr. Deveron in New Orleans, Dr. Simpson in Atlanta, and Drs. Osler and Clements in Montreal. As a result of these investigations it was found that about 2 per cent of the hogs from certain sections were infested with trichinæ, while the hogs in some States were quite free of these parasites.*

The work assumed by the new Bureau grew rapidly and soon became so extensive that it was thought advisable to separate the various lines of activity and create divisions to handle the work to better advantage. Therefore, the Division of Quarantine, the Inspection Division, the Division of Animal Pathology (later known as the Pathological Division), and the Division of Field Investigations and Miscellaneous Work were formed on April 1, 1891.† In August of the same year the divisions engaged in laboratory work were installed in a new building located at 1362 B Street Southwest, where room was available for continued expansion. The discoveries made up to this time in connection with swine diseases and Texas fever were so important and comprehensive as to revolutionize previously accepted views in regard to the nature of these diseases. With the more complete equipment afforded by the new laboratories the work of the Division of Animal Pathology was gradually extended to include studies of actinomycosis, glanders, rabies and poultry diseases.

The Annual Report of 1891 contains some of the early drawings prepared by Mr. W. S. D. Haines, who has remained with the Bureau up to the present time. The favorable attention attracted by publications of the Bureau has been partly due to the skillful technique and accuracy of their illustrations.

The charge by the English authorities that some of the steers landed in England from American ports were affected with pleuropneumonia necessitated a careful study by the Division of Animal Pathology of the lesions found in cases of sporadic pneumonia as compared with those found in true contagious pleuropneumonia.‡

On May 15, 1895, Dr. Theobald Smith resigned from the Bureau,

* See "Meat Inspection," page 27, and "Meat Inspection Division," page 255.

† See "Organization," page xi.

‡ See "Export Trade in Cattle and Meats," page 8.

and Dr. Veranus A. Moore, who had been laboratory assistant since December 22, 1886, was appointed Chief of the Division of Animal Pathology. He was assisted by Dr. Charles F. Dawson, who was appointed on September 10, 1893, and together they gave attention especially to the study of rabies in man and domestic animals, tuberculosis in swine, diseases of poultry, and continued investigations regarding the presence of bacteria in milk and dairy products, which were begun several years earlier.

During the decade and more that Dr. Smith was directing the investigations of the Division, its work became well organized, the laboratory workers were established in efficient procedures of investigation, and although many discoveries of scientific and economic importance were made, many perplexing problems continued to face the workers of the Division.

Dr. V. A. Moore resigned as Chief of the Pathological Division on September 30, 1896, and was succeeded by Dr. Victor A. Nørgaard, a native of Denmark, who had been appointed veterinary inspector in the Bureau at Chicago on August 1, 1891. Numerous dips and preparations were tested in the laboratory and in the field under his direction to ascertain their effectiveness in destroying ticks on cattle.*

In November, 1901, a most unusual outbreak of disease occurred among the cattle in a dairy barn in the District of Columbia, from the effects of which a number of cows were lost. Investigations showed that this enzootic disease was caused by bacilli of the enteritidis group.

On December 1, 1901, Dr. Nørgaard resigned as Chief of the Pathological Division and Dr. John R. Mohler, who had been Assistant Chief of the Division since June 1, 1900, was appointed Chief.

The building occupied by laboratories of the Bureau since August, 1891, was rented. The many advantages to be enjoyed should the Government own the buildings in which its workers were employed became obvious, and plans were drawn in 1903 for new buildings to be located on public lands then occupied by the Department of Agriculture. The completed buildings were accepted in March, 1908, and the Pathological Division soon became established in its present commodious rooms, where an abundance of light for microscopic work is available from windows on the north side of the building and where direct sunlight does not interfere.

On July 1, 1914, Dr. Archibald R. Ward was appointed Chief of the Pathological Division to succeed Dr. Mohler, who was advanced

* See "Tick Eradication Division," page 318.

to the position of Assistant Chief of the Bureau. Soon after Dr. Ward assumed the direction of the Division, foot-and-mouth disease appeared in Michigan and most of the laboratory force was transferred to the field to assist in eradicating the outbreak.

Dr. Ward was succeeded on July 1, 1915, by Dr. Adolph Eichhorn, who had been working in the laboratories since his transfer to the Pathological Division on May 1, 1906. Dr. Eichhorn held this position until December 31 of the following year, when he resigned, and Dr. John S. Buckley became Acting Chief of the Division. On January 1, 1919, Dr. Buckley was appointed Chief of the Division. He entered the service of the Bureau March 1, 1898, and was transferred to the Pathological Division on December 1, 1900.

GLANDERS*

In August, 1888, the Commissioners of the District of Columbia requested Dr. Salmon to take charge of matters relating to the health of horses in the District. After a survey of the situation he subjected all suspicious horses to the Strauss test for glanders. This was the first extensive application by the Bureau of laboratory tests in diagnosing glanders. The Strauss method proved of great assistance in detecting centers of infection, as results could be obtained more quickly and more reliably than by the culture tests previously employed. Later Konew's precipitation test began to attract favorable attention and from 1908 to 1910 it was employed by the Pathological Division as a confirmatory test. In 1910 all previous methods of diagnosing glanders gave way to the complement-fixation test, which is more rapid and more reliable than any of the earlier tests.

While engaged in the eradication of pleuropneumonia the inspectors of the Bureau discovered an unexpected amount of glanders among the horses and mules of the country, and concerted efforts were made in cooperation with the States to combat this disease. Centers of infection were found in widely separated regions, usually in stables that housed large numbers of animals under one roof, but occasionally farm animals were found infected. Great difficulty was encountered generally in securing suitable destruction of the diseased animals.

The infection of glanders was introduced among the Army horses stabled at St. Asaph, Va., during the winter of 1900 and 1901, and before the seriousness of the outbreak was fully appreciated the disease had spread to many animals. The Pathological Division was called upon to verify the diagnosis and to assist in eradicating the

* See "Field Inspection Division," page 299.

outbreak. In all cases where a decided reaction to mallein had been obtained, the diagnosis was confirmed by animal inoculation.

STUDY OF MILK*

Shortly after the tuberculin test, in the early nineties, revealed that tuberculosis was more common among dairy cows than we previously had reason to believe, studies were begun in the Division of Animal Pathology to determine the frequency with which virulent tubercle bacilli occur in dairy products. These studies afterwards were continued, in the form of both independent and cooperative investigations, by the Division of Animal Pathology and the Experiment Station at Bethesda, Md., and yielded results that have materially influenced the methods now in use to protect public health against bovine tuberculosis.

The earlier studies were mainly tests with samples of milk from the general commercial supply, and definitely proved that the occurrence of virulent tubercle bacilli in all grades of market milk, from the highest to the lowest, was ominously common. Later studies included butter, cheese, cream, etc., and investigations regarding the sources of the tubercle bacilli in dairy products, the duration of their virulence in different dairy products, the kind of cows that expel tubercle bacilli in a way that leads to their introduction into milk and its products, the types of the bacilli in dairy products, methods through which the public health can be protected against tubercle bacilli in dairy products, etc.

A detailed account of the investigations would fill several large volumes; therefore, nothing more can be done here than to give a brief statement of the more important results obtained.

It was shown that tubercle bacilli are of common occurrence in the milk of tuberculous dairy herds; that the frequency with which milk is infected with tubercle bacilli cannot be satisfactorily explained by the presence of udder tuberculosis among dairy cows, or the elimination of tubercle bacilli from the bodies of tuberculous cows through udders to which the disease has not extended; that the commonest way for tubercle bacilli to be expelled from the bodies of tuberculous cows is through their bowels with their feces; that many apparently healthy tuberculous cows, or cows that would not be suspected to be subjects of tuberculosis without the aid of the tuberculin test, expel tubercle bacilli from their bodies with their feces; that partly digested vegetable matter, undoubtedly feces, is not infrequently an impurity

* See "Experiment Station," page 48.

in cows' milk; that it is easily possible for tubercle bacilli to enter milk with cow feces, even if the milk is obtained from a healthy member of a tuberculous dairy herd; that the presence of a single unsuspected case of tuberculosis in a dairy herd may lead to the periodic contamination of the milk from the herd; that the proportion of the tubercle bacilli in milk which clings to the cream globules is larger than that which sinks with the sediment, no matter whether the cream is separated from the milk with a centrifuge or simply permitted to rise to the surface; that upwards of one quarter of the samples of the sediment which collects in cream separators of public creameries examined is contaminated with tubercle bacilli; that tubercle bacilli are present in cream, ice cream, butter and cheese made from infected milk; that tubercle bacilli in milk remain virulent longer than the time required for the milk, through decomposition, to become unfit for use as food; that tubercle bacilli in ordinary salted and unsalted butter remain alive the better part of six months; that tubercle bacilli, in ordinary salted butter, cause tuberculosis in hogs that eat the infected butter after it is more than three months old, in quantities no greater than the average person consumes; that virulent tubercle bacilli may be a source of danger in fresh cheese but rarely occur in cured cheese; that bovo-vaccination, or the injection of cattle with tubercle bacilli of the human type to protect them against tuberculosis of the kind caused by tubercle bacilli of the bovine type, is very dangerous, as it too often converts the treated animals into unsuspected, apparently healthy disseminators of tubercle bacilli of the human type; that the tubercle bacilli in dairy products almost invariably are of the bovine type; that tuberculous lesions in the udders of cows may long remain too small to be detected through physical examination and yet seriously infect their milk; that tuberculosis, through its spread from other parts of the body of an apparently healthy tuberculous cow, may very rapidly lead to the presence of extensive and superlatively dangerous tuberculous lesions in the udder; that pasteurization of milk, using a temperature and a period of time insufficient to affect its taste, odor or digestibility, kills the tubercle bacilli it may contain, and that, under existing conditions, no better advice regarding the protection of public health against bovine tuberculosis can be given than the following:

All milk should be obtained from dairy herds that have been proved free from tuberculosis with the tuberculin test, or should be pasteurized before it is used as food in any form.

Regarding definite practical results from these studies, it may be well to give one or two examples. Bovo-vaccination, which showed a tendency to become a common method for controlling tuberculosis among cattle, was found to have so many objectionable and dangerous features that its use has gone wholly out of existence. A number of years ago it was found that about 14 per cent of the samples of cream cheese on the market was contaminated with virulent bovine tubercle bacilli. This evil was at once fought, and the periodic tests that are now being made and will be continued in the future show that the corrective measures recommended to the producers of cream cheese are effective and are regularly being practiced. Ten years ago cream cheese, an elegant, palatable, nutritious food, recommended by physicians for children and invalids, was found to be more commonly contaminated with virulent tubercle bacilli than any other dairy product; and now, so far as tubercle bacilli are concerned—and this statement is based on hundreds of carefully made tests—there is not a safer dairy product on the market.

What the significance of this work for public health is may be judged when we know that recognized authorities like Dr. E. R. Baldwin of the Tuberculosis Sanitarium at Saranac Lake, New York, and Dr. W. H. Park, the Director of the New York City Research Laboratories, estimate that 10 per cent of the deaths from tuberculosis among children are due to bovine tuberculosis, and that such men as the English tuberculosis investigators, Cobbett and Griffith, believe that the danger to which public health is exposed through the presence of tuberculosis among dairy cattle is in excess of rather than below the general estimates.* To get a clear idea of the harm chargeable to bovine tuberculosis, we must add to the deaths it causes among children the much larger number of children who suffer attacks which interfere with and greatly reduce their health, happiness and efficiency, and often end in only a partial recovery, or the kind of recovery through which the victim, after the cessation of the actual disease, is left permanently more or less crippled.

MYCOTIC STOMATITIS

During the summer and fall of 1901 cattle owners in many sections of the Middle West became alarmed at the appearance in their herds of a disease affecting the mouths and feet of cattle, which bore considerable similarity to foot-and-mouth disease. The outbreak was carefully investigated by Dr. Mohler and found to be mycotic stoma-

* See "Tuberculosis Eradication Division," page 366.

titis, caused by eating grasses upon which certain red and black rusts had formed.

This disease appears in some sections of the country nearly every year as a result of climatic conditions. When autumnal rains fall in a section that has been badly drouth-stricken during the preceding summer months, the troublesome rusts develop quickly, followed by disease and the loss of some cattle. In 1903 Dr. U. G. Houck of the Bureau was sent to California to investigate a suspected outbreak of foot-and-mouth disease, but it proved to be mycotic stomatitis.

ABORTION DISEASE*

In 1896 Dr. Bang of Denmark announced his discovery of a bacillus which was named *Bacillus abortus* (later revised to *Bacterium abortum*), which was believed to be the causative agent of infectious abortion of cattle. The Pathological Division began the study of this disease in 1900. In the Chief's description of the Division's activities for that year may be found the following statements:

It appears that infectious abortion in cattle is constantly spreading among the dairy herds of the United States and numerous outbreaks have been reported during the last fiscal year. The disease is caused by a specific bacillus, pure cultures of which have been obtained from an outbreak among the cattle at St. Elizabeth's Hospital, District of Columbia.

The records of the Division for the years 1900 and 1901, furthermore, show that a diagnosis of infectious abortion was established in numerous instances as a result of the isolation of the abortion organism from diseased bovine placental membranes. It may thus be observed that not only was the seriousness of the malady attracting attention at this time, but that a sufficient understanding of the cultural requirements was available for conducting bacteriological diagnostic procedures, and that the Pathological Division was among the early investigators of the disease.

During the year 1910 the symptoms, modes of transmission, agents of dissemination, pathogenesis, pathological anatomy, and methods of prevention and treatment were studied. More satisfactory methods of diagnosis were perfected and utilized as a result of the application of the serological tests. As a result of these studies information was obtained which has been of value in reaching a better understanding of the disease.

The 1914 Report of the Chief of the Bureau contains a reference to immature and hairless pigs, that in the light of our present knowledge regarding swine abortion deserves mention. It reads as follows:

* See "Experiment Station," page 53.

In March, 1914, a fully developed hairless pig was received from Middlebury, Ind., with a history that it was two weeks premature, and that other sows on the same farm had also aborted. No further information from this source was obtained, although requested. Cultures made from the liver, stomach contents and kidneys revealed an organism resembling *Bacillus abortus* in cultural and morphological characteristics. These cultures when used as antigens in both agglutination and complement-fixation tests gave the same results with two known negative, two known positive, and with unknown bovine sera, as were obtained with antigens prepared from *B. abortus* of Bang from bovine origin.

This statement merits interest because it calls attention to the hitherto unrecorded fact that aborted swine fetuses may constitute a host for organisms that morphologically, culturally, and serologically are identical with *Bacterium abortum* of Bang.

During the latter part of 1916, as a result of a special appropriation by Congress, the Division was enabled to give increased attention to the investigation of abortion. Plans were accordingly made to study the disease from as many angles as possible and under a variety of conditions. An opportunity was presented for the purchase of a small experimental herd of cattle. Efforts were directed toward gaining more information as to how diseased animals eliminate the causative organism, how the infection gains entrance into healthy subjects, where the infection localizes and propagates in the bodies of animals, and how immunizing agents or other methods may be utilized in preventing and controlling the disease. As a result of the experiments conducted with this herd and other studies a somewhat clearer conception of the malady was gained.

SKIN DISEASE IN HORSES

For some years horses running upon the ranges of the Umatilla Indian Reservation in Oregon suffered from a disease causing an abnormal loss of hair during certain seasons of the year. The condition finally became so serious that in 1901 the Pathological Division was asked to study this disease with the hope of finding some remedy. It was found that the skin affection was due to the presence of a fungus, *Fusarium equinum*. Numerous tests led to the selection of a mixture of light dynamo oil and sulphur, which proved effectual in treating the disease.

RABIES

Rabies had been more or less prevalent in and around the District of Columbia since December, 1892, when the first case was scientifically diagnosed. The increase of the disease during the year 1899 led the Pathological Division to devote more time to the study of this

disease, including the perfecting of methods of staining suspected tissues for the purpose of reaching a diagnosis. At first laboratory animals were inoculated as a means of determining the presence or absence of rabies. In 1900 the microscopic examination of the plexiform nerve ganglion was found by Gehuchten and Nelis of Louvain, Belgium, to afford a sufficient basis for a diagnosis. This method of examination was used by the Division for about three years, as it was more rapid than any method of examination used up to that time. The discovery of minute protozoan bodies within the nerve cells of rabid animals as indicators of the presence of rabies was made by Adelchi Negri of Italy in 1903, which led to a complete change of procedure in the work of our laboratory. The microscopic examination of the brain tissue of suspected animals, as recommended by Negri, shows that rabies is still prevalent in the District of Columbia and in most of the States of the Union.

Rabies vaccines, used to protect exposed animals, have been under scientific scrutiny during the past year and have not apparently measured up to claims made for them, but the investigations are not yet concluded.

DOURINE*

The presence of dourine in this country was first suspected in 1885, and was definitely recognized in 1886. In 1892 the Pathological Division commenced an investigation. It was found that the initial outbreak occurred in Illinois, where it was introduced by an imported stallion, and from which point it spread, and horses in several States had been destroyed by its attacks. By 1903 the disease had appeared in so many States that it was decided to take aggressive steps toward its suppression. As this was a new disease in the United States, Dr. Mohler, Chief of the Division, was sent to the National Veterinary School at Alfort, France, to make a thorough study of dourine and the methods of combating it. He brought back to the United States a dog that had been infected with the protozoön, *Trypanosoma equiperdum*, obtained from a horse affected with dourine. After numerous attempts, artificial growths of the protozoön were obtained, but no satisfactory immunizing material was produced from these cultures, although every procedure that seemed promising for the attainment of this end was employed.

So many affected animals were found in South Dakota, Montana, New Mexico and Arizona that it became necessary to enlarge the equipment of the laboratory in order that diagnoses might be made

*See "Field Inspection Division," page 279.

more promptly of the large numbers of samples of serum that were being sent to the Washington laboratory. As the complement-fixation test was giving very satisfactory results in testing other diseases, suitable antigens were devised for testing dourine samples by that method. The single type of graduated pipette first used in making complement-fixation tests for glanders and dourine was very satisfactory, but it was too slow for the Bureau's purpose. The ingenuity of the men who were testing dourine serum in the pathological laboratory was called into play in 1916. A multiple pipette charging 12 tubes at once was devised which has proved of great value in hastening the tests. As many as 1,200 samples are tested in a single day with this equipment. Apparently the disease has been about extirpated from horses kept on farms, but it still exists in a few bands that run at large under range conditions.

MALTA FEVER*

In 1905 the Department of Agriculture imported a number of goats from the Island of Malta for the purpose of obtaining foundation stock of choice milking strains. The presence of some disease was discovered in the goats while they were held in quarantine at the port of entry. Samples of diseased tissues were forwarded to the Pathological Division, where the presence of the causative agent of Malta fever was found. Following the identification of this disease all the animals in the importation were destroyed as a means of preventing the spread of infection to goat stock in this country.

SURRA*

An importation of Zebu cattle from India arrived at the port of New York in 1906. Dr. Mohler requested permission to inspect the cattle the day before the quarantine period was to expire. Two of the Zebus seemed abnormal and at once aroused his suspicions. Blood was drawn from them and injected into rabbits which were procured in the vicinity, with the result that surra parasites were found. The quarantine was continued and a systematic study made of all the animals. The cattle that had developed the disease were promptly destroyed. Each animal of the apparently healthy portion of the herd was confined to an individual screened stall; thus they were held in a fly-proof stable on Carteret Island at the entrance of New York harbor until repeated blood examinations had shown that they were free from surra parasites, and until frosts four months later had re-

* See "Quarantine Division," page 135, and "Animal Husbandry Division," page 244.

moved all danger of the transfer of virulent blood from animal to animal by means of blood-sucking flies. Through the detection of the surra parasite in this importation, our livestock industry was saved from great damage. An extensive study of surra as it appeared in this importation was made in the Pathological Division and much was learned of the character of surra and of closely allied diseases.

TRYPANOSOMES DISCOVERED AT A QUARANTINE STATION

About 130 horses belonging to officers of the Army were held in quarantine at Newport News, Va., on August 31, 1919, when they returned to this country from overseas service. Complement-fixation tests with the blood of these animals revealed the presence of trypanosomiasis in one horse. This animal was destroyed and the diagnosis was confirmed by post-mortem examination.

Recently, in 1923, in an importation of camels, trypanosomes of a species as yet unidentified were encountered. These animals originated in India, from which country they came only a few months before.

SMELTER FUMES

For some years prior to 1906 stock owners in the vicinity of the copper smelters had complained of great losses of animals under conditions which seemed to indicate slow, insidious poisoning. In the fall of 1906 the Pathological Division participated in a study of the affected animals. It was found that the stack of a single copper smelter in Montana was ejecting from 22 to 30 tons of arsenic every twenty-four hours. The effects of the fumes and deposits on vegetation could be traced for 12 miles. Many horses, cattle and sheep in the affected areas showed the symptoms and lesions of chronic arsenic poisoning. Experiments revealed that similar symptoms and lesions could be produced by the continued feeding of arsenic.

TUBERCULOSIS*

The increasing prevalence of tuberculosis in some of our most valuable dairy herds in the early nineties made a more extended study of this disease almost imperative.

Tuberculin was introduced by Dr. Robert Koch in 1890. Its value as a diagnostic agent was studied by Drs. Smith and de Schweinitz in 1891-92 with the result that its reliability in the detection of tuberculosis in our country was gradually established and the manu-

* See "Experiment Station," page 53; "Quarantine Division," page 125; "Tuberculosis Eradication Division," page 350.

facture of the product in large quantities was immediately undertaken in the laboratories of the Bureau. As a result of other studies Dr. Theobald Smith was enabled to announce in 1895 that two varieties of tubercle bacilli affect mammals. These were designated the human type and the bovine type.

The question of the effect of bovine tuberculosis upon the health of man, through the use of both milk and meat from tuberculous animals, and of the danger to man arising from caring for a tuberculous herd, as well as the propriety of allowing tuberculous attendants to care for healthy animals, also received attention.

Investigations relative to the immunization of cattle against tuberculosis were made in 1905-6. Cattle known to be tuberculous were purchased and treated by various methods with living, attenuated and sterilized cultures of tubercle bacilli, in the hope of finding a method of treatment which would serve to check the advance of the disease or possibly overcome it completely. Cattle that were free from tuberculosis were also purchased and treated in the same manner with a view to immunizing them against the infection of this disease.

A plan was developed in 1906 for eradicating tuberculosis from all cattle in the District of Columbia and surrounding territory, and the Pathological Division inaugurated the work. The test was applied to many herds in Virginia, Maryland and the District of Columbia. The Pathological Division continued in charge of the work until May 27, 1907, when it was turned over to the Quarantine Division as a regulatory instead of a research activity.

In connection with the testing of the dairy cows for tuberculosis, a careful study was made of milk to determine the effect of certain bovine diseases upon the milk supply. Investigations were also made at this time to ascertain the length of time that typhoid bacilli would remain alive in contaminated milk, and how long tubercle bacilli would remain alive when present in butter or cheese. As a result of the work conducted by the Pathological Division and the Experiment Station, the recommendation was made that no milk from cows suffering from anthrax, rabies, gastroenteritis, septic condition or showing clinical symptoms of tuberculosis should be used for human food even though pasteurized.

In 1901 Dr. Robert Koch announced that tuberculosis of the bovine species presented no material dangers to members of the human family. This claim was not in conformity with the views of most scientists. Leading laboratories of the world, including the Pathological Division, immediately undertook to investigate the matter. The

final conclusions drawn from several years of research as shown at the International Tuberculosis Conference held in Washington in September, 1908, were that while bovine tubercle bacilli were seldom found in the adult human lung, still fully 9 per cent of the cases of tuberculosis in children are caused by tubercle bacilli of the bovine type, showing that the presence of bovine tuberculosis is a matter of concern to the human family.

A flock of milk goats was brought from Europe to the United States in the summer of 1920. Little is known relative to the conditions under which they were kept in their native land, whether they were closely stabled with tuberculous cattle or not, but after they reached their destination it was discovered that several of the animals were tuberculous. It seems probable that the goats contracted the disease from tuberculous cattle, since the cultures of tubercle bacilli that were recovered from lungs of the affected goats corresponded very closely to the characteristics of the bovine type of tubercle bacillus.

AVIAN TUBERCULOSIS

The increasing prevalence of avian tuberculosis was recognized by the Pathological Division and during 1908 a systematic study of the disease in fowls was inaugurated for the purpose of determining its relationship with mammalian tuberculosis, and especially with regard to transmissibility to hogs. Among the interesting results of the investigation was a demonstration of the ready susceptibility of hogs to avian tuberculosis through eating carcasses of fowls dead of the disease, and the finding of virulent tubercle bacilli in eggs from infected hens.

FOOT-ROT IN SHEEP

Serious outbreaks of foot-rot in sheep in the Middle West in 1906, followed a year or two later by the appearance of lip-and-leg ulceration, led to the study of *Bacillus necrophorus* (later known as *Actinomyces necrophorus*) and its economic importance. This bacillus was found to be one of the destructive organisms present in cases of foot-rot of sheep and cattle, in lip-and-leg ulceration of sheep, in necrotic stomatitis of swine, and in calf diphtheria. The Pathological Division devised methods for the control of necrobacillosis in the field, and after getting this work firmly established, it was transferred to the Field Inspection Division to be continued as a regulatory activity.

OPHTHALMIA

Occasionally in the fall of the year cattle arrive at various public stockyards totally blinded because of enlarged eyes showing opaque corneas. Bacteriological study of the affected eyes showed the presence of diplococci, but all attempts to transmit the disease to other cattle failed. Another investigation made in 1917 also was unsuccessful.

EFFECTS OF FEEDING COTTONSEED MEAL

Laboratory tests demonstrated the presence of pyrophosphoric acid in certain cottonseed meals. Feeding experiments demonstrated that when this salt was fed in even less amounts than were found is one pound of the meal it would, if fed daily, induce symptoms in pigs closely resembling those observed after feeding cottonseed meal ground from the seeds of certain varieties of cotton plants. It was also found that certain varieties of cottonseed are practically non-toxic unless heated.

FOOT-AND-MOUTH DISEASE*

In 1902 foot-and-mouth disease made its appearance in eastern Massachusetts, and again in 1908 it suddenly developed in cattle shipped to the Buffalo yards from Michigan. It was noted that both of these outbreaks originated near farms where calves were kept which had been used in the cultivation of smallpox vaccine. Dr. Mohler succeeded in getting some of the imported seed virus that had been used by the vaccine laboratories during 1908 on the calves which carried the disease from the laboratories to the farms where they were sent. In cooperation with the Hygienic Laboratory of the U. S. Public Health Service, he tested the virus on susceptible calves and sheep, with the result that typical cases of foot-and-mouth disease were produced. This made it evident that the 1908 outbreak of foot-and-mouth disease in this country was introduced through contaminated imported vaccine, and the outbreak of 1902 probably had a similar origin. This Division also took a prominent part in confirming the diagnosis and in outlining the methods of procedure in combating the foot-and-mouth disease outbreaks of 1902, 1908 and 1914-15.

BIGHEAD OF SHEEP

A disease of sheep known as bighead took heavy toll from the flocks on the ranges of Idaho, Utah and Wyoming for many years. Many theories had been advanced as to the cause of these losses,

* See "Field Inspection Division," page 280, and "Expert Trade in Cattle and Meats," page 8.

such as drinking alkali water, breathing gases emanating from cracks in the ground, or drinking water from melting snow. The investigation of this disease in 1910 resulted in the collection of important information which seems to point to the ingestion of certain species of plants present on the range combined with certain atmospheric conditions as the probable cause of the disease.

FORAGE POISONING

A number of other investigations of importance to the farming public have been made by the Pathological Division, among which may be mentioned the study of forage poisoning in horses. The theory of the relationship of botulinus poisoning as a possible factor in the etiology of the disease was developed during the investigation of this disease. During 1912 and 1913 the losses of horses from forage poisoning were extremely heavy. Kansas and Nebraska were the principal sufferers, although the trouble was prevalent in Georgia, Louisiana, Maryland, New Jersey, Oklahoma and Oregon. While the active agent in the development of the disease is not yet definitely known, it is evidently conveyed to the animal by means of feed or water, since the spread of the infection is usually promptly checked by complete change of pasture.

HEMORRHAGIC SEPTICEMIA

Various outbreaks of hemorrhagic septicemia have been investigated by the Pathological Division. The organism has been identified in cattle, hogs, sheep, goats, buffaloes, horses, rabbits and fowls. Bacilli from all these various species of animals have been recovered and grown upon artificial media for many years in our laboratory.

In December, 1911, a request was received from the Director of the National Park Service, through Dr. E. J. Cary of the Bureau of Animal Industry, that an investigation be made into the losses of buffaloes in the Yellowstone National Park. It was stated that 22 buffaloes had died in two weeks. Tissues were forwarded to the Pathological Division, and from them the bipolar organism causing hemorrhagic septicemia was isolated. A vaccine was prepared with which the entire herd was vaccinated once a year during the years that have ensued, and by this means the disease apparently has been controlled.

Extensive investigations were made during the past year on the question of the cause of a souring of hams, the results of which

indicated that the packing-house manipulations were at fault, rather than a diseased condition of the meat as had been suggested.

CHRONIC BACTERIAL DYSENTERY

In 1908 the attention of the Bureau was directed toward a heifer at the quarantine station at Athenia, N. J., that was gradually growing thinner and weaker in spite of the best of care and feed. Dr. Mohler was called to Athenia to make an investigation, and it was soon learned that the animal was suffering from an attack of chronic bacterial dysentery. This was one of the early recorded cases in which the presence of this disease in the United States was definitely proved by the usual clinical and bacteriological examinations.

CONTROL OF BIOLOGICAL PRODUCTS*

A law was passed by Congress on March 4, 1913, regulating the manufacture, sale and shipment of viruses, serums, toxins and analogous products used in the treatment of domestic animals. This law became effective on July 1, 1913, and the Bureau of Animal Industry was charged with its administration. A portion of the work indicated by the law was assigned to the Pathological Division, including the examination of stock cultures used by commercial establishments in the preparation of biological products, and the inspection of samples of the finished products, to insure their potency and freedom from contamination. During the first year the law was in effect the Pathological Division rejected 2,813,003 cubic centimeters of commercial biological products, as worthless or contaminated.

An extensive investigation of the effectiveness of the ophthalmic mallein test for the diagnosis of glanders was made in the year 1914. Practicing veterinarians, State and municipal officials throughout the country cooperated with the Bureau in conducting this test. Ophthalmic mallein was furnished gratis to reliable veterinarians who desired to make a careful study of the ophthalmic test to determine its reliability. A large majority of those who used this test seemed to prefer it to the subcutaneous application of mallein.

Numerous letters were received during the year 1921 calling attention to rat viruses on the market, represented to be sure exterminators of rats. Samples of these viruses were obtained and subjected to careful tests with the result that most of them were found to be absolutely worthless as rat destroyers.

* See "Division of Virus-Serum Control," page 342.

BLACKLEG AND ANTHRAX

Early in 1897 the Pathological Division began the manufacture and free distribution of a vaccine for immunizing susceptible cattle against blackleg. This undertaking grew rapidly until in 1917, when more than six million doses were being supplied yearly to cattle raisers. The use of this vaccine brought marked relief to the cattlemen who had become greatly discouraged owing to the heavy losses they had sustained. The preparation and distribution of the vaccine was discontinued June 30, 1922, by Act of Congress.

Anthrax vaccines on the market in 1913 and for some time prior were proving unsatisfactory in many cases. An investigation by the Pathological Division revealed that the vaccines then in use frequently lost potency if stored for several weeks before being used. Experiments were made in the hope of finding a way of correcting this fault, and finally the spore vaccine used by Selavo of Italy was substituted for the bacterial vaccine then in general use. It was learned that the spore vaccine would retain its original potency longer than other forms of cultural vaccine, although it could not be relied on indefinitely. Serum derived from the blood of hyperimmunized horses was used with the spore vaccine for protective purposes, but it seemed also to possess some value as a cure.

CASEOUS LYMPHADENITIS OF SHEEP

In 1899 an investigation was made of a disease of sheep which, on post-mortem examination, were found to be affected with enlarged caseous lymph glands. It was first reported from southern California in 1897, soon after meat inspection was established there. As a result of this study it was determined that the disease was caused by an organism called *Bacillus pseudo-tuberculosis* of Preisz. The disease prevails in certain districts of the United States, but owing to its benign nature and very chronic course, its presence is seldom noted except on post-mortem examination of the affected animals. All classes of sheep are equally susceptible, but fatal cases are rarely known. In some instances the lungs may be studded with caseous nodules, producing a condition which may be mistaken for tuberculosis. The liver and spleen and in rare instances the kidneys may also contain one or more of the characteristic nodular lesions.

DISEASES OF BIRDS AND POULTRY

Much valuable work on the diseases of birds and fowls has been accomplished in the Pathological Division. Various diseases of birds,

known to exist in other countries, were recognized here as a result of laboratory investigation, and several new diseases were discovered. More effective means of combating outbreaks of disease have been devised, and publications having for their object the dissemination of information to veterinary practitioners, poultry owners, and those engaged in avian disease investigations have been issued.

It was reported to the Bureau in the fall of 1893 that infectious enterohepatitis (blackhead) was destroying many turkeys in New England. In some sections the disease had become so prevalent and destructive that turkey raising was being discontinued. Dr. Smith began an investigation of the disease that led to the discovery by him in 1894 of a minute parasite in the internal organs of the affected turkeys which he demonstrated to be the cause of the disease, and named it *Amæba meleagridis*.

In 1895 a description was given of a disease of fowls which no doubt had been frequently mistaken for cholera. The disease was called infectious leukemia and its causative microorganism *Bacterium sanguinarium*. This disease is now known as fowl typhoid and is one of our most common poultry diseases.

From the time the Bureau was established it has been interested in the welfare of the animals, birds and reptiles exhibited at the National Zoological Park. Fatalities are reported regularly to the Bureau and postmortems are conducted by some representative of the Pathological Division. Thus, in connection with rendering assistance in maintaining the health of these animals in the Park an unusual opportunity is presented for the study of diseases having a wide range of characteristics.

Early in 1901 a highly fatal disease of chickens was investigated by the Division and was found to be caused by a nonpyogenic streptococcus. Methods were developed for immunizing susceptible birds. The disease, not having previously been described, was given the name apoplectiform septicemia. It was later observed affecting chickens in Sweden and the results above mentioned were confirmed.

Bacillary white diarrhea of baby chicks is one of the most destructive diseases of poultry. Since its primary source is the infected hen, and the causative microorganism, *Bacterium pullorum*, is transmitted through the egg, the principal problem in its control is the detection and elimination of the adult carriers. During 1916 an intradermal test for application in the field was developed and found to compare favorably with the laboratory serum test.

Coccidiosis is another disease which causes heavy losses of chicks

between three and eight weeks old. This disease was investigated by the Pathological Division during the year 1907 and found to be caused by a protozoan organism named *Eimeria avium*.

Extensive experiments for the purpose of establishing an immunity in fowls against fowl cholera were conducted during 1915 and 1916. It was found that bacterins did not serve as immunizing agents, but that a marked resistance against the disease could be induced by the injection of a living culture of a non-virulent strain of the fowl cholera organism.

A highly contagious and rapidly fatal disease of quail, designated "quail disease," was first studied by the Bureau during the year 1906. The colon bacillus was found associated with the lesions, as had been shown by Klein in England. This disease has proved very destructive among the quail captured in Mexico and shipped to the United States for stocking game preserves. A further study of this disease in birds of Mexican origin in the spring of 1920 disclosed the fact that a coccidium is a causative agent in the production of the disease. It was found that recovered quail remain carriers of the organism and that fowls are not susceptible to this species of coccidium.

During January of 1916, an investigation of a disease among imported quail resulted in the discovery that these birds are susceptible to bird pox, and experiments disclosed that the disease could be transmitted from quail to chickens.

Considerable variation in tolerance to drugs of a toxic nature exists in animals of different species. While these variations have been pointed out in the case of mammalian species, little information is found in literature on the toxicity to the avian class of drugs or poisonous substances which may be of value in the treatment or control of bird diseases. During 1918 experiments were carried out for the purpose of determining the toxic and lethal doses for fowls of 27 of the more commonly used medicinal agents, and of poisonous substances to which fowls not infrequently have access.

TAKOSIS OF GOATS

Considerable interest developed in dairy sections in goat raising in 1901 and 1902, and many goats were shipped from southern localities, where they were numerous, to more northern sections. After such transportation a destructive disease appeared in many instances, and extensive investigation was at once begun to determine the nature of the disease. The lungs and digestive organs of the goats were affected,

causing a steady wasting of the diseased animal, hence the name takosis was applied to the disease. The losses were caused by a small coccus which spread rapidly into the various tissues of the goat. To this destructive organism the name *Micrococcus caprinus* was given. Measures for checking the spread of takosis among goats were devised.

MILK FEVER

For many years dairymen whose herds were composed of heavy-milking cows had suffered serious losses from milk fever. In 1904 great relief from this scourge was given by the discovery in Europe that distention of the udder of the affected cow with oxygen or sterile air would give relief, and in many instances would save the life of the animal. Studies carried on by the Division at this time proved that the injection of filtered atmospheric air was very effective in curing the trouble and an apparatus was perfected for its administration.

AMEBIC DYSENTERY IN MONKEYS

In 1916 a study was made of an outbreak of a fatal disease among the monkeys at the National Zoological Park. The disease occurred among a group of spider monkeys. Eight of the nine which became affected died of dysentery. Protozoan organisms having the general structure and characteristics of the ameba generally considered the causative agent of human "tropical dysentery" were isolated from the diseased animals.

COCCIDIOIDAL GRANULOMA

An infection of cattle known as coccidioidal granuloma was observed and studied in 1918. Natural infection of the bronchial and mediastinal lymph glands was determined, and the causative parasite recovered.

SWAMP FEVER

A destructive disease known as swamp fever, typhoid of horses, and infectious anemia, appeared among horses in several Western States that were kept in low-lying sections and was called to our attention in 1906, when the Division began an investigation. Many valuable facts were learned regarding the disease, especially in regard to its transmission from horse to horse. By making use of these facts horses could be saved from contracting the infection, although no satisfactory remedy has been discovered for curing cases that are once established.

VESICULAR STOMATITIS

In November, 1916, a shipment of 130 head of cattle from Wauneta, Nebr., was held at the Kansas City stockyards because 57 of the animals showed symptoms and lesions suspicious of foot-and-mouth disease. Immediately the Bureau began a series of experiments which established the diagnosis of vesicular stomatitis. Among the subjects that received consideration during the study of this outbreak was the nature of the causative organism, its virulence, resistance and transmissibility, and immunization and the effects on the virus of its passage through a series of calves. It was developed in the study of vesicular stomatitis in this country that in any future outbreaks of disease bearing a resemblance to foot-and-mouth disease horses should be inoculated with suspected material. The outbreak of 1916 was the first outbreak of vesicular stomatitis in the United States brought to the attention of the Bureau, and its work on this outbreak was the first, so far as is known, that was done in the United States.

BUTTER COLOR TOXICITY

In 1918 the Pathological Division cooperated with the Bureau of Chemistry in an investigation of the toxicity of various butter-coloring preparations that were on the market for sale to the public. Several of the colors then in use were found to possess irritant properties when applied to the skin and mucous membranes of test animals, but most of the colors proved to be harmless.

BOTULISM

During the year 1920, several opportunities were presented for the Pathological Division to cooperate with the Bureau of Chemistry in a study of *Clostridium botulinum* (formerly known as *Bacillus botulinus*) obtained from cans of spoiled olives, spinach and corn. Cultures of the organism from these sources were found to be extremely poisonous for test animals, 0.0001 cubic centimeter proving fatal to guinea-pigs. The growth of *C. botulinum* in canned vegetables is accompanied by the production of gas, as well as the formation of its specific toxin. Antitoxin for both types of *C. botulinum* were prepared and considerable quantities of the product have been sent to other laboratories for experimental use. In several instances this antitoxin was supplied for use in treating human and equine cases of botulism.

SWINE ERYSIPELAS

The appearance of swine erysipelas in the United States has not been marked by any serious outbreaks resulting in large numbers

of fatalities, as have been known to occur in European countries where the disease is prevalent. In fact the presence of this disease in the United States was not positively demonstrated until 1920 when Dr. Creech, of the Pathological Division, in a number of cases isolated an organism from urticarial lesions of swine, or the so-called "diamond skin disease," which possessed all the characteristics, culturally, serologically and in its pathogenicity for experimental animals, of *Erysipelothrix porci* (formerly *Bacillus erysipelatis suis*). As a result of his findings the conclusion was reached that "diamond skin disease," which has long been known to exist in this country, is caused by *E. porci* and should therefore be classed as a chronic form of swine erysipelas. More recently a few isolated cases of the disease in the acute form have been observed in this country.

POISONOUS PLANT INVESTIGATIONS

The investigations of poisonous plants and their effects seem to have been started in the United States Department of Agriculture with the appointment in 1894 of Mr. V. K. Chesnut as assistant botanist in charge of poisonous-plant investigations. The work to be conducted by Mr. Chesnut was assigned to the Division of Botany (afterwards made a part of the Bureau of Plant Industry). The first laboratory space assigned to poisonous plant investigations was in the Bureau of Animal Industry under Dr. de Schweinitz; later, laboratory space was occupied in the Bureau of Chemistry, and still later, laboratory and office space was assigned for this work in the Thirteenth Street building. During the time in which Mr. Chesnut was connected with the poisonous-plant work, Dr. Reid Hunt carried on some pharmacological studies, particularly on death camas, doing the chemical work in the Bureau of Chemistry, while the pharmacological work was done in Johns Hopkins University. Dr. Hunt probably did the first pharmacological work which was undertaken in the Department of Agriculture. Dr. Torald Sollmann, who also participated in the poisonous-plant investigations, made a special study of the lupines. His laboratory work was done in Western Reserve University.

In the late summer and fall of 1903 Dr. H. T. Marshall was employed by Mr. Chesnut to make a special investigation of the loco problem in Montana. During Mr. Chesnut's connection with this work a considerable number of valuable papers were published, the most important being Bulletin No. 26, entitled "The Stock Poisoning Plants of Montana," by V. K. Chesnut and E. V. Wilcox. Mr.

Chesnut organized in a detailed way an administrative office, and amongst other things left a most valuable card index of poisonous plants. He continued in charge from 1894 to 1904, and after his separation from the Department he continued for a year or more to serve as a collaborator.

After Mr. Chesnut left the Department of Agriculture, the investigation of poisonous plants was assigned to Dr. Rodney H. True, whose title at that time was physiologist in charge of drug plant, poisonous plant and tea investigations. During the summer of 1904, under Dr. True's direction, and with the cooperative assistance of Mr. Chesnut, Dr. H. T. Marshall carried on a series of field experiments with loco plants in Montana. The results of these loco experiments were not published by the Department, but appeared some years later in a bulletin published by the University of Virginia.

In 1905 Dr. C. D. Marsh was engaged by Dr. True as an expert to begin a series of field investigations of loco poisoning. Dr. Marsh later received the title of physiologist in charge of poisonous-plant investigations, and has continued in that work up to the present time. The loco investigations which were begun by Dr. Marsh were initiated largely through the efforts of certain citizens of Hugo, Colo., especially Judge C. M. Miles and Mr. J. J. Keppel. A house and land suitable for pastures were obtained at Hugo, Colo., where the work was carried on for four years. This work was conducted in cooperation with the Agricultural Experiment Station of Colorado, the Experiment Station furnishing the first lot of animals that was used for experimental purposes.

During the time the station was located at Hugo a subsidiary station was operated at Woodland Park, at the base of Pike's Peak. Another station was located at Imperial, Nebr., with the cooperative assistance of the Experiment Station of Nebraska.

After the closing of the Hugo station in 1908, another station was established in 1909 on the Gunnison National Forest Reserve in Colorado, for the special purpose of studying the problem of larkspur poisoning. This station was furnished by the Forest Service through a cooperative agreement, and investigations were conducted there for three successive summers. In addition to other assistance, a botanist had been engaged for this work during the occupation of the Hugo station. During the period of occupation of the Gunnison National Forest station, two botanists were connected with the force. For some years the Forest Service assumed the salary of one

botanist, as well as the expense of providing an experiment station. At the conclusion of the work on the Gunnison National Forest Reserve, a station was established in 1912 near Greycliff, Mont., for the special study of poisonous-plant problems in the Yellowstone Valley. This station, too, was provided by the Forest Service, and was occupied for three successive summers.

In 1915 an experiment station was established on the Fishlake National Forest at Salina, Utah. This station also was provided by the Forest Service through a cooperative arrangement. The preceding stations had many inconveniences, as they were regarded as temporary. The new Salina Experiment Station was somewhat more elaborate than any of the previous stations, as three houses, a barn and extensive corrals were built, and the large pastures were fenced.

Since 1915 the experimental work in the investigation of poisonous plants has been carried on by the Pathological Division of the Bureau of Animal Industry. The force engaged in this work has been gradually enlarged until at the present time, in addition to the general experiments to ascertain the effect of poisonous plants on animals, attention is also given to a study of the chemical and pathological properties of these plants.

Many improvements have been added in the conduct of the work of the station, so that it is now run as a fairly complete animal hospital. A careful record is kept of the symptoms exhibited by poisoned animals, of the results of a study of the poisonous principles of the plants, of the habits and distribution of the plants, and of measures which can be taken to reduce the extremely heavy losses of range animals. Most of the investigations have been confined to the western United States because of the extremely heavy losses of animals on the range. Some work, however, has been done on poisonous plants found in the East.

The poisonous-plant investigations have been conducted in cooperation with other agencies. Formal cooperative assistance has been received from the State Experiment Stations of Colorado and Nebraska. The railroads of the West have in many ways rendered most important assistance. The Forest Service has cooperated in material ways, and the Bureau of Plant Industry has given great assistance by furnishing a botanist for the force. Assistance has been received at various times also from the Bureau of Chemistry, although there has been no formal cooperation from that Bureau.

While the project was under the direction of Dr. True, Dr. A. C. Crawford was engaged for the chemical and pharmacological work

and remained in the Bureau of Plant Industry until 1908. He was then transferred to the Pathological Division of the Bureau of Animal Industry, where for two years he was engaged in the study of loco weeds, mistletoe and cottonseed. Later in the year Dr. C. L. Alsberg took Dr. Crawford's place in the Bureau of Plant Industry and devoted part of his time to chemical and pharmacological work on poisonous plants. When Dr. Alsberg became Chief of the Bureau of Chemistry in 1912, Mr. O. F. Black continued the chemical work until the Bureau of Animal Industry took up the poisonous-plant investigations.

While the work was being carried on at Hugo, Colo., in addition to other temporary assistants, Mr. A. B. Clawson became a permanent member of the force. He has had immediate charge of much of the experimental work and is now the pathologist of the office.

Some of the heaviest losses among range animals are due to poisonous plants. It has been estimated that in Colorado alone the annual loss from this cause is \$1,000,000. The annual loss of sheep in Wyoming is also very great. A few years ago the plants causing these losses were not known, but research in the field and in laboratories has revealed a number of them. Measures have been taken to protect the stock by advising the owners of animals of the varieties of plants which are poisonous, their location, habits, etc. The losses from poisonous plants, through this information, are being rapidly reduced.

COLLOIDAL GOLD TEST

During the year 1922 the colloidal gold test was applied to the spinal fluids of a number of animals which had died of various diseases. Particular attention was paid to dourine because of its analogy to syphilis, which responds to the colloidal gold test.

The Schick test was applied to horses during the year 1922 to demonstrate the presence of diphtheria antitoxin. It was found that serum from certain normal horses in quantities of 1 cubic centimeter would neutralize several minimum lethal doses of diphtheria toxin for guinea-pigs. This protection was demonstrated by the application of the Schick test to be due to the presence of diphtheria antitoxin.

CONCLUSION

The Pathological Division has been in existence for thirty years, every day of which has been employed in the betterment of conditions of the livestock of the United States. It has been and still is

used as a court of last resort by veterinarians and State officials in the diagnosis of obscure diseases of animals, by which means material aid has been given in quickly checking dangerous diseases of animals. Many outbreaks of anthrax, rabies, blackleg, etc., have thus been "nipped in the bud."

The workers of the Bureau of Animal Industry have been exceedingly modest in seeking public acclaim, but on numerous occasions results of their research have been used to excellent advantage in various Government activities not of the character of research. For instance, the discovery by Dr. Mohler of surra in an importation of Zebu cattle kept this disease out of the country. The detection of Malta fever in a shipment of goats from Europe doubtless saved goat herds of this country from becoming infected. The results obtained from the investigations in the laboratories has proved of great assistance to practicing veterinarians of the country, who freely consult the research laboratories.

SUMMARY OF IMPORTANT EVENTS

1884. Bureau established, May 29.
 Dr. Theobald Smith appointed, July 1.
 Ergotism in Kansas studied.
 Glanders outbreak investigated.
 Parasitic bronchitis of calves studied.
 Trichiniasis in American hogs determined.
1885. Gapes in chickens studied.
1886. First inoculation with hog-cholera virus for prevention of disease.
 Hog cholera and swine plague proved separate diseases.
1887. Examination of cholera hogs from various points shows presence of constant bacteria.
1888. Dr. Salmon given charge of D. C. horses for eradication of glanders.
 Strauss method of diagnosis of glanders used.
 First attenuation of hog-cholera germs by heat.
1889. Inoculation of hogs for the prevention of hog cholera.
 Noticeable spread of tuberculosis observed.
Piroplasma bigeminum discovered as the cause of Texas fever.
 Agency of ticks in the transmission of Texas fever discovered.
1890. Tuberculin introduced by Dr. Robert Koch.
 Mallein discovered in Russia by Helman and Kalning.
1891. Division of Animal Pathology (afterwards Pathological Division) established, April 1.
 Dourine discovered in Nebraska.
 W. S. D. Haines's drawings first appear in Annual Report.
 Mallein investigated as to effectiveness and reliability.
 Tuberculin studied by Smith and De Schweinitz.
1892. First case of rabies in the District of Columbia scientifically proved.

1893. Slaughter of horses affected with dourine in Nebraska and South Dakota.
Blackhead in turkeys investigated by Dr. Theobald Smith.
Active study of tuberculosis begun.
1894. Study of infectious leukemia begun.
1895. Dr. Theobald Smith announces difference between human and bovine tubercle bacilli.
Various forms of pneumonia described.
1897. Free distribution of blackleg vaccine begun.
1898. Bacteriological study of milk begun.
Experiments with cattle dips for killing ticks.
1900. Plexiform ganglion used in the diagnosis of rabies.
Bacillus of infectious abortion isolated from cows in D. C.
1901. Mycotic stomatitis of cattle investigated.
Dermal mycosis of horses studied.
Tests made on army horses at St. Asaph for glanders.
1902. Foot-and-mouth disease occurs in New England.
Enteritidis affects cattle at St. Elizabeth's Hospital.
Infectiveness of milk from tuberculous cattle studied.
Study made of takosis in goats.
1903. "Negri bodies" in rabies discovered by Negri of Italy, and the demonstration of these bodies has been used as a rapid diagnostic procedure in this laboratory since then.
1904. Foot rot of sheep and *Bacillus necrophorus* (*Actinomyces necrophorus*) studied.
Dourine studied at Alfort, France.
1905. Malta goats imported.
Successful artificial growing of protozoa in Pathological laboratory.
Bee parasites determined.
1906. Zebu cattle imported.
Experiments in immunization against tuberculosis.
Study of tuberculosis in hogs.
Experimental feeding of cottonseed.
Tuberculin testing of D. C. cattle begun.
Quail disease investigated.
Eradication of tuberculosis from D. C. cattle begun.
1907. Effect of cattle diseases upon milk supply studied.
White diarrhea of incubator chicks studied.
1908. Moved to permanent laboratory in East Wing.
Effects of smelter fumes investigated.
Foot-and-mouth disease discovered at Buffalo.
Konew's method of diagnosing glanders adopted.
Transfer of avian tuberculosis to mammals.
Length of life of typhoid bacilli in milk studied.
1909. Infectious ophthalmia of cattle investigated.
Viability of tubercle bacilli in butter and cheese studied.
1910. Cottonseed meal studied.
Complement-fixation adopted for the diagnosis of glanders.
Bighead of sheep studied.
Chronic bacterial dysentery of cattle investigated.
1911. Ringworm of sheep studied.
Hemorrhagic septicemia in buffaloes at Yellowstone Park.

1912. Investigation of Malta fever in Texas.
 Forage poisoning in Kansas and Nebraska.
 Systematic study of abortion disease begun.
 Botulism of horses studied in an experimental way.
1913. Federal control of viruses and serums begun.
1914. Foot-and-mouth disease appears in Michigan and other States.
 Reliability of ophthalmic test for glanders studied.
 Hairless pigs investigated.
1915. Investigation of plant poisoning of stock transferred to the
 Division.
 Experiments in anthrax vaccination made.
1916. Investigation of various treatments for anthrax.
 Observations made on amebic dysentery in monkeys.
 Chicken pox discovered in quail.
 New method of diagnosis for presence of *Bacterium pullorum*.
 Immunity tests in fowl cholera.
 Multiple pipette devised.
1917. More than 6,000,000 doses blackleg vaccine distributed.
 Investigation of anthrax germs in tannery refuse.
1918. Examination of a disease of the eyes of cattle.
 Improvement of methods in complement-fixation test for dourine.
 Experiments in avian toxicology.
 Coccidioidal granuloma in cattle studied.
1919. Experiments made with butter colors.
 Army horses tested on return from World War.
1920. Study made of botulism.
 Tuberculosis occurs in a flock of goats.
 Study made of swine erysipelas.
 Natural transmission of quail disease investigated.
1921. Softened, cured hams investigated.
 Various rat viruses examined.
1922. Colloidal gold test of dourine samples investigated.
 Schick test applied to horses for detection of antidipteria toxin.
 Botulinus antitoxin prepared.
1923. Studies of rabies immunization method made.
 Detection of trypanosomes in blood of imported camels.
 Studies made of ham souring.

PERSONNEL OF THE PATHOLOGICAL DIVISION

Chiefs of Division:

- Dr. THEOBALD SMITH, from July 1, 1884, to May 15, 1895.
 Dr. VERANUS A. MOORE, from May 15, 1895, to Sept. 30, 1896.
 Dr. VICTOR A. NØRGAARD, from November 1, 1896, to December 1, 1901.
 Dr. JOHN R. MOHLER, from December 1, 1901, to July 1, 1914.
 Dr. ARCHIBALD R. WARD, from July 1, 1914, to July 1, 1915.
 Dr. ADOLPH EICHHORN, from July 1, 1915, to December 31, 1916.
 Dr. JOHN S. BUCKLEY, from January 1, 1919, to date.

Acting Chief of Division:

- Dr. JOHN S. BUCKLEY, from January 1, 1917, to January 1, 1919.

Assistant Chief of Division:

- Dr. HENRY J. WASHBURN, from February 1, 1907, to January 16, 1909.

Acting Assistant Chiefs:

DR. CHARLES F. DAWSON, from May 15, 1895, to March 1, 1900.

DR. JOHN R. MOHLER, from March 1, 1900, to December 1, 1901.

DR. HENRY J. WASHBURN, from December 1, 1901, to February 1, 1907, and from January 16, 1909, to July 1, 1915.

DR. JOHN S. BUCKLEY, from July 1, 1915, to December 31, 1916.

DR. HENRY J. WASHBURN, from January 1, 1917, to date.

Zoological Division

GENERAL REVIEW

The Zoological Division was apparently first recognized as a distinct entity in 1891, when Dr. Charles Wardell Stiles was appointed as Assistant in the Division of Animal Pathology June 3, 1891, and placed in charge of the branch known as the Zoological Laboratory.

Before the establishment of the Zoological Laboratory, however, Dr. Cooper Curtice, who entered the Bureau August 1, 1886, and served under his first appointment until May 31, 1891, had conducted investigations on the parasites of domestic animals and had contributed some highly important facts to our knowledge of these organisms, among others the essentials of the life history of the Texas fever tick* (published in 1891), description of the parasite causing nodular disease of sheep (*Esophagostomum columbianum* Curtice, 1890), discovery of the migration of ox-warble larvæ in early stages from the esophagus toward their final location beneath the skin of the back (1890-1891), and formulation of the probable life cycle of this parasite which has been verified by subsequent investigators except as to the mode of entrance of the larvæ into the body. Dr. Curtice overlooked the fact, more recently established, that the newly hatched larvæ penetrate the skin at the base of the hairs on which the eggs of the fly are laid and later appear in the esophagus. He assumed that the larvæ are taken into the mouth as a result of the cattle licking themselves and thus reach the wall of the esophagus where they spend a considerable period of their life history before continuing their migration up to the back to complete their larval development.

Dr. Stiles continued in charge of the Zoological Laboratory until June 1, 1903, having, however, resigned his appointment in the Department of Agriculture, August 5, 1902, to accept a position as Chief of the Division of Zoology of the Hygienic Laboratory of the U. S. Marine Hospital Service (now the U. S. Public Health Service), devoting thereafter, through a cooperative arrangement between the two Bureaus, a portion of his time to the Bureau of Animal Industry, pending selection of his successor in that Bureau.

During the service of Dr. Stiles in the Bureau of Animal Industry he carried out many investigations on animal parasites, as is attested by the copious bibliography of Stiles, Stiles and Hassall, and Salmon and Stiles, on subjects such as trichinosis and other zoological

* See "Tick Eradication Division," page 319.

questions relating to meat inspection, tapeworms of cattle and sheep, roundworms of cattle, sheep and goats, flukes of cattle, sheep and swine, hookworms, zoological nomenclature, and numerous other subjects.

For about a year, beginning in the spring of 1898, Dr. Stiles represented the Department of Agriculture as Scientific Attaché to the American Embassy at Berlin, conducting some investigations in Germany which demonstrated the incorrectness of certain allegations relative to the frequent origin of trichinosis cases in Germany from imported American pork.* Dr. Stiles showed that no cases that could be traced to American pork had occurred in Germany, and on the other hand that over 32 per cent of the cases of trichinosis in that country during a period of about 18 years could be traced to pork that had been inspected and passed by German inspectors as free from trichinæ, thus demonstrating very clearly the frequent failure of microscopic inspection as a prophylactic measure, and also throwing considerable light upon the true reasons for foreign discrimination against American pork.

Probably the most noteworthy contribution made by Dr. Stiles during his service in the Bureau of Animal Industry was his discovery of the American hookworm of man, *Necator americanus* (Stiles, 1902), and the establishment of the fact that hookworm disease is not only widely prevalent in the Southern United States, but is one of the most important public-health questions of the South. This work on hookworms has led to great improvements in rural sanitary conditions. The world-wide campaign for hookworm eradication which has been in progress for several years under the auspices of the International Health Board may be looked upon historically as tracing back more or less directly to the hookworm work of Dr. Stiles.

Dr. Brayton H. Ransom was appointed Scientific Assistant in charge of the Zoological Laboratory June 1, 1903, and has continued in charge until the present time. With him have been associated a number of other investigators, among them Dr. Cooper Curtice, Dr. Albert Hassall, Dr. Maurice C. Hall, Dr. Marion Imes, Dr. E. A. Chapin, Miss E. B. Cram, Dr. H. B. Raffensperger, Dr. Benjamin Schwartz, Dr. H. W. Graybill, Mr. Howard Crawley, and Dr. H. G. May, of whom the first eight named are still engaged in the Division.

It is uncertain when the Zoological Laboratory first began to be

* See "Export Trade in Cattle and Meats," page 8, and "Meat Inspection Division," page 261.

known informally as the Division of Zoology or Zoological Division. The latter names appear for the first time in the Annual Report of the Bureau for the year 1901.

Under the direction of Dr. Ransom the Division has continued to contribute to the advance of knowledge in the subject of parasitology. Among the investigations carried on in the Zoological Division since 1903, the results of which have been published from time to time, may be mentioned investigations on gid in sheep, tapeworms and eye nematodes of poultry and other birds, stomach worms, hookworms and other nematodes of ruminants, scabies of cattle, sheep and swine, lice of hogs and cattle, cattle ticks, ear ticks, sheep ticks, sheep tapeworms, parasitic protozoa, tapeworm cysts of the muscles of cattle, sheep, hogs and reindeer, trichinosis, nematodes of horses, tapeworms of chickens and turkeys, intestinal roundworms of hogs, gullet worms of cattle, sheep and hogs, anthelmintics, ox-warbles, toxins of parasites, tapeworms of dogs and other carnivores, and parasites of various wild animals. In these investigations many facts new to science of more or less importance have been discovered.

Work done (1907-1912) in the Zoological Division on the arsenical dip, that indispensable agent in tick eradication, proved it to be a highly efficacious remedy for cattle ticks when properly used in proper strength, and established the strength and methods of use that would insure the destruction of the ticks without injury to the cattle. Investigations that established the thermal death point of trichinæ and the effects of refrigeration and various curing processes upon trichinæ led to the present methods used by the Bureau in dealing with the trichinosis question (1913-1920). The tapeworm cysts common in the muscles of sheep were proved to be the intermediate stage of a previously unrecognized species of dog tapeworm, instead of a dangerous human tapeworm as formerly supposed (1912-1913). The principal facts in the life history of the sheep stomach worm were determined in the Zoological Division (1906). Following various experiments on a smaller scale relating to the control of stomach worms in sheep, more extensive experiments have been in progress since 1914, when a farm of 160 acres near Vienna, Va., was leased for the purpose. By the investigational work done on this farm, a method of preventing stomach-worm losses among lambs has been devised, consisting in systematic dosing with 1 per cent copper sulphate solution combined with supplementary sanitary measures, which promises to prove satisfactory under

practical conditions. Other schemes that have been tried have failed to prevent losses, and others that prevented losses have proved unsuited to practical conditions or otherwise uneconomical.

Investigations in the Zoological Division have shown that the gullet worms of cattle, sheep and hogs have their intermediate stages in dung beetles (1914), and that a common stomach worm of horses passes its intermediate stage in the house fly—this latter discovery (1911) leading to the further important discovery by French, Belgian and Australian investigators that the larvæ of this and closely related worms which cause "summer sores" and dermal granulomata are introduced into the skin by infested flies feeding on wounds and moist surfaces. Numerous important facts have been discovered concerning anthelmintics, including the establishment (1921) of the anthelmintic properties of carbon tetrachlorid, which has proved a very valuable remedy for hookworms, ascarids and certain other parasites. In fact carbon tetrachlorid is not only a very valuable remedy for the treatment of certain intestinal worms of domestic animals, but appears destined to assume a similar importance in the treatment of human hookworm to that of quinine in the treatment of malaria and has already been used in the treatment of many thousands of patients in various parts of the world, with results highly superior to those obtained from any other remedy.

Investigations on gapeworms conducted in the Zoological Division during recent years (1916-1920) have shown that turkeys are a common source of gapeworm infection among chickens, that young chickens lose their susceptibility as they become older, whereas old as well as young turkeys are susceptible and commonly harbor gapeworms without showing evidence of infection, facts of immediate importance in the control of gapeworm disease and of considerable scientific interest in their bearing on the general question of parasitism.

The theory advanced by one investigator that rats and mice serve as intermediate hosts of the common intestinal roundworm of human beings and hogs, based on observations made by him as to the migrations of the larvæ of this parasite, in artificially infected rats and mice, from the intestines to the lungs, and back again to the intestines before they are passed out of the body in the feces, and thus supposed to contaminate food or drinking water of human beings or pigs, has been disproved by extensive investigations begun in 1917 and carried on in the Zoological Division since that time, which have clearly demonstrated that in pigs as well as in small laboratory

animals the larvæ after hatching out in the intestine migrate to the lungs, and then back to the intestines, but in the pigs settle down in the intestine upon their return and develop to maturity, instead of passing out of the body in the feces as they do in the smaller laboratory animals. It has also been shown that the passage of the larvæ through the lungs of young pigs is liable to cause severe symptoms of the type commonly designated as "thumps," and that many of the losses of common occurrence among young pigs are caused by infection with this parasite. Another point of great importance from a practical standpoint that has been determined in the course of the investigations on the roundworm of the pig is the diminishing susceptibility to infection as pigs grow older. This and various other facts that have been learned have led to the development of a successful method of minimizing losses among pigs by taking certain simple precautions which more or less completely prevent roundworm infection until the pigs are past the most susceptible age. This method, which has been called the McLean County (Ill.) system of swine sanitation, has been demonstrated to be of great value in the practical prevention of verminous and other filth-borne diseases of swine, and is rapidly coming into use not only in McLean County but elsewhere in Illinois and in other States in the Middle West. The popularization of this method has been greatly facilitated by a motion picture film entitled "Exit Ascaris" which was prepared and issued by the Department in 1921.

Many new species of parasites have been discovered and described in the course of investigations carried on in the Zoological Division. The collection of specimens of parasites belonging to the Division is one of the largest in the world.

Another feature of the work of the Zoological Division which deserves special comment is the Index-Catalogue of Medical and Veterinary Zoology. This catalogue, which has been prepared in cooperation with the Public Health Service, has proved extremely valuable to all workers in the field of parasitology, and is one of the most important reference works in parasitology that has ever been published (1902-1921).

Throughout its history the Zoological Division has been active in research in the field of parasitology. As evidence of this activity, apart from the brief review which has been given above, it may be noted that the scientific books, pamphlets, and articles in periodicals published from the Division number more than 500.

Some of the activities of the Zoological Division that have been

mentioned in the foregoing general review are considered more in detail in the following discussion of various subjects that have been investigated in the Division. The subjects selected for special discussion are not necessarily those in which the most important results have been secured in the investigations carried on in the Zoological Division. The material presented should be taken as examples of work done in the Division and not as a comprehensive and well-balanced account of all that has been accomplished. The preparation of such a history in which the numerous parts comprising it are arranged in proper perspective, and emphasized or subordinated in accordance with their importance, has not been possible in the time available.

FRINGED TAPEWORM OF SHEEP (*Thysanosoma actinioides*)

The first parasitological investigation undertaken by Dr. Curtice after his appointment in the Bureau in 1886 was a study of sheep tapeworms in Colorado. Dr. Curtice's investigation of these parasites which he identified as the fringed tapeworm, a species first described from South America by Diesing in 1835, was carried on in Colorado in the late summer and autumn of 1886 and in the spring of 1887, and also in Washington, specimens and infested animals having been shipped from Colorado for the purpose. Dr. Curtice came to the conclusion that the fringed tapeworm, which then was, as it still is, one of the most common internal parasites of range sheep in the Western United States, has a considerable influence upon the health of the sheep and is very detrimental, especially to lambs and yearlings, and though sheep do not die from tapeworm disease alone, the parasite appears to render them more susceptible to other affections and less able to withstand the inclement weather of the winter. Then as now the fringed tapeworm was limited in its distribution to the portion of the United States west of the Mississippi. It has never become established in the East. Dr. Curtice found that the parasite persists in the adult stage in older sheep throughout the year. He discovered very small forms in lambs as early as the beginning of the third month of life and determined that it takes at least six months for the worms to attain their full growth. Young parasites may be found in sheep of any age at any time of year excepting possibly the winter months. Trials of various remedies failed to give satisfactory results. Attempts to infect lambs by feeding mature segments of the tapeworm and by keeping them in pens with infested sheep gave negative results. The investigations

threw no light on the question of the mode of infection. This, as in the case of all unarmed tapeworms of herbivorous animals, still remains a profound mystery, though we assume by analogy with what is known concerning the life histories of tapeworms, and considering the food habits of sheep, that the fringed tapeworm probably has an intermediate stage in some small invertebrate, possibly an insect, that is likely to be swallowed by sheep while grazing or drinking. Our knowledge of the fringed tapeworm has been extended but little since Dr. Curtice's investigations in 1886 and 1887. Other workers in the Division (Ransom, Hall) have since made investigations on this parasite and have spent much time and labor in attempting to find out the mode of transmission from one sheep to another without success. Experiments conducted by Ransom and Hall (reported in 1912) with extract of male fern as a remedy, claimed by de Renzi and others to give good results in certain cases of somatic taeniasis and found by Railliet, Moussu and others to be an efficacious remedy against *Fasciola hepatica*, which like *Thysanosoma actinioides* lives in the bile ducts, gave negative results. We are therefore still in the dark with reference to both prophylaxis and treatment of the fringed tapeworm.

CATTLE TICKS*

In 1889 Dr. Curtice worked out the essentials of the life history of the Texas fever cattle tick, demonstrating that the parasite grows to maturity on the animal to which it attaches as a seed-tick, which was a novel fact, as all other species of ticks whose life history was at that time known fall from the host at the completion of each stage and attach to a new host after molting. Dr. Curtice also noted the time required for the various stages to pass through their development from the beginning of the egg stage to the engorgement of the female. His experiments demonstrated that it was possible to rear ticks on cattle after hatching the seed ticks from eggs deposited by engorged female ticks in the laboratory, and thus facilitated the crucial Texas fever experiments carried out by Theobald Smith in 1890, in which cattle without exposure to Southern cattle or to ground contaminated by them were infected with Texas fever by placing upon them seed ticks that had emerged from eggs deposited by female ticks taken from Southern cattle.

Another noteworthy contribution made by Dr. Curtice to the cattle tick question was in 1896 when he read a paper before the

* See "Tick Eradication Division," page 318, and "Biochemic Division," page 174.

Virginia State Veterinary Medical Association in which he urged that the eradication of ticks be undertaken and outlined procedures by which this could be accomplished. During the years 1902 to 1906 Dr. Tait Butler made a practical demonstration of tick eradication on an extensive scale in North Carolina following up work begun in 1899 by Dr. Curtice as State Veterinarian of North Carolina, and finally tick eradication as a Federal project was launched in 1906.

In 1907 some extensive investigations on the effects of arsenical dips on ticks were begun in the Zoological Division, following some experiments the year before by Dr. J. W. Parker of the Bureau field force in Texas, which he had undertaken by direction of the Chief of the Bureau, who had been favorably impressed by the reports of the results of some trials of arsenical solutions as tick destroyers made by Dr. N. S. Mayo in Cuba. Simultaneously with Dr. Parker's experiments, tests were made by the Live Stock Sanitary Board of Texas, all of which indicated that arsenical solutions were valuable tick destroyers, confirming Dr. Mayo's experience in Cuba and the still earlier experience of others in Australia. It was finally established by the investigations made in the Zoological Division that ticky cattle if dipped twice at an interval of about a week in an arsenic, soda, and pine tar mixture (containing arsenic equivalent to 0.22 of 1 per cent of arsenic trioxid in the form of sodium arsenite, as shown by analyses of the dipping baths made by the Biochemic Division) would be freed from ticks, and could then be moved to clean ground without carrying viable ticks with them. In these investigations it was found that arsenic does not kill all of the ticks promptly and that some few may even survive to deposit eggs. In such cases, however, if the dipping is properly done, the ticks that survive to deposit eggs deposit smaller numbers than they normally do, and of those deposited few, if any, hatch, and the seed ticks hatching under these conditions do not long survive. The investigations also showed that cattle dipped in arsenical dip, if they continue to occupy tick-infested places, will rarely become re-infested with ticks until several days have elapsed. Thus it is evident why the method of tick eradication in general use at the present time—dipping in arsenical solution every 14 days—is effective. The ticks that get on the cattle between dippings are either killed or so seriously injured by later dippings that they produce few, if any, progeny, and, meanwhile, after each dipping the cattle are protected from reinfection for a period of several days. Thus the chances that the ticks will successfully complete their life cycle

after systematic dipping has begun are so greatly reduced that the degree of infestation rapidly decreases. Fewer and fewer ticks are found on the cattle, and at the same time the seed ticks on the pasture are dying from starvation if they do not become attached to the cattle; if they do attach they are caught by the next dipping. After about 16 dippings tick infestation of both cattle and pastures entirely disappears. It has been found in practice that when repeated dippings are given every two weeks a somewhat weaker arsenical solution can be used than that (0.22 per cent) established as efficacious in ridding cattle of ticks in two dippings.

From time to time following Dr. Curtice's early investigations various life-history studies of cattle ticks have been made in the Zoological Division and data have been collected and published by Graybill and others that have been very useful in practical tick eradication. Considerable attention has also been paid to the question of differentiation between the Texas-fever tick and the ticks of other species likely to be mistaken for it, and several publications have been issued giving the results of investigations on the taxonomy and morphology of ticks (Salmon and Stiles; Stiles and Hassall).

NODULAR DISEASE OF SHEEP

During the winter of 1888-1889 Dr. Curtice discovered the cause of nodular disease of the intestines of sheep, a very prevalent disease in the Southern and Eastern United States, commonly before and since that time mistaken for tuberculosis because of the gross appearance of the lesions. The cause of this condition was found to be the larva of a parasitic worm, a nematode belonging to a previously undescribed species of the genus *Æsophagostomum*, named by Curtice in 1890 *Æsophagostoma* (properly *Æsophagostomum*) *columbianum*. The larval worms which cause the nodules as a result of the irritation set up by their presence in the intestinal wall, after a certain amount of development, escape into the lumen of the intestine and live in the colon, where they develop to maturity, producing eggs that pass out of the body of the host in the feces. The nodules, at first resembling very small watery vesicles, increase in size and become filled with a cheesy material (hence the resemblance to tuberculosis lesions) which later, after the young worms have escaped or died in the nodules, may become more or less completely calcified. In some cases the nodules are extraordinarily numerous, and though their preferred location is the wall of the cecum they may be found anywhere along the intestine from the duodenum to the anus. Since Curtice's

observations were made the nodules have also been seen not uncommonly on the diaphragm and parietal wall of the abdominal cavity beneath the peritoneum, and superficially on the liver, in the mesenteric lymph nodes, and on the omentum. Dr. Curtice did not follow the life cycle of the worm from the time the eggs escape from the sheep's intestine until the young worms that hatch from them again return to a sheep's intestine and penetrate into the intestinal wall. In fact, all of the steps in this probable series of events have not even yet been definitely established for this particular species.

OX WARBLER

In 1890 Dr. Curtice published the results of some observations on ox warbles, which he at first considered to belong to the species *Hypoderma bovis* but later (1891) recognized as belonging to the other species of ox warble, *Hypoderma lineatum*, that materially modified the former conception of the life history of these parasites. It had previously been supposed that the young larvæ that hatched from the eggs deposited on the hairs of cattle by warble flies burrowed into the skin of the back and there developed into the large grubs which form the swellings on the backs of cattle commonly known as warbles, these grubs leaving the cattle when fully grown and after passing through a quiescent stage in the ground—the pupa—finally emerging as adult flies ready for reproduction. Dr. Curtice, however, was led to suggest from his observations that the young larvæ after hatching from the eggs on the hairs are swallowed as a result of the cattle licking themselves, or that the larvæ thus taken into the mouth lodge in the back of the mouth or in the esophagus, that they then remain for a considerable period in the wall of the esophagus, and later migrate from the esophagus up to the back of the animal. This theory was based on the appearance of the grubs in the walls of the esophagus in November (observations at Washington, D. C.) long before they are found in the backs, which is not until about the end of December. At the time of their first appearance beneath the skin the grubs were observed to be no larger than those found in the esophagus at that time and altogether similar. By the latter part of January or early February all of the grubs were found to have disappeared from the esophagus together with all traces of inflammation in that organ so noticeable in cattle slaughtered in January. Dr. Curtice also found in the month of November larvæ in the same stage as those in the esophagus in apparent course of migration along the ribs and in connective tissues adjacent to the spleen. Hinrichsen had

already in 1888 found grubs in the spinal canal, without, however, explaining their presence. This theory advanced by Dr. Curtice, except as to one point, is still accepted and has been substantiated by the work of later investigators. In recent years, however, it has been proved by Carpenter, Hadwen and others that the newly hatched larvæ actually burrow into the skin at the base of the hairs that bear the eggs from which they have hatched, and they need not be swallowed to reach the esophagus, as Dr. Curtice assumed, but get there, apparently, by an active migration through the connective tissues from the point at which they penetrated the skin, later migrating from the esophagus up to the back.

During recent years considerable attention has been devoted to the difficult problem of preventing the damage done by ox warbles, the investigations having been directed especially toward the discovery of methods of treatment for the destruction of the grubs or for the repulsion of the flies. Results of experiments reported by Imes and Schneider in 1921 indicate that wading tanks containing insecticidal or fly-repellent solutions may prove helpful in reducing warble infestation among cattle that can not readily be subjected to the handling necessary in the methods of treatment that have thus far been found efficacious.

TRICHINOSIS*

Since as early as 1881, when the Department of State instituted an inquiry into the pork industry with reference to causes that might operate to render pork products dangerous to human health, the Federal Government has shown considerable concern over the question of trichinosis, and the subject has at various times been under investigation in the Zoological Division. The earlier investigations were stimulated largely by the restrictions placed upon American pork by foreign governments because of its alleged dangerous character dependent upon the prevalence of trichinæ in American hogs. As a matter of fact, practically all pork shipped to Europe has been exported in the cured state and it has long been known that thorough curing is destructive to the vitality of trichinæ, so that consumers of American pork in Europe have never been in serious danger of trichinosis from that source. Moreover, no cases of trichinosis in Europe have been definitely traced to American pork. As already noted, the recorded cases of trichinosis in Germany, a country which had been particularly severe in restrictions on imported pork, were carefully studied by Stiles (1898-1899), and he was unable to find evidence of

* See "Meat Inspection Division," page 261.

cases originating from American pork, though he did discover that about a third of several thousand cases that occurred during a period of 18 years had been caused by pork which had been microscopically inspected and passed as free from trichinæ by German inspectors. The United States Government from 1892 until 1906 conducted microscopic inspection for trichinæ, but this was done frankly to meet the requirements of foreign trade and was applied only to export pork, the position taken being that microscopic inspection is not an efficient safeguard against trichinosis, and that its great expense does not justify it as a prophylactic measure. In the United States, therefore, microscopic inspection by the Federal Government has been carried on only because certain European countries, notably Germany, would not permit the importation of American pork without prohibitive restrictions unless it had been microscopically inspected. Finally in 1906, after a requirement was imposed by some of the European countries that American pork be reinspected in those countries notwithstanding its inspection in this country, microscopic inspection was abandoned by the United States Government. From time to time there have been agitations directed toward the establishment of microscopic inspection as a routine of Federal meat inspection, a measure, however, that if applied to all hogs slaughtered under Federal inspection and thoroughly done would cost as much as or more than the several millions of dollars now spent annually on the meat-inspection service. As a result of investigations carried out in the Zoological Division the trichinosis problem so far as concerns Federally inspected pork has been solved in a way that is believed to be much more satisfactory than any possible solution based upon the inherently faulty practice of microscopic inspection and at a cost that is infinitesimally small compared with the millions that would have to be spent in microscopic inspection.

Until it was discovered by Ransom in 1913 and announced in 1914 that trichinæ in pork could be destroyed by refrigeration it was considered that the parasites were unaffected by cold. It has been shown, however, that if the temperature is low enough the trichinæ invariably die in a comparatively short time. Trichinous pork kept at a temperature not exceeding 5° F. for a period of 20 days becomes quite innocuous.

Studies made in the Zoological Division by Ransom and Schwartz, the detailed results of which were published in 1919, established definitely the thermal death point of trichinæ, concerning which many conflicting and loose statements were previously current, and the

Bureau now recognizes a temperature of 137° F. as ample for the destruction of trichinæ.

As comparatively little actual experimental work had ever been done on the effects of curing upon trichinæ, some investigations on this question were begun in 1914, the detailed report of which was issued in 1920 (Ransom, Schwartz and Raffensperger). Based on these investigations a number of practical methods of curing for application to various kinds of pork products customarily eaten without cooking have been formulated which can be depended upon to destroy the vitality of any trichinæ that may be present.

Finally it has been shown by experiments reported by Schwartz (1920, 1921) that the viability of trichinæ may be destroyed by x-rays in massive doses. No practical method of using x-rays for trichina destruction, however, has been discovered.

With the results of the investigations referred to above as a basis, the following scheme of handling the trichinosis question in relation to Federal meat inspection has been devised:

Fresh pork and ordinary varieties of cured pork which are considered proper for human consumption only after cooking are subjected to no special control with reference to the possibility of the presence of trichinæ. There appears to be no practicable way by which any method of sanitary control by the Government can protect consumers of pork in general from the danger of trichinosis if they eat uncooked or improperly cooked pork. Fortunately, the great mass of the American people do not like pork unless it is well cooked. To help in the education of the public as to the importance of properly cooking pork, attention is called to this point by press notices issued from time to time from the Department.

All products containing any muscle tissue of pork that are prepared in establishments operating under Federal inspection to be sold as cooked products are required to be cooked under the supervision of inspectors according to certain methods which it has been found will insure a sufficiently high temperature to destroy any trichinæ that may be present. Accordingly the consumer of pork products cooked in establishments operating under Federal inspection is adequately protected from the danger of acquiring trichinosis from this source.

Finally, as concerns the class of pork products prepared customarily to be eaten without cooking (of which large quantities are manufactured in establishments operating under Federal inspection to supply a considerable demand from consumers with food customs of foreign

origin involving the use of pork prepared in various ways by curing, drying, smoking, etc., and eaten without cooking), strict regulations are in force governing the preparation of such products and they are kept under close supervision in order to insure their freedom from viable trichinæ when released from the manufacturing establishment into the channels of trade. Various alternative methods of preparation are permitted in which refrigeration and certain processes of curing, smoking, and heating may be used, so that the manufacturer has a considerable latitude of choice and can follow the methods among those established as efficacious in destroying trichinæ that he finds most suitable to his circumstances.

The methods above outlined have now been in successful operation for several years, and during this time no cases of trichinosis have come to light that could be traced to cooked products or to products customarily eaten without cooking that were prepared in establishments operating under Federal inspection, though cases traced to other sources have been not infrequent.

HOO KWORM DISEASE

Probably the most striking contribution made by Dr. Stiles during his service in the Bureau was his discovery in 1902 of the prevalence of hookworm disease in certain sections of the Southern United States, together with his discovery the same year of a new species of human hookworm, *Necator americanus*, at first named *Uncinaria americana* and later transferred to the new genus *Necator*. *Necator americanus* is now known also in many other parts of the world, and the other common species of human hookworm, *Ancylostoma duodenale*, known in Europe since 1843, is not rare in the United States. Dr. Stiles demonstrated that hookworms, which had been practically overlooked in this country, affected a high percentage of the rural population in many parts of the South, and that these parasites were responsible for much of the illness of the people in these localities, often wrongly described as laziness, shiftlessness, etc.

Since the remarkable findings made by Dr. Stiles, great improvements in health conditions in rural communities in the South have been brought about through a campaign for hookworm eradication by counties and States, and the world-wide campaign for hookworm eradication that was undertaken a number of years ago by the International Health Board had its origin more or less directly in the hookworm investigations made by Stiles.

Recently the Zoological Division has made another contribution

which promises to play an exceedingly important part in hookworm eradication, in the discovery by Dr. Hall in 1921 of the anthelmintic value, particularly against hookworms, of carbon tetrachlorid. As a result of Dr. Hall's discovery, this remedy is already being used in many parts of the world, and in the Fiji Islands alone prior to June, 1922, had been used on over 12,000 cases with results much superior to those of any remedy before known, the reports stating that it removed over 98 per cent of the hookworms present and cured over 90 per cent of the patients with a single treatment. Carbon tetrachlorid appears destined to take a similar rank in the treatment of hookworm disease to that which quinine holds in the treatment of that other great scourge of the warm countries of the earth, malaria.

STOMACH WORMS OF SHEEP

The common stomach worm of ruminants (*Hæmonchus contortus*), a particularly serious pest of sheep, was first carefully studied with reference to its life history by Ransom in 1905 and 1906. Prior to these investigations very little was definitely known concerning the life history of this parasite. It was found that the larvæ, after hatching from the eggs that occur in the feces of infested animals, reach an infective stage in from ten days to two weeks and are then ready to be taken into the body. The eggs and newly hatched larvæ were found to be very easily killed by freezing or drying, whereas the larva in the infective stage is highly resistant and can remain alive for long periods of time even amid very dry surroundings, or when continuously or repeatedly frozen. It was also shown that under certain conditions of moisture (dew, fog or rain) the infective larvæ commonly crawl up grass blades, becoming quiescent with a change in these conditions, and crawling still higher when the conditions again become favorable. Veglia recently (1916), from work carried on in South Africa, has found that the larvæ may also crawl back again to the ground under certain conditions. This upward migration when a film of moisture is present on grass blades or other objects was also noted by Ransom to characterize the larvæ of two other nematodes of sheep, *Æsophagostomum columbianum* and *Bunostomum trigonocephalum*, the nodular worm and hookworm, which indicated that this habit, a favorable one for the parasite because it increased its chances of being ingested by grazing animals, would likely be found a common one among the related parasites of the herbivora. In sheep that were fed stomach-worm larvæ in the infective stage it was found that the parasites developed to egg-producing maturity in

about three weeks. These investigations, which were reported in 1906, established the main facts in the life history of the stomach worm and were the starting point of numerous studies and experiments that have since been made in the Zoological Division bearing upon the practical control of this parasite.

Since 1914, when a farm of 160 acres at Vienna, Va., near Washington, was obtained on lease by the Bureau for the purpose, extensive tests have been in progress of various methods of managing sheep under farm conditions to prevent stomach-worm losses among lambs. At the present time, after trying many different plans, Dr. Cooper Curtice, who has been in charge of the experiments, has settled upon a method involving the systematic administration every three or four weeks of a 1 per cent solution of copper sulphate to all sheep on the farm as the most practical means of control yet discovered, the treatment being supplemented by certain changes of pasture that fit in readily with usual farm practices. Pasture changes alone without medicinal treatment have proved either too complicated for general use or not adequate to prevent stomach-worm losses.

GULLET WORMS IN CATTLE, SHEEP AND POULTRY, AND THREAD WORMS IN THE TONGUES OF HOGS

Soon after entering the Bureau, Dr. Stiles (1892) published an account of *Gongylonema scutatum*, a common parasite in the mucosa of the esophagus of sheep and cattle, enlarging upon the earlier more imperfect descriptions. About twenty years later the life history of this parasite was worked out in the Zoological Division by Ransom and Hall (results first reported in 1915), who found that the eggs passed in the feces of the host were ingested by dung beetles of various species, that the larvæ developed to certain stages in these insects, and completed their development to maturity when infested insects were ingested by sheep or cattle, as is likely to happen naturally while the animals are grazing, dung beetles often being present on blades of grass and hence often swallowed by grazing animals. In the investigations on the life history of *Gongylonema scutatum* it was discovered that cockroaches, though obviously not the normal intermediate hosts, could readily be infested, and these insects proved very useful in studying the larval stages of the parasite.

In 1904 Dr. Ransom described a new species of *Gongylonema* (*G. mgluvicola*) which occurs in the wall of the crop of chickens. This same parasite, apparently, was seen in the Division of Animal Pathology in 1885 in a chicken that was in some experiments on the gape-

worm, but it was recognized only as a nematode present in the mucous lining of the crop and was not studied in detail.

Recently (1922) Dr. Chapin of the Zoological Division has described as a new species of *Gongylonema* (*G. ransomi*) a thread worm common in the mucosa of the tongues of hogs in the United States. This parasite, which has been looked upon by others, including Ransom and Hall, who experimented with it in connection with their life-history studies on *Gongylonema scutatum*, as of the same species as the European parasite known as *Gongylonema pulchrum*, has been found by Chapin to show certain differences from the descriptions of the European form that have previously been overlooked, differences that indicate that the American form is not the same as *Gongylonema pulchrum*. The *Gongylonema* from the tongues of hogs may prove to be the same as *Gongylonema hominis* first reported by Ward in 1916 as a human parasite, which was found in the mucosa of a child's mouth in Arkansas, but this is as yet uncertain. Thus far three cases of *Gongylonema* in man are known, all reported from the United States. In 1921 thread worms in the tongues of hogs began to attract considerable attention in the Federal meat inspection, and because of their prevalence as determined by examination of many thousands of hog tongues at the various meat-inspection stations, the rule of requiring the removal of the mucous membrane from hog tongues prepared for use as human food has been generally adopted in packing establishments operating under Federal meat inspection. Removing the mucous membrane also removes the worms, which are objectionable in meat for human consumption even though not directly transmissible to man from that source.

MISCELLANEOUS NEMATODES OF RUMINANTS

In 1907 a brief paper by Ransom was published in which several new species and genera of nematodes parasitic in the alimentary tract of ruminants were noted, and in 1911 a more extensive paper on the subject was published. In 1920 the result of a study of the genus *Nematodirus* by May was published which has cleared up some of the uncertainties concerning specific identities in this group of nematodes. In 1907 Ransom recorded the results of investigations on the life history of *Strongyloides papillosus*, a common intestinal nematode of sheep which is transmissible also to rabbits, and showed that the larvæ which penetrate the skin migrate to the intestine and there develop to maturity; this being the first instance in which the adult stage of a species of *Strongyloides* had been experimentally produced in the

intestine as the result of penetration of the skin by the larvæ.

The first record of a gapeworm in cattle in the Western hemisphere was made in 1920, the parasite having been discovered in Porto Rico by Dr. Bagué, who forwarded specimens to the Zoological Division. On examination these were found to be probably identical with *Syngamus laryngeus*, hitherto known only from the Orient. This finding suggests that the parasite was probably imported at some time with Zebu (Brahman) cattle, and its establishment in Porto Rico indicates the likelihood of its establishment sooner or later in the United States. A small nematode, *Cooperia punctata*, which occurs in the small intestine of cattle, sometimes in enormous numbers, was shown by Ransom in 1920 to have the habit of burrowing in the adult stage into the wall of the intestine, producing lesions somewhat resembling on casual examination the lesions caused by *Æsophagostomum* larvæ.

STOMACH WORMS AND SUMMER SORES OF HORSES

In 1861 Carter in India described some nematodes which he had found to be of common occurrence in the common house fly. The significance of these nematodes (*Habronema muscæ*), which were often observed afterwards in flies in various parts of the world, remained unknown for 50 years, until it was determined through investigation in the Zoological Division (Ransom, 1911) that they are the larval stages of a nematode that occurs as an adult in the stomach of the horse. The maggots of houseflies in the manure of infested horses ingest the eggs of the parasite, and the larvæ develop within the bodies of the maggots, reaching a stage at which they are ready to be transferred to the horse at about the time the fly transforms from the pupa into the adult. The young worms collect commonly in the proboscis of the fly, and, as has been recently demonstrated experimentally by Johnston and Bancroft (1920) in Australia, escape in the presence of warmth and moisture, as, for example, when a fly is sucking moisture from the mucous membranes, or from abrasions on the skin of a horse. Horses swallow many flies (and fly pupæ, which are common in the chaff in the bottoms of mangers), and in this way also the nematodes, as well as by escape from the proboscis of flies, reach their final host, in whose stomach they develop to maturity. Another chapter in the story of these parasites of flies and horses was added by Decazeaux (1915), Bull (1916, 1919), and Van Saceghem (1917, 1918), who recognized that the larval nematodes found in cutaneous granulomata, summer sores, and verminous nodules on the nictitating membrane are identical with the larvæ of *Habronema*

muscæ or related species, these latter also occurring in flies as larvæ, and in the stomach of the horse as adults. Van Saceghem furthermore was able to produce conjunctivitis and verminous nodules on the nictitating membrane by introducing the larval nematodes taken from flies, and typical summer sores by exposing wounds on the skin of a horse to the attacks of flies known to be infested with *Habronema muscæ*, thus confirming the results of morphological comparisons between the nematodes of summer sores and those found in flies. Bull also has produced a typical cutaneous granuloma by the subcutaneous inoculation of a horse with larvæ of *Habronema megastoma* taken from flies.

HORSE STRONGYLES AND SWAMP FEVER

In 1917 Ransom and Hadwen, representing respectively the U. S. Bureau of Animal Industry and the Canadian Health of Animals Branch, undertook a cooperative investigation into the possible relation between horse strongyles, which are very common and often occur in enormous numbers in the large intestine, and so-called swamp fever. An infected region in Saskatchewan, Canada, was visited by Hadwen in 1917 and by Ransom and Hadwen in 1918 and a considerable number of cases resembling swamp fever were examined. Over 30 autopsies were made in 1918 (September and October), and in practically each case careful collections of internal parasites were made. Material was also obtained for later inoculation experiments—blood, feces, and dried worms and bots. Cases of infectious anemia were later produced at Washington by inoculations of the blood brought from Saskatchewan, but no transmission of the disease was secured by inoculation of the dried worms and bots from infected horses, nor by infection with larval strongyles reared in cultures made from the feces of infected horses. Horses exposed to soil in which swamp-fever horses were kept for long periods, and which thus became contaminated by larval strongyles from the diseased horses, failed to acquire the disease except in the autumn, and as some cases of the disease also appeared among horses kept in neighboring paddocks, the soil of which had not been contaminated by the diseased horses, the results of the experiment were more in harmony with the theory of insect transmission than with a hypothesis involving the strongyles. In the Canadian horses on which autopsies were made ulcers, often of considerable size, were of frequent occurrence in the fourth division of the colon marking the location of nests of a blood-sucking strongyle, *Triodontophorus tenuicollis*. The other two species of this genus which were also common were not observed to bear any

relation to ulcer formation. Prior to the work of Ransom and Hadwen another author had called attention to these ulcers, but the fact that only one of several species of *Triodontophorus* appears capable of causing the ulcers in question was first announced with the publication in 1918 of some of the results of the first year's work in Canada.

BEEF AND PORK MEASLES

About 1911 Bureau inspectors, notably at the Omaha meat inspection station, then in charge of Dr. W. N. Neil, began finding a considerable number of cases of tapeworm cysts (*Cysticercus bovis*), the intermediate stage of the unarmed tapeworm of man, *Tania saginata*, in cattle slaughtered under Federal inspection. This evidently was the result of improved methods of inspection rather than of a sudden increase of the frequency of the parasite, which formerly was not often found in cattle slaughtered in the United States. In cooperation with many of the meat-inspection stations, investigations on different aspects of the question of beef measles were carried out by the Zoological Division. Data were obtained as to the distribution and relative frequency of the parasites in different portions of the carcass, various methods of inspection were tried to determine the most practical and efficacious methods of discovering the parasites, the effects of refrigeration upon the vitality of the parasites were studied, shipments of cattle showing high percentages of infestation were traced back to the point of origin and the conditions under which they had been kept and fed were investigated, and various other phases of the question were given consideration. On the basis of the results of these investigations the present Federal regulations governing the methods of inspection and disposal of carcasses found affected by these parasites were formulated. Among other facts of practical importance determined by these investigations may be mentioned those relating to the effects of freezing upon the vitality of *Cysticercus bovis*, in accordance with which slightly infested carcasses may be passed for food after they have been solidly frozen and kept under refrigeration at a temperature not higher than 15° F. for not less than six days.

During the last 10 years the frequency of *Cysticercus bovis* among cattle slaughtered under Federal inspection has materially decreased. This may be due in part to improved sanitary conditions on farms and in cattle feed-lots (that there has been much improvement in this respect is questionable), but is undoubtedly largely the result of the efficient inspection of beef for tapeworm cysts, which eliminates

practically all danger of the spread of tapeworm infection from beef slaughtered under Federal inspection, correlated with which is the fact that even on farms in the districts in which most of the beef cattle are produced, and not alone in the cities and towns, most of the meat that is consumed comes from establishments operating under Federal inspection.

The pork measles parasite (*Cysticercus cellulosæ*), the intermediate stage of the armed tapeworm of man, *Tænia solium*, which is very rare in this country compared to the beef measles parasite, has been studied in the Zoological Division with reference to the details of its morphology in connection with the question of the identity of the sheep measles parasite and of the reindeer measles parasite, but no extensive investigations in other directions have been made on the parasite. It is of interest to note that in test inspections of about 1,000,000 hog hearts in 1913, these hearts coming from the hogs slaughtered during a period of two weeks at meat-inspection stations in all parts of the United States, only 28 hearts were found infested with *Cysticercus cellulosæ*. In a considerable number of the 28 cases the diagnosis was uncertain and in only a few of them was it definitely determined that the parasite was present. Since that time there has been no apparent increase in the prevalence of *C. cellulosæ*. The comparatively few cases that are found each year trace back in most instances to localities with a large Mexican population.

SHEEP MEASLES

Tapeworm cysts in mutton were first observed in 1866 in England and were named *Cysticercus ovis* by Cobbold in 1869, afterwards being recorded also in France, Germany, Algeria, German Southwest Africa and New Zealand. They were looked upon generally as *Cysticercus cellulosæ*, the pork-measle parasite, occurring in an unusual host, the sheep, instead of in the usual host, the pig, and were so considered in the meat-inspection regulations of various countries. A few observers considered them to be *Cysticercus tenuicollis*, the intermediate stage of *Tænia hydatigena* (*Tænia marginata*), a dog tapeworm, in an unusual location, that is, in the muscles instead of in relation with serous membranes. Early in 1912 it was reported almost simultaneously by Dr. O. B. Hess from Seattle and by Dr. S. E. Bennett from Chicago that a number of sheep carcasses had been retained on account of tapeworm cysts in the muscles. On the basis of degenerated specimens that were forwarded to Washington for examination and examined by Dr. Ransom, a diagnosis of *Cysticercus cel-*

lulosa was made in accordance with the generally accepted opinion of meat-inspection authorities as to the identity of mutton cysticerci. A little later, however, information was received that large numbers of sheep carcasses were being found affected with cysticerci at Chicago and Seattle. It then became apparent that the diagnosis of *Cysticercus cellulosa* could scarcely be correct, as it was very unlikely that a parasite known to be rare in the United States in its usual host should be so common in an unusual host. A study of numerous specimens obtained in Chicago showed that the sheep parasite was certainly not *C. cellulosa*, though very similar to it in certain characters. It was also seen that it was different from *C. tenuicollis*. By feeding the tapeworm cysts to dogs the adult tapeworm was reared and found to be of a species not before recognized. Sheep in turn were fed the eggs of the tapeworms and in due course of time the cystic stage was recovered from their muscles.

The investigations of the mutton cysticercus made in the Zoological Division have proved that it is not *Cysticercus cellulosa*, a parasite transmissible to man, but the intermediate stage of a dog tapeworm, and as such, its presence in sheep carcasses involves a less stringent disposal of the affected carcasses, from the meat-inspection standpoint, than if it were actually *C. cellulosa*, as had formerly been assumed. The same investigations also have shown what is necessary to prevent the spread of the parasite, namely, the proper management of dogs on farms and on the sheep ranges.

GID

The first well-authenticated case of gid in the United States was reported in 1905 by Ransom on the basis of some specimens found by Professor Cooley of the Montana Agricultural College in the brains of sheep that died at Bozeman, Montana. Further studies were afterwards made by Hall, who, among other findings, established the fact of the occurrence of the adult stage of the parasite in coyotes as well as in dogs. As yet, except for a few sporadic cases elsewhere, the parasite appears to be confined to the State of Montana, where it is, however, evidently well established and whence it is likely to spread to other localities sooner or later. Among the sporadic cases, one outbreak in New York in 1907 is of interest, as when brought to the attention of the Bureau through the publication of a paper in 1910 by Taylor and Boynton of Cornell University it was largely responsible for the inauguration in 1910 of a Federal quarantine on imported sheep dogs, this outbreak having been traced by Taylor and Boynton

to imported sheep dogs. Under the provisions of this quarantine all imported sheep dogs are subjected to fecal examination for the presence of tapeworm eggs, and if found infested with tapeworm are required to be treated for the removal of the parasites before release from quarantine. Since this quarantine was first established fecal specimens from over 2,900 imported sheep dogs have been examined in the Zoological Division, and of these 381 were found infested with tapeworms of various species and treated for the removal of the parasites. In only one case was the tapeworm definitely determined as the gid tapeworm, though there were many other cases in which there was present a species of tapeworm that is very difficult to distinguish from the gid parasite, and some in which the tapeworm may actually have been the gid tapeworm though determined as belonging to the other closely similar species.

ASCARIS

Following the important discovery made in 1916 by Lt. Col. Stewart of the Indian Medical Service of the migration of the newly hatched larvæ of *Ascaris lumbricoides* from the intestine to the lungs and back again to the intestine of rats and mice experimentally infected, a discovery which has led to a modification of the former conception of the life history of this parasite and to the development of a better understanding of the disease caused by it, the Zoological Division has made extensive studies on *Ascaris* which have brought to light a number of facts that are of great importance in their scientific and practical aspects. Stewart's experimental results were confirmed, but his suggestion that rats and mice act as intermediate hosts of *Ascaris* was not substantiated. It was found that the migration of the larvæ from the intestine to the lungs and back to the intestine which occurs in rats and mice also occurs in other animals, including the pig, one of the usual hosts of the parasite, man being the other. In rats, mice, guinea pigs and rabbits, experimentally infected, the larvæ do not long remain in the intestine after their journey through the lungs but soon pass out of the body in the feces, the occurrence of which in his experimental rats and mice led Stewart to offer the suggestion that these animals act as intermediate hosts and that after becoming infected by swallowing the eggs of the parasite found in the feces of infested human beings and pigs they pass on the infection to human beings and pigs by contaminating food and drinking water with their feces containing the young worms that have undergone partial development during their journey through the lungs. The

results of the experiments conducted in the Zoological Division, however, have failed to show that rats and mice are of importance as spreaders of *Ascaris* as suggested by Stewart, but go to prove that no intermediate hosts are necessary.

In pigs (and likewise in human beings) the larvæ behave as they do in the small laboratory animals, but when they return to the intestine after passing through the lungs instead of soon leaving the body in the feces they settle down and develop to maturity. Young sheep and goats have been found to occupy an intermediate position in their adaptability as hosts of *Ascaris* between rats, mice, etc., and the usual hosts (man and pig), inasmuch as the larvæ after returning to the intestine are able to continue their development but do not reach fertile maturity. Stewart observed that his experimental rats and mice commonly died from pneumonia during the invasion of the lungs by the young worms, and investigations in the Zoological Division have shown that similar cases are of common occurrence among young pigs both under experimental and field conditions. In fact, many of the cases of so-called "thumps" in pigs are the results of *Ascaris* infection. The investigations have also shown that pigs become more resistant to infection as they become older and also less susceptible to injury by the lung stage of the parasite, and after reaching an age of about four months they are little likely to become seriously infected, which is an important point in the system of roundworm control that has been worked out on the basis of experimental work and that has now been for four years in successful use, particularly in McLean County, Illinois, where a considerable number of the members of the County Farm Bureau have cooperated with the Bureau of Animal Industry in the practical tests of the method in question, on which account it is frequently referred to as the McLean County System of Swine Sanitation. Incidentally it has also been found that this method is of value in preventing losses not only from worms but from certain diseases, such as necrotic stomatitis and enteritis, that are so frequently associated with the use of permanent hog lots.

In 1921 the results of investigations were published which demonstrated step by step the path of migration followed by the larvæ of *Ascaris* in their journey through the body by way of the blood stream and lymphatics, including also proof of the fact that the migrating larvæ commonly reach the peripheral lymph nodes, showing that they sometimes return to the heart from the lungs and are distributed to various parts of the body in the systemic circulation.

In 1921 also the motion picture film entitled "Exit Ascaris" was made in cooperation with the Office of Motion Pictures of the Department. This film, which presents the principal facts in the life history of the roundworm, its effects on pigs, and the method of control, has proved very popular and useful in bringing the recent knowledge of the parasite to livestock owners. To supply the large demand for the film, 36 copies have been put into circulation by the Department up to the present, besides which a considerable number of copies have been purchased by various agricultural organizations, farm bureaus, agricultural schools, etc.

GAPEWORMS

One of the articles in the First Annual Report of the Bureau of Animal Industry is a translation by Theobald Smith of a memoir on gape disease of fowls by Ménégnin, and in the Annual Report for 1885 some experiments were reported which showed that earthworms were not, as Walker had suggested, necessary intermediate hosts for the parasite. No further investigations of importance on the disease were carried out in the Bureau of Animal Industry until comparatively recently, when some studies were made in the Zoological Division (1915-1920) that have added a number of interesting points to the knowledge of this serious malady of chickens, of great practical value in their bearing on the problem of prophylaxis, and have contributed also some facts that have an important bearing upon certain questions in the general biology of parasites. It has been found that the gapeworm is a parasite that appears to be better adapted to the turkey than to the chicken, inasmuch as adult turkeys are commonly infested (though they may at the same time show no symptoms) in localities in which the parasite is absent from adult chickens, and as chickens are susceptible to infestation only while very young, whereas turkeys of all ages may be readily infected.

The history of gapeworm disease in various parts of the world, so far as can be determined from the published records, also indicates that the turkey has been chiefly responsible for the introduction of the parasite into the various localities where it occurs. Furthermore, in the localities in which the question of the relation of the turkey to gapeworm disease has been investigated by the Zoological Division, the evidence obtained has shown that the most serious gapeworm trouble occurs among chickens when they are associated with turkeys, and that in the absence of turkeys the parasite is unlikely to be troublesome and tends to disappear. Another interesting point is that in turkeys the gapeworm commonly grows to nearly twice the size

that it attains in chickens, which is in accord with other evidence that the turkey is a more favorable host than the chicken.

The case of the gapeworm also adds another example to the list of those parasites that, though they cause comparatively little inconvenience as a rule to the hosts to which they are well adapted, seriously injure the strange hosts in which they are able to live but in which they do not find the conditions for their existence altogether favorable.

PARASITIC PROTOZOA

Studies of a considerable number of parasitic protozoa have been made in the Zoological Division, including Piroplasma, coccidia, flagellates, Sarcosporidia, and other groups. Stiles in 1893 named and described three species of Sarcosporidia from birds. One of these, *Sarcocystis rileyi*, which forms very large cysts of striking appearance in the breast muscles of various species of wild ducks, was more completely studied with special reference to its spores by Crawley in 1911. Crawley described two new species of Sarcosporidia in 1914, and in 1914 and 1916 published the results of studies on the life history of *Sarcocystis muris* of the mouse in which he followed the early evolution of the parasites in the intestinal cells following the feeding of infected meat. He was able also to confirm the work of Nègre (1907), who found that the feces of mice from the 15th to the 60th day after feeding with infected meat contain a resistant stage that will survive drying and that will produce Sarcocystis infections in other mice. This work on the Sarcosporidia of mice suggests a possible means by which strictly herbivorous animals such as sheep, cattle and horses, in which Sarcosporidia are very common, become infected, that is, some carnivorous animal which has eaten infected meat becomes infested with the intestinal stage and then spreads the infection in its feces where it may be picked up by herbivorous animals while grazing or drinking.

Crawley in 1909 and 1912 published the results of studies on a trypanosome, which he named *Trypanosoma americanum* in 1909, that he found to be of common occurrence in the blood of American cattle. *T. americanum* is readily discovered by means of bouillon cultures of cattle blood drawn under aseptic conditions although very scarce in the circulating blood and rarely seen in smears. This parasite multiplies profusely in cultures at ordinary room temperature. It is apparently the same form as that found in Japanese cattle by Miyajima (1907) and by Martini (1909) in Philippine cattle. Miyajima believed the trypanosome to be a stage in the life history of the Texas

fever parasite, but Crawley was able to show that trypanosomes occur in the blood of cattle which have never been exposed to the possibility of Texas fever, as well as in cattle from Texas fever districts. *Trypanosoma americanum* is very similar to if not identical with *Trypanosoma theileri*, which has been reported from cattle in various parts of the world, and like the latter it is apparently non-pathogenic to cattle.

Crawley in 1913 (observations published in 1916) found in smears made from infectious cattle fever ticks and from crushed eggs which they had deposited, small cigar-shaped protozoan parasites of similar appearance to those considered by Koch (1906), who worked in South Africa, to be a stage in the development of the Texas fever organism, and resembling also a certain stage in the development of *Piroplasma canis* described by Christophers (1907) from dog ticks (*Rhipicephalus sanguineus*). In the same ticks in which the supposed stage of the Texas fever parasite was found, Crawley also observed spirochetes, possibly the same species (*Spirochaeta theileri*) that occurs in South African fever ticks, which are known in South Africa to transmit to cattle not only Texas fever but another disease caused by the spirochetes. As yet no disease of cattle in this country caused by spirochetes has been recognized.

SHEEP SCAB*

In 1898 Salmon and Stiles prepared a careful compilation of the existing knowledge of sheep scab, and also reported the results of experiments in its treatment. Their judgment in limiting the remedies approved for use in official dippings to lime-sulphur and to nicotin, which had already long been established as standard remedies for sheep scab, has been vindicated by the many years of experience that the Bureau has had with the question of treatment since that time. Experiments carried on by the Zoological and Biochemic Divisions in 1906 and following years with so-called coal-tar dips resulted so favorably that the use of such dips if they came up to certain standards of composition was for a time permitted by the Bureau, but it was soon discovered that the good results obtained under experimental conditions could not be assured under practical conditions, and the coal-tar dips were soon abandoned so far as concerned their use in official dippings for sheep scab. Numerous experiments carried on in the Zoological Division of the Bureau have failed to reveal any better remedies for sheep scab than lime-sulphur and nicotin.

* See "Field Inspection Division," page 295.

The most recent investigations on sheep scab carried on in the Zoological Division have been those made by Dr. Imes and under his direction. The results obtained that are of practical importance are incorporated in a Farmers' Bulletin on this subject that was issued in 1916 and revised in 1920.

MISCELLANEOUS EXTERNAL PARASITES OF LIVESTOCK

Investigations made by the Zoological Division on several of the many species of external parasites that affect domesticated animals have been referred to elsewhere. In addition to these investigations other studies on various external parasites have been made. For example, in 1905 the results of a study by Stevenson on the hog louse and methods of treatment were published. A Farmers' Bulletin on hog lice and mange issued in 1920 is based on experiments carried out by Imes, who was placed in charge of investigations in the Zoological Division on the treatment and control of external parasites of livestock in 1914. Among other investigations in this field carried out by Dr. Imes or under his direction may be mentioned investigations on the sheep tick, cattle scab, sheep scab (which has been elsewhere mentioned), cattle lice, and the ear tick, the results of which in each case have been utilized in the preparation of a Farmers' Bulletin. The series of Farmers' Bulletins written by Dr. Imes forms a very valuable library on the practical control and eradication of the various external parasites in question.

Since the establishment of the Federal Insecticide and Fungicide Board in 1910 the Zoological Division has cooperated with this Board in investigating by experimental methods the efficacy of numerous proprietary preparations and of their ingredients in the treatment of livestock for insect parasites, these investigations having reference to claims of efficacy made by the manufacturers of these preparations. Much useful assistance has thus, as well as by expert testimony in connection with legal actions on the part of the Board, been furnished by the Zoological Division to the Insecticide and Fungicide Board in the enforcement of the law.

ANTHELMINTICS

Various workers in this division have summarized from time to time the important papers on anthelmintics in connection with the publications on parasitic diseases, and in addition experiments along the line of treatment have been conducted from time to time. Thus in 1896 Stiles published experiments in regard to the tolerance of

chickens for copper sulphate solution and for turpentine. In 1902 Stiles reported the results of experiments indicating that arsenic, thymol and creosote were not of value in expelling the fringed tapeworm of sheep, that intratracheal injections, fumigations and the oral administration of substances eliminated through the lungs were not of value in killing lungworms, and that copper sulphate, gasoline, thymol and creosote were of some value in controlling stomach worms and other nematodes of ruminants. Stiles also reported that where sheep were in a standing position when dosed, the liquids administered went directly to the fourth stomach for the most part, this conclusion being based on the experimental administration of colored fluids, the animal treated being then killed and immediately examined post mortem. The efficacy of the anthelmintics tested in the above experiments was judged in part from the results of fecal examinations after treatment, in part from post mortem examination of the animals treated, and in part from clinical improvement. The same year, 1902, Stiles and Pfender reported the results of experiments to determine the efficacy of thymol in removing whipworms from dogs. In these experiments feces were examined after treatment to some extent and the animals subsequently examined post mortem. In 1912 Ransom and Hall made some experiments on the effect of anthelmintics on parasites situated outside of the lumen of the digestive tract.

In 1915 experiments carried on by Foster indicated that oil of chenopodium was quite effective in removing ascarids from swine. The results of the treatment in these experiments were ascertained by fecal examinations. This same year the subject of anthelmintic treatment was made a separate project of the division and experiments were begun by Hall and Foster. The method adopted for testing drugs consisted in administering definite doses of drugs to animals, carefully collecting all parasites from the feces passed up to the time the animal was killed, usually a period of 4 days, and then collecting all worms present post mortem. In this way the efficacy of a drug could be accurately ascertained for the doses used and under the conditions of the experiment. As a result of critical tests of this sort numerous anthelmintics recommended on the basis of clinical experience for the removal of various worms from various host animals have been found ineffective and unreliable, while other anthelmintics recommended on the same basis have been found as effective as clinical experience indicated. In some cases the therapeutic dose has been definitely ascertained for these drugs for the first time and in other cases the proper technique and procedure in administering the drug has

been ascertained. A comprehensive study of this sort was published by Hall and Foster in 1918.

In further investigations, substances not in use as anthelmintics were tested and one such substance, carbon tetrachlorid, has been found to be a very effective anthelmintic. This drug was found to be more effective than any of the drugs in use for removing hookworms. It was first established as the best drug for the removal of hookworms from dogs and was recommended in correspondence with veterinarians for trial as a drug for removing hookworms from fur foxes. It was also shown to be quite effective in removing ascarids from dogs and is much used for removing these worms from dogs and foxes owing to the fact that it is distinctly safer than the somewhat more effective oil of chenopodium. It is now established in veterinary medicine as the best treatment for removing hookworms from dogs and foxes. On the basis of these facts, of toxicity tests on monkeys made in cooperation with the Hygienic Laboratory, and of the absence of unpleasant symptoms when the indicated therapeutic dose of the drug for man was taken by the investigator (Hall), the drug was brought to the attention of the medical profession. The Rockefeller Foundation promptly undertook the work of testing this drug in human medicine and the published reports up to the present time show that the drug has been given to over 100,000 patients and has so far proved more effective, safer, cheaper and less unpleasant in its effects on the patient than any of the drugs heretofore in use against hookworms. The drug has the advantage of being a definite chemical and not a variable mixture, as is oil of chenopodium. While this drug needs more study, it appears destined to have an extensive use in human and veterinary medicine in controlling certain parasitic worms and especially hookworms.

Largely as a result of the studies noted above, we now have a number of dependable treatments, established by critical tests, for many of the parasitic diseases. For centuries the drugs known as anthelmintics have been a heterogenous group of "worm medicines," concerning which we had little definite knowledge. Effective and ineffective drugs were alike recommended on the basis of clinical experience. Today we have dependable treatments, based on exact information, for a number of the parasitic worms of domesticated animals and an established experimental method of proved value for finding such treatments for other worms.

VERMINOUS TOXINS

During the years 1916-1920 various studies were made in the Zoological Division, notably by Schwartz, of the effects of the toxins of parasitic worms and of other parasites on animals, by injecting into experimental animals substances isolated from the tissues of the parasites and by observing the reactions upon blood produced by these substances *in vitro*. A method of serum therapy for trichinosis proposed by one investigator on the basis of the results of certain experiments he had conducted was tested and found inefficacious. Considerable attention has been paid to so-called parasitic anaphylaxis, and some interesting contributions (Ransom) have been made to the knowledge of this phenomenon.

INDEX-CATALOGUE OF MEDICAL AND VETERINARY ZOOLOGY

An important piece of work done in the Zoological Division, which was begun by Dr. Hassall in the spring of 1891 soon after his arrival in Washington and later continued by Stiles and Hassall, is the Index-Catalogue of Medical and Veterinary Zoology, one of the most valuable reference works in parasitology ever published. The first part of this catalogue published as Bulletin 39 of the Bureau of Animal Industry was issued in 1902, and succeeding parts appeared from year to year. The last part of this Bulletin was issued in 1912, the 36 parts published having a total of 2,766 pages and giving as complete a list as it was possible to obtain of the published books and articles relating to parasitology. Supplementing this bulletin the portion of the Index-Catalogue in which the literature of parasitology is indexed by subjects has been issued as Bulletins of the Hygienic Laboratory, U. S. Public Health Service, through a cooperative arrangement, Dr. Stiles having continued to maintain his interest in the catalogue after leaving the Bureau of Animal Industry. Hygienic Laboratory Bulletin 37 containing the Index on Trematoda and Trematode Diseases (401 pages) was issued in 1908, Bulletin 85 on Cestoda and Cestodaria (467 pages) was issued in 1912, and Bulletin 114 on Roundworms (886 pages) was issued in 1920. Another portion of the catalogue indexing all known species of parasites according to the hosts in which they occur is now in preparation for the printer. This great work will form an enduring monument to the tireless industry and painstaking care of the authors, an exceedingly tedious task of the most exacting nature in its requirements for accuracy of detail and completeness of scope, the successful accomplishment of which has been of incalculable benefit in facilitating research

in parasitology by providing the means by which any worker can readily trace the literature on the particular subject or subjects in parasitology in which he is interested.

COLLECTION OF PARASITES

The collection of specimens of parasites belonging to the Zoological Division which was begun by Stiles and Hassall in 1891 has become one of the largest and most complete collections of the kind in the world. It has proved of great value for study and reference and has been extensively used not only by the staff of the Division but by other parasitologists to whom it has in various ways been rendered available. Up to the present time (June, 1922) over 10,000 entries have been made in the catalogue of the collection. In addition to the specimens covered by these catalogue entries there are several thousand specimens entered in another catalogue and deposited by the Bureau in the U. S. National Museum.

MISCELLANEOUS

Among the various subjects that have been investigated in the Zoological Division and the results of which have been published the following not specifically mentioned elsewhere in this review of the activities of the Division, may be noted:

Flukes of cattle, sheep and swine; thorn-headed worms of swine; tapeworms of hares and rabbits; nematodes of rodents; parasites of the fur seal; country slaughterhouses in their relation to disease; methods of fecal examination for the presence of parasites; tapeworms of dogs and cats; tapeworms of poultry and other birds; parasites of foxes; fly repellents; parasites of reindeer; frogs, toads and carp as eradicators of fluke disease; stomach worms of swine; echinococcus; worms in the eyes of chickens and other birds; coccidiosis; flukes of the family Heterophyidæ; lungworms; kidney worms; dogs as carriers of parasites and disease; prevalence and distribution of the parasites of sheep and cattle; and relation of parasites to the southern livestock industry.

Among the parasites of the domestic animals which have been described by the Zoological Division as new species are the following: *Dicrocoelium complexum* from the cat; *Diplospora bigemina*, *Tænia balaniceps*, *Tænia ovis* (first description of adult worm) and *Multiceps gaigeri* from the dog; *Agamodistomum suis*, *Hyostromylus rubidus* and *Gongylonema ransomi* from swine; *Moniezia trigonophora*, *Æsophagostomum columbianum*, *Ostertagia trifurcata*,

O. marshalli, *O. occidentalis*, *O. bullosa*, *Cooperia pectinata*, *Nematodirus furcatus*, *Capillaria brevipes* and *C. longipes* from sheep; *Trichostrongylus falculatus* from goats; *Trichostrongylus capricola* and *Nematodirus abnormalis* from sheep and goats; *Moniezia planissima*, *Nematodirus helvetianus*, *Oncocerca lienalis* and *Trypanosoma americanum* from cattle; *Nematodirus dromedarii* from the dromedary; *Gongylonema ingluvicola* from chickens; and *Ornithostrongylus quadriradiatus* from pigeons. Two new hookworms, *Necator americanus* of man and *Uncinaria lucasi* of fur seals, were also described from this laboratory. A large number of new species of parasites of other animals, notably those of rabbits and rodents, have been described in the course of miscellaneous investigations.

Important contributions have been made in the Zoological Division in connection with the life history of the following parasites: *Hypoderma lineatum*, *Margaropus annulatus*, *Ornithodoros mégnini*, *Æsophagostomum columbianum*, *Hæmonchus contortus*, *Nematodirus filicollis* (or *N. spathiger*), *Strongyloides papillosus*, *Habronema muscæ*, *Gongylonema scutatum*, *Syngamus trachealis*, *Ascaris lumbricoides*, *Macracanthorhynchus hirudinaceus*, *Cysticercus ovis*, and *Piroplasma bigeminum*.

Certain lesions, symptoms and other pathological conditions have been reported for the first time from this laboratory in connection with *Thysanosoma actinioides*, *Ornithostrongylus quadriradiatus*, *Cooperia punctata*, *Triodontophorus tenuicollis* and *Ascaris lumbricoides*.

SUMMARY OF IMPORTANT EVENTS

1886. Aug. 1. Dr. Cooper Curtice appointed in charge of parasitological investigations. Investigation of fringed tapeworm begun.
1887. Studies on flukes in liver and lungs of cattle published.
1888. Early stages of rabbit tapeworms described.
1889. The disease due to fringed tapeworm in sheep first described.
1890. Observations on the ox warble published with a formulation of the life history.
 "Parasites of sheep" published, covering, among other things, the description of *Æsophagostomum columbianum* Curtice, 1890, as the cause of nodular disease, or knotty guts.
1891. The essential features of the life history of the Texas fever tick first described.
 Dr. Albert Hassall transferred to Zoological Laboratory, March 7.
 Dr. Cooper Curtice resigned May 31, 1891.
 Dr. Charles Wardell Stiles appointed in charge of Zoological Laboratory, June 3.
 Work begun on the Index-Catalogue of Medical and Veterinary Zoology, and the parasite collection of the Bureau.

1892. Intermediate host for thorny-headed worm of swine in United States first reported.
Strongylus ostertagi (*Ostertagia ostertagi*) first reported from the United States.
 A new coccidian (*Coccidium bigeminum* Stiles, 1892) reported from dogs.
 A new stomach worm, *Strongylus rubidus* Hassall and Stiles, reported from swine.
 Detailed description of gullet worm of sheep and cattle published.
1893. Revision of the adult cestodes of cattle, sheep and allied animals published, including description of the new species *Moniezia planissima* Stiles and Hassall, 1893, and *M. trignonophora* Stiles and Hassall, 1893.
1894. Detailed description of *Fasciola magna* published, with a comparison with other flukes and a summary of outbreaks of fascioliasis. First record of *Distoma westermani* (*Paragonimus westermani*) from the United States published.
 A protozoan, *Icthyophthirius multifiliis*, reported from fish in the United States, with measures for its control in aquaria.
 Trichinosis experimentally produced in *Spermophilus tridecemlineatus*.
 Catalogue of American parasites published.
 A new fluke, *Distoma (Dicrocoelium) complexum* Stiles and Hassall, 1894, reported from cats in the United States.
 A new fluke, *Distomum tricolor* Stiles and Hassall, 1894, reported from hares and rabbits in the United States.
1895. Report on the rarity of *Tænia solium* in the United States published.
 Six new tapeworms described from hares and rabbits.
1896. Report on tapeworms of poultry published.
 Report on adult tapeworms of hares and rabbits published.
1898. Publication on flukes and tapeworms of cattle, sheep and swine, with special reference to the inspection of meats.
 Report on sheep scab published.
 Publication of inventory of genera and subgenera of the trematode family Fasciolidæ.
 Dr. Stiles appointed Scientific Attaché to American Embassy at Berlin, Germany.
1899. Report on internal parasites of the fur seal, with the description of a new hookworm, subsequently named *Uncinaria lucasi* Stiles and Hassall, 1901, as a cause of deaths among seals.
1900. Studies published on a muscle fluke of swine, lung flukes in swine, and the conical amphistome in cattle.
 Report on kidney worm of swine published.
1901. Report on cattle ticks of United States published.
 Report published on hookworm disease in man and animals in the United States.
 Treatment published for roundworms in cattle, sheep and goats.
 Report published on trichinosis, showing that cases of trichinosis in Germany had been erroneously attributed to eating American pork and that microscopic inspection for trichinæ was not an effective preventive measure as practiced.
 Report on verminous diseases of cattle, sheep and goats in Texas.
 A pupa-like stage described in the development of *Ornithodoros mégnini*, the spinose ear tick.
Boophilus australis reported from Cuba and Porto Rico.
1902. A new hookworm, *Uncinaria americana* Stiles, 1902, reported from

man in the United States, and the probable distribution and importance of this parasite indicated.

Lambliia duodenalis reported for the first time from the United States.

Emergency report on surra published.

Anguillula aceti reported from human bladder.

Publication begun on the Index-Catalogue of Medical and Veterinary Zoology: Authors.

Report on thymol as ineffective for removing whipworms from dogs.

Dr. C. W. Stiles resigned August 5 to enter U. S. Public Health and Marine Hospital Service, but continued supervision of the Zoological Laboratory until June 1, 1903.

1903. Dr. B. H. Ransom appointed in charge of Zoological Laboratory, June 1.

1904. A new nematode, *Gongylonema ingluvicola* Ransom, 1904, described from American chickens.

The eye-worm, *Oxyspirura mansoni*, first reported from American chickens.

A new nematode, *Strongylus quadriradiatus* Stevenson, 1904, described as the cause of losses among pigeons.

Davainea echinobothrida, and not *Davainea tetragona* as formerly assumed, shown to be cause of nodular taeniasis of intestines of American chickens.

1905. The first well authenticated case of gid reported from the United States.

Report on tapeworms of American chickens and turkeys published.

Report published on external parasites of swine, with methods of control.

1906. Microscopic examination for trichinæ abandoned in meat inspection. Life history of the stomach worm, *Hæmonchus contortus*, described.

1907. Dr. Maurice C. Hall appointed June 20.

Development in intestine of adult nematodes of the genus *Strongyloides*, following cutaneous infection, first published.

Descriptions published of new genera and species of nematodes from cattle, sheep and goats, including *Trichostrongylus capricola*, *Ostertagia trifurcata*, *O. marshalli*, *O. occidentalis* and *Cooperia pectinata*.

Probstmayria vivipara reported for the first time from the United States.

1908. Index-Catalogue of Medical and Veterinary Zoology: Trematoda and Trematode Diseases, published in collaboration with Hygienic Laboratory.

Cysticerci in the muscles of sheep reported from the United States for the first time.

Fasciola magna reported from sheep for the first time.

1909. *Trypanosoma americanum* described from American cattle.

Report published on the tænioid cestodes of North American birds.

Studies published on the control of Texas fever tick by pasture rotation methods.

1910. Distribution of gid in the United States ascertained and coyote shown to be a host of the gid tapeworm.

Historical review of the gid parasite and allied parasites published.

A new tapeworm, *Taenia balaniceps* Hall, 1910, described from the dog in the United States.

Federal quarantine on imported sheep dogs established to prevent introduction of dangerous worms.

Methods of control of stomach worm of sheep proposed.

1911. The life history of a stomach worm of horses, *Habronema muscæ*, described.
 Monograph of nematodes of ruminants published, including, among other things, 2 new species, *Capillaria brevipes* Ransom, 1911, and *C. longipes* Ransom, 1911.
 Investigations begun on beef measles to determine meat inspection procedure.
 A new nematode, *Trichostrongylus falculatus* Ransom, 1911, described from the goat.
Physocephalus sexalatus first reported from the United States.
 Studies published on methods of examining feces for parasites.
 Studies published on the biology of the Texas fever tick.
1912. Studies published on arsenical dip for cattle ticks, indicating that 0.22 per cent of arsenic trioxid is approximately the safe and effective arsenic content and that 2 dippings at a 7 to 10-day interval will free cattle of ticks.
 Cysticerci in muscles of reindeer reported from North America for first time.
 Studies published on nematodes of swine and injuries due to them.
 A new nematode, *Ostertagia bullosa*, Ransom and Hall, 1912, described from sheep.
 The distribution of some important parasites of sheep and cattle in the United States ascertained and published.
 Studies on the protozoan parasites of domestic animals published.
 Index-Catalogue of Medical and Veterinary Zoology: Cestoda and Cestodaria, published in collaboration with the Hygienic Laboratory.
1913. Experiments published showing that arsenical dip containing 0.1869 per cent of arsenic trioxid will protect cattle from infestation for 2 days but not for 5 days, the protection being due to a killing action, not a repellent action, of the arsenic.
 The cysticerci in muscles of sheep shown to be the larvæ of a dog tapeworm and not to be *Cysticercus cellulosæ* as formerly supposed.
1914. The destruction of trichinæ by refrigeration reported as a control measure for trichinosis.
 Sheep farm established at Vienna, Va., for investigation of sheep parasites with Dr. Cooper Curtice in charge.
 Methods of destroying *Cysticercus bovis* by refrigeration reported.
 Studies on repellents for protecting animals from flies reported.
 Publication of experimental demonstration of the life history of *Sarcocystis muris*, confirming Nègre's work.
 A new protozoan, *Sarcocystis leporum* Crawley, 1914, reported from rabbits.
 Dr. Marion Imes placed in charge of investigations on control and treatment of external parasites, September 1.
1915. The life history of the gullet worm, *Gongylonema scutatum*, ascertained and published.
 Investigations of gapeworm of poultry begun.
Syngamus laryngeus reported from the Philippines for the first time, this being the second report of this parasite.
 The third American case of *Dipylidium caninum* in man reported.
 Studies published on the dog as a carrier of parasites and disease.
1916. Dr. M. C. Hall resigned September 16.
 Monograph published on nematodes of rodents.
 A new tapeworm, *Multiceps gaigeri* Hall, 1916, with a larval stage in goats, described from the dog.
 Report published on the parasites of cattle.

- Report published on stages of *Piroplasma bigeminum* occurring in Texas fever ticks and their eggs.
Report on sheep scab and methods of control published.
1917. Oil of chenopodium found effective in removing ascarids from swine. Studies published covering new facts in the life history of ascarids of swine, including the fact that ascarid larvæ may cause serious or fatal pneumonia in the course of their migration through the lungs of young pigs, and the fact established that no intermediate host is necessary.
Studies published on sheep tick and methods of control.
1918. Studies published on cattle lice, cattle scab and spinose ear tick, with methods of control.
Studies on anthelmintics published, showing efficacy of chenopodium for removing ascarids of dogs and swine.
Studies published on horse strongyles, reporting for the first time *Triodontophorus tenuicollis* as the cause of ulcers in the large intestine.
Observations published on the life history of trichinæ.
Keeping sows clean just before and after farrowing and cleanliness of surroundings for young pigs suggested as a basis for preventing ascarid infestation in pigs.
1919. Dr. M. C. Hall reappointed April 1.
Larval ascarids in the lungs reported as a common cause of so-called thumps in young pigs.
Monthly treatment with copper sulphate solution combined with pasture rotation reported as a control measure for stomach worms in sheep.
The turkey shown to be the important factor in gapeworm disease of poultry, the adult turkey harboring the gapeworm and serving as a carrier without symptoms.
Experiments on the efficacy of sanitary measures in preventing ascarid infestation in pigs begun in McLean County, Illinois, in charge of Dr. H. B. Raffensperger.
Results of experiments establishing the thermal death point for the destruction of trichinæ by heat published.
Studies published on a blood-destroying substance in *Ascaris lumbricoides*.
Monograph of the tænioid cestodes of dogs, cats and allied carnivores published.
1920. Index-Catalogue of Medical and Veterinary Zoology: Roundworms, published in collaboration with the Hygienic Laboratory.
Publication of methods of curing pork ascertained as effective in destroying trichinæ.
Studies of effect of x-rays in destroying trichinæ published.
Studies published on nematodes of the genus *Nematodirus*, describing the new species *N. abnormalis*, *N. helveticus*, *N. furcatus* and *N. dromedarii* from domesticated ruminants.
Studies published on hemolysins of parasitic worms.
1921. *Cooperia punctata* shown to cause pronounced lesions of digestive tract in calves, with resultant injury and death.
Species of *Oncocerca*, including either *O. reticulata* or *O. cervicalis* or probably both, reported from the United States.
Carbon tetrachlorid reported for the first time as an anthelmintic; shown to be more effective in removing hookworms from dogs than other remedies in use and brought to the attention of the medical profession as possibly superior to drugs in use in human medicine for this purpose. This drug also shown to be effective in removing *Strongylus* and ascarids from horses.

- Publication of studies on parasites of sheep with control measures.
 The swine hookworm, *Crassiosoma urosulatum*, reported for the first time from the United States, together with cases of sheep and dog hookworms in swine.
 The swine kidney worm, *Stephanurus dentatus*, reported for the first time from cattle.
1921. *Dipylidium sexocoronatum* reported from the cat for the first time.
Syngamus laryngeus reported for the first time from the Western Hemisphere.
 Insecticidal solutions in wading tanks found of value in controlling ox warble.
 Detailed studies published on the migration of ascarid larvæ in the host.
 A new record published of *Hymenolepis diminuta* in man.
 Motion picture film "Exit Ascaris" made and exhibited.
 Studies published on the toxins of parasitic worms and effects of these on host blood.
1922. Studies published on animal parasites of foxes.
 Nematodirus reported as cause of serious injury to sheep.
 Studies published on lungworms of domestic animals.
 Successful control measures reported for stomach worms in lambs.
 A new gullet worm, *Gongylonema ransomi* Chapin, 1922, described from American swine, and measures taken in meat inspection service for the removal of this worm from hog tongues.
Alaria americana reported from the cat for the first time and *Oxyuris compar* of the cat shown to be *O. ambigua* of the rabbit.
 Studies published on common parasites of live-stock and treatments for removing them.
 Studies published on roundworms of swine.
 Studies published on the toxic effects of ascarid fluids on man.
Triodontophorus tenuicollis, *T. brevicauda*, *Gyalocephalus equi*, *Cylicostomum coronatum*, *C. pseudo-catinatum*, *C. nassatum* var. *parvum*, *C. longibursatum* and *C. minutum* reported from horses in the United States for the first time.
 Field work on the control of stomach worms of sheep begun in Schuyler Co., Mo., under Dr. E. M. Nighbert.
1923. Studies published on carbon tetrachlorid as an anthelmintic.
 Rectal injections of anthelmintics found effective in removing cecum worms from poultry; intravenous injections ineffective in destroying strongyles in aneurisms.
 Studies published on arecolin hydrobromid as an anthelmintic.
 Successful experimental production of intrauterine infestation of pups with dog ascarids.
 Studies published on the prevention of intestinal worms in swine.
 Studies published on internal parasites of dogs and cats and treatments for removing them.
 Studies published on hookworms of swine.

PERSONNEL OF THE ZOOLOGICAL DIVISION

Chiefs of Division:

- Dr. COOPER CURTICE, appointed in charge of parasitological investigations August 1, 1886. Resigned May 31, 1891.
- Dr. CHARLES WARDELL STILES, appointed in charge of Zoological Laboratory June 3, 1891. Resigned August 5, 1902, but continued in charge until June 1, 1903.
- Dr. BRAYTON H. RANSOM, appointed in charge of Zoological Laboratory June 1, 1903. Title changed to Chief of Zoological Division July 1, 1906.

Quarantine Division*

With the view of preventing the introduction of foreign diseases of cattle into the United States, the first session of the 29th Congress, under date of December 18, 1865, passed the first act providing for the prohibition of the importation of cattle from foreign countries. The same Congress, under date of March 6, 1866, amended this act, making it apply likewise to the hides of neat cattle. The Secretary of the Treasury was directed to make such regulations as were necessary to put the law into immediate effect. This same law was reenacted in 1878 as a part of the Revised Statutes.

The first prohibition under the act was issued by the Secretary of the Treasury on July 31, 1875, excluding neat cattle and the hides of neat cattle from Spain on account of the presence of foot-and-mouth disease. This order was withdrawn in October of the same year, and on November 3, 1875, a similar order was made prohibiting the importation of neat cattle and the hides of neat cattle from Great Britain and Ireland on account of the prevalence of foot-and-mouth disease. This order remained in effect until March 16, 1876, when the Secretary of the Treasury allowed the importation of blooded stock from Great Britain and Ireland, provided they were accompanied by a certificate from the United States consular officer that such animals were at the date of exportation in a sound and healthy condition and free from foot-and-mouth disease or any indication thereof. When in 1879 the Treasury Department learned that contagious pleuropneumonia existed in England, the ports along the Atlantic seaboard were closed on February 26 of that year to English cattle until otherwise ordered. This prohibition against England was revoked July 1, 1879, and suspended as to European ports, provided all cattle were kept in quarantine on arrival not less than 90 days under customs officers at the expense of the parties interested.

On July 30, 1883, the Secretary of the Treasury issued an order requiring that all neat cattle from any part of the world, except North and South America, be subjected to a quarantine of 90 days at the port of entry. Stations for the accommodation of imported cattle were provided at the ports of Portland, Me., Boston, Mass., New York, N. Y., and Baltimore, Md. Animal quarantine stations have

* Since the history of the Quarantine Division was written the activities and responsibilities of that Division have been transferred to the Field Inspection Division; therefore, the history of what was formerly the Quarantine Division properly would come under the heading of Field Inspection Division, but for convenience we prefer in this sketch to maintain the identity of the Quarantine Division and give its history separate from the Field Inspection Division.

been continuously maintained at the ports of Boston, New York and Baltimore since 1883.

By a provision of the Sundry Civil Bill approved July 7, 1884, money appropriated for establishing and maintaining quarantine stations for neat cattle was to be expended by the Commissioner of Agriculture under the supervision of the Secretary of the Treasury. Accordingly, on August 25, 1884, the Commissioner of Agriculture, George B. Loring, issued an order specifying that all neat cattle arriving in the United States from any part of the world except North and South America be landed only at such ports along the Atlantic seaboard as were provided with cattle quarantine accommodations under control of officers of the Department of Agriculture, and that persons contemplating importation of cattle must obtain permits from that Department. George B. Loring was Commissioner of Agriculture 1881-1885. He was succeeded by Norman J. Colman, who served as Commissioner from 1885 until February 11, 1889, when he was appointed by the President the first Secretary of Agriculture. The law of August 25, 1884, applied to only one class of livestock, namely, neat cattle.

TRANSFER OF AUTHORITY FROM TREASURY DEPARTMENT TO DEPARTMENT OF AGRICULTURE

On August 25, 1884, the year in which the Bureau was established, an order was promulgated over the signature of Hon. George B. Loring, Commissioner of Agriculture, and Mr. Charles E. Coon, Acting Secretary of the Treasury, giving notice that after that date all regulations governing the quarantine of neat cattle would be issued by the Commissioner of Agriculture. This order specified that the ports then provided with quarantine stations at which cattle might be landed subject to specified conditions were Portland, Me., Boston, Mass., New York, N. Y., Baltimore, Md., and such additional ports as might be provided with quarantine accommodations approved by the Commissioner of Agriculture and supervised by the proper officers under provisions of the order. A number of temporary stations had been provided, and on July 1, 1885, an order of the Commissioner of Agriculture was issued abolishing the quarantine stations at Portland, Me., Coopersburg, Pa., Chester, Pa., and New Orleans, La., and establishing a station at San Francisco, Calif. On October 1, 1885, the Commissioner ordered the removal of the quarantine station at Waltham, Mass., to Littleton, Mass., and designated that station Littleton Neat Cattle Quarantine Station.

On May 1, 1883, Dr. D. E. Salmon had been called to Washington by Commissioner George B. Loring to establish a veterinary division of the Department of Agriculture. Commissioner Loring, who was educated as a physician, but from about 1857 had devoted his time to scientific farming and politics, gave special attention to the diseases of animals. The law passed on May 29, 1884, providing for the establishment of a Bureau of Animal Industry enabled him to appoint Dr. Salmon as the first Chief of the Bureau, which appointment took effect on May 31, 1884. It was on this date that the organization of the Bureau began under Dr. Salmon's direction.

ESTABLISHMENT OF PERMANENT QUARANTINE STATIONS

The Sundry Civil Bill of July 7, 1884, having empowered the Commissioner of Agriculture to expend money appropriated for establishing and maintaining quarantine stations, Dr. Salmon, in the First Annual Report of the Bureau (1884), in referring to quarantine stations at the ports of Boston, New York and Baltimore, made the following recommendations:

As the necessity for these stations will be permanent, it would seem advisable for the Government to acquire more secure possession either by long lease or purchase of suitable grounds which could be placed in a satisfactory condition for cleaning and disinfection. While not entirely free from objections, the present arrangements must be considered as very satisfactory when we take into account their temporary character, the small appropriations for establishing them and the short time during which they have been in operation.

Under the direction of Dr. Salmon the practice of maintaining a number of small quarantine stations near a port of entry was abandoned and arrangements were perfected for the maintenance of but three quarantine stations on the Atlantic seaboard. The station for the port of Boston was located at Littleton, Mass., some 32 miles west of Boston. This station had been transferred from Waltham to Littleton in 1885. The Littleton station was located on leased property consisting of about 32 acres. The quarantine station for the port of Baltimore, known as the Patapasco Station, was located at Halethorp, Md., on a leased tract of about 15 acres. The animal quarantine station established by the Treasury Department for the port of New York was also located on leased land, at Garfield, N. J., the stables, fencing, water supply and other equipment having been provided by the Government. This tract of land consisted of about 30 acres. While none of these stations was on the water front, they were readily accessible from the respective ports by rail and were each provided

with a railroad siding and suitable facilities for the unloading and reloading of cattle.

Being on leased land, the buildings constructed at these stations were naturally of a somewhat temporary character and in course of time began to show the effects of age. While the leases of the various properties were favorable to the Government as regards tenure and privilege of cancelling the lease on short notice, it became more and more apparent that the quarantine of imported livestock was to be a permanent practice, and an effort was begun to obtain appropriations from Congress which would make possible the purchase of suitable lands and station equipment for these three Atlantic seaboard ports, thus assuring, as recommended by Dr. Salmon in 1884, stations in a satisfactory condition for cleaning and disinfection.

In October, 1888, a quarantine station was established at Mount Airy, near Philadelphia, with Dr. A. C. Young as superintendent, but was used for only two shipments of cattle entering that port from Antwerp, viz, 11 head of Swiss and 6 of Holstein cattle. At this time Dr. Young was stationed at Philadelphia in charge of contagious pleuropneumonia eradication work in that section.

Among the early superintendents of quarantine stations were Dr. Madison Bunker at the Waltham, Mass., station (1884); Dr. A. H. Rose at the Patapasco, Md., quarantine station (1884); Dr. F. Bridge, Coopersburg, Pa. (1884); Dr. A. H. Rose, Littleton, Mass. (1886-1888); Dr. A. M. Farrington, Garfield, N. J., station (1884-1886); Dr. W. H. Lowe, Garfield, N. J., station (1887-1893). Later superintendents were Dr. J. B. Hopper, Garfield, N. J., station (1894-1897); Dr. W. B. E. Miller, Garfield, N. J., station (1898-1899); Dr. George W. Pope, Garfield and Athenia, N. J., station (1900-1908); Dr. E. T. Davison, Athenia, N. J., station 1909 to present date. When meat inspection was inaugurated at Boston and Baltimore the inspectors in charge of meat inspection were placed in charge of the quarantine stations at these ports.

ESTABLISHMENT OF QUARANTINE PERIOD

On account of the danger of importing disease in other classes of animals, the Act of August 30, 1890, was passed, including sheep, other ruminants and swine with neat cattle and prohibiting the importation of any such animals as were diseased or affected with any disease or which had been exposed to such infection within 60 days next before their exportation. The administration of this law was entrusted to the Secretary of Agriculture, who was authorized to

place and retain in quarantine all neat cattle, sheep, other ruminants and swine imported into the United States at such ports as he should designate. The regulations now in force for the inspection and quarantine of cattle, sheep, other ruminants and swine imported into the United States are made under authority of this act (approved August 30, 1890) supplemented by later acts. The period of quarantine was fixed by the regulations of the Secretary of Agriculture at 90 days for cattle, counting from the date of shipment, and 15 days for sheep and other ruminants and swine, counting from date of arrival at the quarantine station.

The Act of August 30, 1890, provides for the inspection and quarantine of imported sheep, other ruminants and swine in addition to cattle. In conformity with the act, Hon. J. M. Rusk, Secretary of Agriculture, on October 13, 1890, issued regulations, with the approval of the Secretary of the Treasury, similar to those already in effect which were issued by the Treasury Department on July 19, 1879, signed H. F. French, Acting Secretary of the Treasury. These regulations provided for the inspection and quarantine of cattle, sheep and other ruminants and swine imported into the United States and that they must be entered through certain designated ports on the Atlantic and Pacific seaboards, and along the boundary between the United States and Mexico, and between the United States and British Columbia and Canada. These regulations and the rules prescribed therein for conducting quarantine stations have, with certain modifications, remained in effect until the present date.

In the Annual Report of the Bureau of Animal Industry for the years 1889 and 1890 Dr. Salmon expressed the belief that these regulations would not only protect our herds and flocks, but in view of the assurances received from the British authorities would probably result in the revocation by the British Government of its regulation excluding American sheep from Great Britain.

Under provisions of these regulations, issued October 13, 1890, the quarantine period for cattle except those from North, Central and South America, was 90 days, counting from date of arrival at the quarantine station. By regulations effective March 1, 1900, the quarantine period for cattle was changed to 90 days counting from the date of shipment, except that in the case of cattle from countries of North and Central America, and effective May 1, 1903, the quarantine period for cattle from Great Britain, Ireland and the Channel Islands was reduced to 60 days, counting from date of shipment, and effective October 1, 1909, to 30 days for cattle from Great Britain, Ireland and

the Channel Islands, counting from the date of arrival at the quarantine station. The quarantine period of 15 days, counting from date of arrival at the quarantine station, was continued in effect for sheep and other ruminants and swine from across seas.

The operation of these periods of 30 and 15 days was continued under revised regulations effective May 1, 1923, with a provision for 60 days quarantine counting from the date of arrival at the port of entry in the case of all cattle from any part of the world except Great Britain, Ireland, the Channel Islands, Canada, Mexico, Central America and the West Indies.

DEVELOPMENT OF DIVISION

The Annual Report of the Bureau for 1891 to 1892 shows that Dr. D. E. Salmon designated as the Quarantine Division that section having chiefly to do with the importation, quarantine and exportation of animals, the importation of hides and the disinfection of vessels. On February 1, 1890, Mr. R. G. Blaine was appointed Superintendent of Quarantine Stations. His designation on March 27, 1891, was changed to Chief, Quarantine Division. This position was abolished April 15, 1893, and Mr. Blaine resigned from the Bureau service May 15, 1893. Following this date, the quarantine work was administered more directly by the Chief of the Bureau until 1896, when the Quarantine Division, with its added duties, including the Bureau's accounts, was designated as the Miscellaneous Division, and Dr. A. M. Farrington was appointed Chief July 1, 1896. Dr. Farrington was succeeded by Dr. T. A. Geddes January 1, 1899, who served as Chief of the Miscellaneous Division until November, 1900, when he in turn was succeeded by Dr. R. W. Hickman November 1, 1900. On July 1, 1903, the Miscellaneous Division was again officially designated the Quarantine Division, and was continued as such under the direction of Dr. Hickman as Chief until his retirement on March 31, 1922, at which time he had completed an uninterrupted term of 34 years in the Bureau's service.

The continuous expansion and increasing volume of work in connection with the various accounts necessitated in 1906 the organization of a separate Office of Accounts. After that time the duties of the Quarantine Division were primarily those related to the inspection and quarantine of import livestock, supervision over import animal by-products, the inspection of export livestock and the disinfection and fitting of ocean steamers for their shipment, under provisions of regulations issued by the Secretary of Agriculture.

Following the retirement of Dr. Hickman, Dr. George W. Pope, who since August 1, 1917, had been Assistant Chief of the Quarantine Division, conducted the work as Acting Chief until May 1, 1922, when the Quarantine Division was merged into the Field Inspection Division.

TUBERCULIN TESTING ABROAD

Prior to 1900 the tuberculin test had never been required for import cattle, and it was felt by Dr. Salmon that cattle coming forward almost continuously from Great Britain might be the means of disseminating tuberculosis among the valuable herds of purebred cattle in the United States. Accordingly B. A. I. Order 56, issued December 28, 1899, provided that all cattle over 6 months old imported into the United States after March 1, 1900, which were subject to quarantine and except as otherwise provided in the regulations, should be tested with tuberculin after their arrival at quarantine. Soon after this regulation became effective it appeared evident that as a result of tuberculin testing import cattle after arrival in the United States importers would suffer serious losses through the condemnation of their animals, and on November 10, 1900, an amendment to Order 56 was issued to provide that all cattle of this kind over 6 months old imported after December 1, 1900, should be tested with tuberculin by an inspector of this Department stationed in Great Britain or after arrival at the quarantine station in the United States. Dr. Geddes was relieved as Chief of the Miscellaneous Division and assigned to London for the special purpose of supervising export shipments to the United States and to apply the tuberculin tests in these cases.

The Bureau continued to provide for the tuberculin testing of cattle in the United Kingdom prior to their shipment to the United States until regulations effective May 1, 1923, required that such cattle be accompanied by a satisfactory tuberculin test certificate of an official veterinarian of the national government of origin, with a further provision for a subsequent tuberculin test made by a Bureau inspector during the last ten days of the quarantine period in the United States.

TRANSFER OF AUTHORITY

Under the Act of April, 1897, the President of the United States was authorized to suspend the prohibition against the importation of neat cattle and the hides of neat cattle whenever the Secretary of Agriculture should certify to him what countries or parts of countries were free from contagious or infectious diseases of domestic animals. By an Act of August 5, 1909, this authority to suspend the

prohibition against neat cattle and the hides of neat cattle was transferred to the Secretary of the Treasury.

There have been various reenactments of the law giving the Secretary of the Treasury authority to control the importation of neat cattle and the hides of neat cattle, the last of which appeared in the Tariff Act of October 3, 1913. Under the authority of this law the Secretary of the Treasury was to determine officially and give public notice thereof whenever a prohibition against the importation of cattle or the hides of neat cattle was suspended as applying to any foreign country or countries or any parts of such country or countries. The Tariff Act approved September 21, 1922, transferred this authority to the Secretary of Agriculture in the following language:

SEC. 306. (a) That the importation of neat cattle and the hides of neat cattle from any foreign country into the United States is prohibited under such rules of inspection as the Secretary of Agriculture may determine.

(b) If the Secretary of Agriculture shall determine that such importation will not tend to the introduction or spread of contagious or infectious diseases among the cattle of the United States, he shall officially notify the Secretary of the Treasury and give public notice that the operation of subdivision (a) of this section shall be suspended as to any foreign country or countries, or any parts of such country or countries.

Under authority of this law the Secretary of Agriculture on December 27, 1922, issued B. A. I. Order 280, authorizing the importation, subject to regulations of the Department of Agriculture, of neat cattle from the Dominion of Canada, Mexico, the Channel Islands, Great Britain, Ireland and New Zealand, and, subject to joint regulations of the Treasury Department and the Department of Agriculture, the importation of neat cattle hides from any foreign country.

PURCHASE OF PROPERTY FOR QUARANTINE STATIONS

Administration of the law applying to import livestock has made necessary the continuous maintenance by the Bureau of animal quarantine stations at the ports of Boston, New York and Baltimore since first authorized by Congress in 1883. The requirement of quarantine for sheep, other ruminants and swine in addition to cattle increased the demand for more adequate facilities at the Atlantic Coast quarantine stations.

Port of New York.—It was not until May, 1900, that Congress made the appropriation which enabled the Bureau to take active steps in procuring land for a new animal quarantine station for the port of New York. An effort was made by Bureau officials to procure prop-

erty for a station accessible by both water and rail. It was found, however, that the funds voted by Congress were not adequate to purchase water front acreage within a practicable distance from the great harbor of New York. After careful search, a tract of land at Athenia, N. J., was found which it was considered would meet the requirements. This property consisted of about 43 acres, adjoined the Erie Railroad, and was a quarter of a mile from the Delaware, Lackawanna & Western road. The property was purchased from six owners at a reasonable price and without litigation.

After the State of New Jersey had ceded jurisdiction to the United States Government and the former owners had been given the requested time for vacating, the active work of establishing a new station was begun on April 1, 1901. Within a few months temporary buildings were moved from Garfield and permanent buildings had been erected upon the station grounds and the station was opened for the reception of import livestock.

In 1903 a special appropriation was made by Congress for the purchase of about 9 acres additional, increasing the land area of the station to about 52 acres. Most of the temporary stables were replaced at intervals by permanent brick stables, until there have been erected 18 substantial brick stables with cement floors and iron fittings and a cattle capacity of 462 head, affording, with the old frame buildings still remaining, a total capacity at this station of 625 head.

Port of Baltimore.—In 1906 a survey was begun for a race course adjoining the animal quarantine station at Halethorp near Baltimore. This, together with the dilapidated condition of the buildings on the station, made it seem advisable to abandon the station and find a new location. Funds were provided by Congress, and the Bureau was successful during the fiscal year 1911 in purchasing for a quarantine station for the port of Baltimore a tract of land at Turner Station on the Baltimore & Sparrows Point Railway, with a good water front on the Patapsco River about five miles from the cattle steamer docks and within the lighthouse area. The grounds, consisting of 17 acres, were rapidly equipped with fencing, a water system, a superintendent's dwelling and nine stables with concrete foundations, floors and side walls. The cattle capacity of the station at present is about 300 head, with room on the grounds for the construction of several more stables with adequate yards.

During the World War the station was closed to livestock and turned over to the War Department for the storage of munitions. The War Department constructed on the property two large storage

buildings and concrete roads extending through the grounds and to the end of the dock, and dredged a channel leading from the main channel of the Patapsco River to the station dock, of sufficient depth for the largest tugs operating in that harbor. When vacated by the War Department following the war the two specially constructed storage buildings became available for the accommodation of livestock.

Port of Boston.—The animal quarantine station for the port of Boston, transferred from Waltham to Littleton in 1885, was maintained with 11 quarantine stables upon leased property at the latter place until the year 1911, when the tract, consisting of $31\frac{3}{4}$ acres, was purchased by the Government. This completed the acquirement under Government ownership of the three stations on the Atlantic seaboard.

Pacific Coast Ports.—Importations of livestock at Pacific Coast ports from countries other than those of North America have been practically limited to occasional shipments of sheep from New Zealand. The volume of these imports has not been sufficient to warrant the purchase of land and equipment for a quarantine station on the Pacific Coast. When importations have been permitted the importer has been required to provide a suitable place meeting with the approval of the Bureau for quarantine purposes.

IMPORTATIONS UNDER SPECIAL LAWS

In conformity with section 9 of "An Act to provide further for the National security and defense by stimulating agriculture and facilitating the distribution of agricultural products," approved August 10, 1917, and an act approved November 21, 1918, to enable the Secretary of Agriculture to carry out during the fiscal year ending June 30, 1919, the purposes of the aforesaid act, appropriate regulations were issued. These acts were to be operative only during the continuance of the war, and the regulations made under them were known as Treasury Department and Department of Agriculture Joint Order No. 3, effective May 1, 1918, and Amendment 1 to same, effective January 1, 1919. The purpose of these laws and regulations was to render possible and govern the importation into the United States of tick infested slaughter cattle from Mexico, South and Central America, the Islands of the Gulf of Mexico and the Caribbean Sea, in order to increase our meat supply. Primarily the entry of such cattle was limited to States below the southern cattle quarantine line, but the privilege was extended by the amendment to include Norfolk, Va., Baltimore, Md., Philadelphia, Pa., New York,

N. Y., Boston, Mass., San Diego, Los Angeles and San Francisco, Calif., and Seattle, Wash. Armour & Co. made four shipments consisting of 1,983 cattle during February and March, 1918, from Costa Rica for entry and immediate slaughter at Jacksonville, Fla.

There were included also in the amendement provisions for rendering these regulations inapplicable in the case of tick-infested cattle imported from Mexico into Texas for purposes other than immediate slaughter, and for the importation of tick-infested cattle from the Virgin Islands into Porto Rico for any purpose when the cattle were otherwise free from disease. Under the latter provision cattle were imported into Porto Rico from the Virgin Islands as follows:

January, 1919.....	59 head
April 1, 1919.....	148 "
July 1, 1920, to June 30, 1921.....	204 "
July 1, 1921, to June 30, 1922.....	326 "
July 1, 1922, to June 30, 1923.....	1,936 "

Prior to the passage of the Act of November 21, 1918, cattle were shipped under agreement between the Navy Department and the Department of Agriculture as follows:

June 13, 1918.....	40 head
August 19, 1918.....	45 "
September 14, 1918.....	39 "
October 23, 1918.....	66 "

This arrangement was made through conferences of officials of the Department of Agriculture and the Navy Department. As both Porto Rico and the Virgin Islands belong to the United States, the control of the Virgin Islands was under the direction of the Navy Department, and the laws of the United States did not apply. The laws of the Government of Denmark, which latter country had sold the Virgin Islands to the United States, were still in effect and administered by officials of the Navy Department.

EFFICIENCY OF QUARANTINE SYSTEM

It is a gratifying fact that our quarantine system has been successful in excluding contagious disease of livestock from the United States. While there have been occasional outbreaks of foot-and-mouth disease in this country since the organization of the Bureau, none of them have been traceable to import livestock or products over which the Bureau maintains supervision. On at least two occasions diseases of a serious nature have been discovered in animals during the quarantine period.

Malta Fever.—In 1905 Malta fever was discovered by Dr. John R.

Mohler, Chief of the Pathological Division, in an importation of 65 goats from the Island of Malta, during the period of quarantine at New York. It was found necessary to destroy all of the importation in order to prevent the introduction of this disease with these animals.*

This importation of goats was undertaken by the Bureau in an effort to obtain a herd of clean, healthy, hardy animals, especially for the purpose of serving as foundation stock to supply those interested in the building up of a milk goat industry in this country. Mr. George F. Thompson, at that time Editor of the Bureau, who had spent considerable time in studying the different breeds of goats, was detailed to make this importation. Mr. Thompson proceeded to the Island of Malta early in the summer of 1905 and shipped the goats to New York via Antwerp, arriving at the former place on September 23, 1905. The goats were immediately taken to the Quarantine Station of the Bureau at Athenia, N. J.

It is understood that about the time Mr. Thompson was in Malta a commission of the British Government was investigating the cause of Malta fever in British troops on that Island and had about reached the conclusion that the disease was conveyed through the milk of goats. Mr. Thompson, who, apparently, doubted the theory of Malta fever being conveyed by goats' milk, drank milk from the animals very freely during the voyage to the United States. He died rather suddenly early in January, 1906, from pneumonia. On one occasion several weeks before his death he remarked that his ailment might be Malta fever and suggested that his blood be tested. Unfortunately, this was not done. As pneumonia is a frequently observed accompaniment of Malta fever, it seems probable that he became infected with the latter disease either while on the Island or during the return journey.

An elderly lady at the Athenia Quarantine Station was in poor health at the time the goats arrived. She was given the milk from the goats for nourishment, and as it agreed with her she used it daily for some time. She was taken with fever and painful swelling of the joints in October, 1905, and passed through a typical attack of Malta fever, diagnosed by the symptomatology and from the fact that her blood gave a positive agglutination reaction with the Malta fever organism (*Micrococcus melitensis*).

Surra. †—*Surra* was discovered by Dr. Mohler, Chief of the Patho-

* See "Pathological Division," page 67, and "Animal Husbandry Division," page 243.

† See "Pathological Division," page 67.

logical Division, in an importation of Zebu cattle shipped from Bombay, India, in 1906, but the disease was not allowed to escape from the special quarantine established for the importation on an Island near Staten Island, New York. The cattle were imported by Mr. A. P. Borden for the Pierce Ranch at Pierce, Texas. The Secretary of Agriculture consented to allow Mr. Borden to import the animals subject to certain especial precautions, including a provision that Dr. William Thompson, veterinary inspector of the Bureau, who had served two years in the veterinary service of the Philippine Islands, proceed to India at Mr. Borden's expense and inspect the animals before purchase, to inquire into the history of the cattle as far as possible and to accompany them on the steamship to the United States. Despite the fact that the blood of these cattle was examined microscopically on two occasions in India and twice again during the ocean voyage en route to New York, with negative results, it was deemed advisable, as mentioned on page 67, to make a more exacting test by rabbit inoculations before accepting the cattle as free from the surra parasite. As a result of the primary rabbit inoculation test it was found that some of the animals in the herd were infected with surra, and following the original test and frequent retests it was necessary during the quarantine period to slaughter 18 of the 51 cattle originally landed and quarantined. The carcasses of the animals slaughtered, with all their parts, including hides, were either incinerated or deeply buried after being covered with quicklime and sulphuric acid.

BUREAU REPRESENTATIVES ABROAD

The conditions in connection with our export cattle and meat trade prior to the establishment of the Bureau in 1884 have been stated in Part I of this sketch. In view of the circumstances it was considered desirable that this Bureau should be represented by its own officials at the post-mortem examinations made on American cattle at the foreign animal wharves. Through the active cooperation of the Department of State the privilege was obtained from the British Government of stationing three veterinary inspectors in Great Britain. Dr. Salmon, Chief of the Bureau, proceeded to England, accompanied by Dr. W. H. Wray, Dr. A. D. Melvin and Dr. J. F. Ryder. They arrived in England in August, 1890.

Dr. Wray was assigned to London effective August 1, 1890, and remained at that post continuously until his death, August 24, 1923.

Dr. Melvin was assigned to Liverpool on July 16, 1890. He was returned to Washington on April 1, 1892.

Dr. Ryder was assigned to Glasgow effective August 1, 1890. Upon the return of Dr. Melvin to Washington, Dr. Ryder was transferred from Glasgow to Liverpool. He was returned to the United States and assigned to Boston, Mass., on March 1, 1904.

Dr. James Johnston, an inspector on the Bureau force at Boston, Mass., was transferred to Liverpool, England, effective January 2, 1904, and succeeded Dr. Ryder, remaining there until June 15, 1906, when he was returned to the United States.

These inspectors were allowed every facility for participating with local officers in the work of inspecting and making post-mortem examinations on American cattle landed in British ports. Since this work was established in August, 1890, the Bureau has maintained continuously one or more veterinary inspectors in England.

As has been previously stated, Dr. T. A. Geddes was sent to Great Britain in 1900. He was assigned to London on November 6, 1900. His particular work, however, was the tuberculin testing of cattle prior to their shipment to the United States. On May 1, 1906, he was transferred from London to Liverpool. On August 31, 1909, Dr. E. P. Schaffter was sent to Liverpool to relieve Dr. Geddes, and Dr. Geddes was returned to the United States and assigned to the Chicago station on October 15, 1909. On August 7, 1912, Dr. Schaffter was ordered to return to the United States, and on September 1 of that year he was placed in charge of the Bureau station at Detroit, Mich.

On September 1, 1913, Dr. A. E. Rishel was assigned to Dr. Wray at London, to continue the work of tuberculin testing of cattle formerly performed by Dr. Schaffter. As a result of reduced shipments of livestock from Great Britain incidental to war conditions, Dr. Rishel was returned to the United States on June 20, 1916, and placed in charge of supervisory work at New York City incidental to importations of hides, skins and other animal by-products offered for importation into the United States at that port.

It appearing necessary in 1921 to furnish Dr. Wray again with an assistant, Dr. E. M. Nighbert was assigned to London and directed to report to Dr. Wray on May 15, 1921. Repeated outbreaks of foot-and-mouth disease in England having interfered seriously with importations of cattle from not only Great Britain but also the Channel Islands, it appeared unnecessary to continue to maintain two inspectors in Great Britain, and Dr. Nighbert was ordered to return to the United States in June, 1922.

Dr. R. W. Tuck, our present representative in Great Britain, was

assigned to the position made vacant by the death of Dr. Wray. He took charge of the station on October 15, 1923, with headquarters at the American consulate, in Cavendish Square, London, England.

TAGGING FOR IDENTIFICATION

The Act of August 30, 1890, providing for the inspection of all export cattle, sheep and swine, made it possible to introduce a system of tagging export cattle, the purpose of which was to enable the Bureau to trace to the point of origin in the United States any animal which might be found at a foreign port affected with contagious disease. On October 20, 1890, the Secretary of Agriculture issued an order and regulations for the inspection and tagging of cattle and sheep for export. This system of tagging cattle with serial numbered metal tags attached to the ear was continued for a number of years with gratifying results.

FITTING OF VESSELS

The steamship transportation of export animals had been criticized severely by humanitarians and also on account of the losses sustained by export shippers.* It was evident that some measure should be taken promptly to insure the safe and more humane handling of livestock going forward to foreign countries, especially cattle. The insurance rates were high, and the British Government, owing to the heavy losses and bad condition in which many animals were found upon arrival in Great Britain, had been seriously considering the prohibition of the traffic.

As a result of improved conditions in cattle ships and fittings, and the enforcement of these regulations, it is shown in the report of the Bureau for 1905, when we were exporting an average of 325,000 cattle a year, that in the first year that the regulations went into effect the losses of livestock, which had previously been about 4 per cent for cattle and somewhat higher in the case of sheep, were reduced to 1.6 per cent for cattle and 1.7 per cent for sheep. This loss was further reduced year after year, until it reached the low point of 0.138 per cent for cattle and 0.751 per cent for sheep. In the meantime the insurance upon export livestock was reduced from 8 per cent to one-third of 1 per cent.

The percentage of loss has continued low, and at the present time the only complaints received by the Bureau are from those who through selfish motives desire less stringent regulations and a modi-

* See "Animal Transportation," page 23.

fication in requirements which will enable them to avoid expense incidental to the construction of proper fittings. Receiving governments, insurance companies, humane societies, consignees of livestock and a large majority of the consignors are apparently in full sympathy with the requirements and purposes of the regulations.

EXPORT CATTLE TESTED

With an increasing demand in certain foreign countries, especially those of South America, for dairy and breeding cattle from the United States, it became essential that purebred export cattle upon leaving the United States should be accompanied by tuberculin-test certificates which would assure receiving governments that every effort had been made to guard against the shipment of any cattle affected with tuberculosis. The necessity for such a provision was emphasized when eight out of ten Holstein cattle from the United States which arrived in Buenos Aires in November, 1913, were slaughtered there on account of being infected with tuberculosis. These cattle were purchased by the Assistant Secretary of Agriculture of the Argentine Republic in his private capacity. The animals originated in the State of New Jersey and prior to shipment had been tuberculin-tested by a veterinarian in the employ of the State of New Jersey.

As a result of this unhappy incident, the Bureau regulations were amended May 26, 1914, to provide that all dairy and breeding cattle for export must pass a satisfactory tuberculin test by an inspector of the Bureau. On June 5, 1919, B. A. I. Order 139 was superseded by Order 264, in which it was specified that tests in these cases be applied by an inspector of the Bureau or by a duly authorized representative of the country to which the animals were to be exported. The Bureau found it difficult to respond promptly to all requests for a tuberculin test in these cases, and frequently it was not possible to test cattle owing to the fact that they had just previously been tested for interstate shipment. Accordingly, Amendment 1 to Order 264 was issued, effective November 1, 1919, providing for the acceptance of test certificates in these cases issued by veterinarians of the various States who were authorized by the State to test cattle for interstate shipment.

Following the establishment of the accredited herd work for the eradication of tuberculosis, and the accrediting of local veterinary practitioners, it was considered advisable to confer upon these accredited men also the privilege of testing export cattle. This seemed

especially desirable in view of the fact that shipments were frequently made from accredited herds which had recently been tested by either a Bureau inspector or an accredited practitioner.* The Bureau regulations were accordingly further amended on May 19, 1921, to provide that all dairy and breeding cattle must pass a satisfactory tuberculin test by an inspector of the Bureau of Animal Industry, by a duly authorized representative of the country to which the animals are exported, or by a State inspector or other veterinarian accredited for testing accredited herds. These are the present requirements for dairy and breeding cattle for export.

Following the World War there was an increased demand for American livestock on the part of certain foreign countries. This was especially apparent in efforts which were being made to restore the devastated agricultural sections of France and Belgium. The Quarantine Division, with the aid and cooperation of the Tuberculosis Eradication Division, undertook the tuberculin testing of all dairy and breeding stock purchased for shipment to foreign countries except in cases where the importing governments assumed the responsibility of inspection and testing of the cattle. Belgium issued an order in 1919 removing all restrictions on shipments from the United States, and in the fiscal years 1920, 1921, 1922 and 1923, 55,809 American and Canadian cattle were forwarded to that country from United States ports. In 1920 and 1921 shipments of dairy cattle aggregating 1,485 head were made to Germany without Bureau inspection and certification but under the supervision of a representative of the German Government. During the fiscal years 1919 and 1920 approximately 11,000 head of dairy cattle accompanied by Bureau tuberculin-test certificates were shipped to France. An experienced vessel inspector was transferred from New York to Newport News, Va., to supervise the fitting of vessels of the United States Shipping Board for the carrying of these cattle, and every effort was made by the Quarantine Division to assist in the proper handling and safe transport of this export stock.

IMPORT HIDES AND OTHER ANIMAL BY-PRODUCTS

Prior to the organization of the Bureau of Animal Industry, regulations governing the inspection and quarantine of import cattle and the sanitary handling and control of import hides were issued by the Treasury Department. That Department continued to issue the hide importation regulations until the termination of 1916, though they

* See "Tuberculosis Eradication Division," page 359.

were administered by the Department of Agriculture through this Bureau. The last regulations issued by the Treasury Department in connection with hide importations were dated May 2, 1910. These were superseded by Treasury Department and Department of Agriculture Joint Order No. 1, effective January 1, 1917, followed by Joint Order No. 2, effective January 1, 1918. The Treasury Department regulations provided that hides of a character requiring disinfection which were not accompanied by a proper certificate of disinfection would be treated as prohibited importations and denied entry, while the Joint Orders provided for the disinfection of hides and other animal by-products either prior to shipment from a foreign country or after arrival at destination in the United States.

The Public Health Service of the Treasury Department is primarily concerned in the regulations governing the importation of animal by-products in so far as they afford protection to tannery workers and the handlers of hides, skins, etc. The Bureau of Animal Industry is interested more especially in protecting the livestock of this country from the infection of foot-and-mouth disease, rinderpest and anthrax, and aims to guard against the pollution of streams receiving effluents from tanneries. Therefore the Public Health Service and the Bureau confer in preparing regulations.

In view of the authority granted the Chief of the Bureau under Joint Order No. 2, it became necessary to issue Bureau Order 256, effective January 1, 1918, specifying methods for the disinfection of hides and skins prior to shipment from a foreign country and also after arrival at destination in the United States. This Bureau Order, which is still in effect, also specifies methods for the disinfection of import glue stock, bones, hoofs, horns, hay, straw, etc. The promulgation of these regulations made it necessary for the Bureau to provide for a general supervision over importation of animal by-products at the important ports of entry in the United States and also a supervision over a large number of tanneries and establishments handling animal by-products. This supervisory work became an important duty of the Quarantine Division. While these regulations still in effect have not been administered without difficulty and a considerable tax upon Bureau resources, they apparently afford a good measure of protection and at the same time admit of the importation of hides and skins which in many instances under previous regulations would have been prohibited. The educational influence of their administration has likewise resulted in a more careful and intelligent handling of these products by those engaged in their importation and preparation for tanning.

INVESTIGATIONS IN FOREIGN COUNTRIES

The Quarantine Division has always endeavored to keep a record of diseases affecting livestock in foreign countries. These for the most part have been based upon official reports received from American consuls through the Department of State. Reports of this character have naturally been incomplete in some instances. While the final inspections of import livestock are made at the port of entry and during the period of quarantine, there are some instances in which inspections and direct investigations have been made relative to diseases of animals in foreign countries which have desired to ship livestock to the United States.

Porto Rico.—In August, 1907, Dr. William Thompson, the veterinary inspector who was detailed to visit India in 1906 in connection with an importation of Zebu cattle, was assigned to Porto Rico to make certain investigations with reference to tick infestation and the importation into that Island of animals from Cuba and other countries. Dr. Thompson completed his work and returned to New York in April, 1908. Since that time the Bureau has maintained a representative in Porto Rico to inspect occasional shipments of livestock entering the Island and to report outbreaks of disease. The inspector now located at San Juan is commissioned at a per diem rate for days actually employed.

Honduras.—In March, 1910, Dr. William Thompson, veterinary inspector, and Mr. James E. Downing, expert in livestock investigations, were sent to Honduras to obtain first-hand information relative to livestock conditions and prevalent diseases of Honduran livestock. This action was taken owing to numerous applications for permission to import cattle from that country. It seemed essential under the circumstances to determine whether or not the importation of cattle from Honduras could be permitted under the Act of August 30, 1890, which prohibits the importation of neat cattle, sheep and other ruminants and swine which are diseased or infected with any disease or which shall have been exposed to such infection within 60 days next before their exportation. These investigations required a journey in Honduras of approximately 1,325 miles on mule back and 50 miles by railroad, and occupied the time from March 29 to July 7, 1910.

Mexico.—In November, 1913, a disease affecting the feet and mouths of horses and cattle was reported to the Bureau as being prevalent in the vicinity of Tampico, Mexico. The reported severity and extent of this disease led the American consul at Tampico to fear that it might be foot-and-mouth disease and would be carried into the United

States. He accordingly reported the fact to the Department of State. As cattle were being permitted importation from Mexico, it was deemed advisable to have an investigation made, and accordingly in November, 1913, Dr. Cooper Curtice was detailed to make an investigation of dairy herds in the vicinity of Tampico. Dr. Curtice arrived at Tampico November 20, 1913. It was determined as a result of his investigation, covering approximately three months, that this disease affecting Mexican cattle was mycotic stomatitis.

Colombia.—In 1915 the Department was urged to permit the importation of cattle from Colombia, it having been represented that the cattle of that country were free from disease and, in some sections, from ticks, and that they could accordingly be certified as required by the regulations of the Department of Agriculture governing the importation of livestock into the United States. It was decided to make an investigation of conditions in Colombia. In April, 1915, Dr. H. H. Ladson, a veterinary inspector in the Bureau, was directed to proceed to Colombia with Mr. Ignatius Uribe, an attaché of the Colombian Legation at Washington. Dr. Ladson's trip consumed three months and his investigation covered the principal cattle-raising section of Bolivar, the territory of the Sinu Valley, the departments of Antioquia, Calidas, Tolima, Magdalena and Atlantico and the Cauca Valley. It was found that the cattle tick was quite generally present in Colombia and that anthrax was present in certain departments, that foot-and-mouth disease was unknown to the ranchmen and that a disease affecting horses, believed to be *mal de caderas*, or *surra*, was present in certain sections. From Dr. Ladson's description it was believed that *surra* may have caused severe losses in that country, as thousands of horses, mules, asses, and, in some instances, cattle were said to have died from diseases, the description of which was indicative of *surra*.

Guatemala.—In June, 1915, Dr. Henry Burke, veterinary inspector, and Mr. S. H. Ray, scientific assistant in beef cattle investigations, proceeded to Guatemala on a mission, the purpose of which was somewhat similar to that of Dr. Thompson and Mr. Downing when they visited Honduras in 1910. Requests had been made for permission to import cattle from Guatemala into the United States at New Orleans. Mr. Ray returned to the United States several weeks in advance of the date set for sailing for home. Dr. Burke remained to conduct some further inspections near Guatemala City, after which he obtained passage on the steamship *Marowijue*, a United Fruit Company boat, which left Puerto Barrios on July 13, 1915. A few hours after

this ship left port a terrific West Indian hurricane swept over the Gulf of Mexico and the *Marowijue* was lost with all passengers and the crew. All data and notes which Dr. Burke had collected during the trip were lost with him. From observations reported by Mr. Ray it appeared that conditions in Guatemala as regards tick infestation were not very different from those observed by Dr. Thompson and Mr. Downing in Honduras, and that cattle from Guatemala were accordingly not eligible for importation into the United States under existing laws and regulations. This was confirmed when a trial shipment of Guatemala cattle that passed inspection by Dr. Burke and also by Bureau inspectors at New Orleans were found upon arrival at National Stock Yards, Ill., to be infested with the cattle tick *Margaropus australis*.

The death of Dr. Burke is not the only instance in which a Bureau inspector engaged in Quarantine Division activities has lost his life in the discharge of his duties. Dr. Harry M. Hart, veterinary inspector on the El Paso, Texas, force in March, 1916, proceeded under orders from El Paso to Columbus, N. Mex., for the purpose of inspecting cattle at Columbus. He arrived too late on March 9 to make the inspection and procured lodging for the night at a local hotel, which was burned that night by Mexican bandits under the leadership of Francisco Villa. It was reported by the wife of the proprietor of the hotel that she saw the bandits take Dr. Hart from his room down one flight of stairs and then shoot him. His charred remains were later found in the ruins of the building.

Countries in South America.—Dr. S. O. Fladness, a veterinary inspector of the Bureau, left the United States in July, 1916, for South America and returned in June, 1918, spending the greater part of the fiscal years 1917 and 1918 in Argentina, Uruguay, Brazil and Paraguay. This assignment of Dr. Fladness was for the purpose of procuring information relative to the animal diseases of South America, especially those that must be considered in connection with meat inspection and the importation of meats and animal by-products into the United States.

Guatemala.—On March 12, 1923, Bureau inspectors L. Enos Day and Howard L. Darby sailed from New Orleans for the Republic of Guatemala for the purpose of studying a reported outbreak of foot-and-mouth disease in that country and also to make arrangements for preventing the disease from reaching the United States. The report of their investigation showed that although a mild form of foot-and-mouth disease was reported to have appeared in great num-

bers of cattle in Guatemala during the months of November and December, 1922, and the early part of January, 1923, it apparently disappeared about the middle of January. During practically a month of travel they were unable to find any disease in cattle in Guatemala which simulated foot-and-mouth disease. They obtained assurances from Guatemalan officials of their desire to cooperate in the event of future outbreaks to prevent the spread of the disease to the United States. They returned from their mission in April, arriving at New Orleans April 19.

MISCELLANEOUS ACTIVITIES

Tuberculin Tests of Dairy Cattle Supplying the District of Columbia

The task of applying the tuberculin test to dairy cattle in the District of Columbia and vicinity was begun in the spring of 1906 under the direction of the Pathological Division, but on May 27, 1907, Dr. B. T. Woodward was transferred from the Pathological Division to the Quarantine Division, at which time this tuberculin test work was taken over by the Quarantine Division.* The principal object was to assist the Health Department of the District of Columbia in its efforts to create a milk supply free from contamination with the germs of tuberculosis. From the beginning of the work in the spring of 1907 up to the close of the fiscal year, June 30, 1908, the test was applied to 2,468 cattle in the District of Columbia, Maryland and Virginia, of which number 387, or 15.68 per cent, reacted. Of the reacting animals 126 were slaughtered under the Bureau's inspection and in all but a single case the presence of tuberculosis was demonstrated after post-mortem examination. The diagnosis by the tuberculin test was therefore confirmed in 99.21 per cent of the animals slaughtered. These tests were without charge and upon the voluntary request of the owners provided that they sign a form of agreement for the proper control and disposal of any reacting cattle.

In connection with this work it is interesting to note that the first accredited herd in the United States was established in the State of Maryland on April 27, 1908. The agreement necessary for the owner to sign in order to participate in the Bureau activities looking to the eradication of tuberculosis provided for the slaughter of the animals which reacted to the test, or their removal from the herd and segregation under the Bang method of handling tuberculous animals; and it also provided for the sterilization of the milk from

* See "Experiment Station," page 53; "Pathological Division," page 69; "Tuberculosis Eradication Division," page 349.

such segregated cows, the restricted use of segregated bulls, the removal at birth of the calves from segregated cows, the cleaning and disinfection, under supervision, of infected premises, the marking of all animals tested, the testing of all animals by a public official before admitting them to the tested herds, and a pledge to comply with all reasonable sanitary measures, indicated by the proper officials of the State or Territory wherein the herd was located. In addition to the agreement, there was a system of identifying animals by the use of ear tags. Under this agreement the herd of cattle owned by Messrs. Ford & Graham, Garrett Park, Md., was established as fully accredited. No reactors being found in the herd on the second annual test, a certificate was issued to Messrs. Ford & Graham on April 27, 1908, as follows:

To Whom It May Concern:

This is to certify that on April 21-22, 1908, the entire herd of cattle of Messrs. Ford & Graham, at the Hermitage Dairy Farm, Garrett Park, Maryland, was tuberculin-tested by an inspector of the Bureau of Animal Industry.

The herd consists of eighty-two (82) Jersey cattle, all free of tuberculosis, and tagged "U. S. B. A. I. 1403-1487" inclusive.

This certificate was signed by Dr. A. D. Melvin, Chief of the Bureau. This herd was kept under supervision by the Bureau and tested annually, certificates being issued upon the completion of each free test. Without question this herd, now the property of George L. Goodaere, Silver Spring, Md., was the first in the United States to be accredited under a definite plan of tuberculosis eradication, based on the stringent requirements of the present uniform methods and rules.

Special Tuberculosis Investigations Begun

In accordance with a provision in the Act of Congress making the appropriations for the Department of Agriculture for the fiscal year ended June 30, 1909, the Secretary was authorized to investigate the prevalence and extent of tuberculosis among dairy cattle in the United States. The Bureau, through the Quarantine Division, inaugurated steps during that year to collect this information by applying the tuberculin test to cattle in various parts of the country. The outbreak of foot-and-mouth disease during that year, however, seriously interfered with this work.

Tuberculin Tests for Interstate Shipment

During the fiscal year 1909 ten States adopted a requirement that dairy and breeding cattle be tuberculin tested as a prerequisite for

their admittance into those States. Previous to this time certain other States had established the same requirement, and it was during this year that cooperative arrangements were made with the authorities of a number of States for the application of the tuberculin test to cattle for interstate shipment. This work was carried on under the supervision of the Quarantine Division at eight of the large stockyards of the country located at Denver, Colo.; Lancaster, Pa.; Minnesota Transfer, Minn.; Portland, Oreg.; Salt Lake City, Utah; Sioux City, Iowa; South Omaha, Nebr.; and South St. Paul, Minn.

Cooperative Tests With City and Indian School Authorities

It was likewise during this same fiscal year (1909) that the Bureau, through the Quarantine Division, began the application of the tuberculin test to dairy cattle in various parts of the country in cooperation with State and municipal authorities. This was primarily tuberculosis-eradication work and distinct from that of testing for interstate shipment.

This cooperative work was begun May 24, 1909, and was undertaken in cooperation with the State authorities of Nebraska and Iowa, especially in the cities of Omaha, Nebr., and Waterloo, Iowa. Among 8,819 cattle tested, 744 reactors and suspects were found.

At the same time an investigation was begun of the milk supply of the various United States Government Indian schools from the standpoint of tuberculosis and sanitation. The institutions included in the first investigation were the schools at Carlisle, Pa.; Stewart, Nev.; Chamberlain, S. Dak.; Green Bay, Wis.; Lawrence, Kans.; Hayward, Wis.; Lac du Flambeau, Wis.; Lapwai, Ida.; Phoenix, Ariz.; Rapid City, N. Dak.; and the Indian insane asylum at Canton, S. Dak. During the following year, 1910, on request of the Office of Indian Affairs, cattle at 31 Indian schools and reservations were tested for tuberculosis. This work was continued by the Quarantine Division until tuberculosis eradication activities were taken over by the Tuberculosis Eradication Division, May 1, 1917. Cooperation with the Office of Indian Affairs resulted in an improvement in the quality of cattle and in the sanitary conditions under which milk was produced at these institutions, and also in the eradication of tuberculosis from their herds.

Tracing Tuberculosis to Farms

An important line of work was also undertaken in 1909 as regards locating centers of tuberculosis infection by tracing the origin of

cattle and swine that were found affected with tuberculosis through the meat-inspection service of the Bureau. The names and addresses of the former owners or feeders of diseased animals were obtained when possible, and notification of the finding of tuberculosis was sent to those persons and to the State sanitary officers of the State of origin. This was the beginning of a system which has been continued and has enabled the State authorities to locate many centers of tuberculosis infection and to undertake measures in cooperation with the owners for the eradication of the disease from their herds.

Eradication of Tuberculosis in the District of Columbia.

On November 26, 1909, there was issued an order of the Commissioners of the District of Columbia for the suppression and prevention of tuberculosis in cattle within the District of Columbia. Under the provisions of this order a permit was required for the entry of cattle into the District of Columbia, and when not accompanied by a satisfactory test chart the animals were quarantined and tested by an inspector of the Bureau. Further, it was provided that all the cattle already within the District, regardless of whether or not the products of such animals were offered for sale, must conform to the regulation. This order specifically provided as follows:

Any person, firm or corporation desiring to bring any cattle into the District of Columbia, except as provided in section 3, paragraph (c), shall first make application and obtain a permit from the Chief of the Bureau of Animal Industry or from the Health Officer of the District of Columbia. The said application shall be in writing, stating the number, sex and the age of the cattle, whether over or under 6 months old, the exact place, date and time at which it is desired to enter said cattle, and their destination within the District of Columbia, together with a declaration showing clearly the purpose for which the cattle are desired to be entered, whether for immediate slaughter, feeding or breeding purposes or for milk production.

Cattle offered for entry into the District of Columbia must be accompanied by a permit as provided in section 2 and must be identified by an official veterinarian of the Bureau of Animal Industry or of the Health Department of the District of Columbia, and must be appropriately tagged before entrance is permitted except as provided in paragraph (c) of this section. Cattle over 6 months old for purposes other than immediate slaughter, unless accompanied by a satisfactory certificate of tuberculin test by a veterinary inspector of the Bureau of Animal Industry or an official veterinarian of the Health Department of the District of Columbia or of the State from which brought, must be immediately taken after identification as provided in paragraph (a) of this section, to a place designated by the Chief of the Bureau of Animal Industry or Health Officer of the District of Columbia and there quarantined apart from all other cattle until officially tuberculin tested and disposed of in accordance with these regulations: *Provided*, That no indemnity shall be allowed for such cattle as shall be slaughtered on account of their being deemed to be tuberculous. When accompanied by certificate of tu-

tuberculin test as herein provided the said certificate must show the place and date, within thirty days of being offered for entry, of inspection and tuberculin testing, also temperature chart, description of the animal or animals, age, markings, and tag numbers, if tagged.

Cattle under 6 months old for purposes other than immediate slaughter when not accompanied by certificates as indicated in paragraph (b) may be brought into the District of Columbia as provided in paragraph (a), but said cattle must be accompanied by affidavits by the breeder or feeder and by the owner or shipper; said affidavits to state that tuberculosis has not been known to exist on the premises, during the six months immediately preceding the offer for entry, upon which said animals have been kept.

Cattle over 6 months old already within the District of Columbia shall be inspected and tuberculin tested by a veterinary inspector of the Bureau of Animal Industry or of the Health Department of the District of Columbia. Cattle under 6 months old shall, in the same manner, be inspected and, when deemed necessary, shall be tuberculin tested, said inspection and tuberculin testing to be repeated annually, or at such times as the Chief of the Bureau of Animal Industry or the Health Officer of the District of Columbia may direct. All such cattle shall be officially tagged "U. S. B. A. I." with a serial number, or "U. S. B. A. I. Reacted" with a serial number.

Any person violating any of these regulations, or entering cattle by fraudulent means, or using false or fraudulent tags, or interfering in any way with the work of any official, or using any false or fraudulent means to enable any cattle to pass the tuberculin test shall be punished by a fine of not more than forty dollars nor less than five dollars.

This order was approved by the Hon. James Wilson, Secretary of Agriculture, on November 27, 1909. The Bureau offered its services to the herd owners involved. The Annual Report of the Chief of the Bureau for the fiscal year 1916, pertaining to the tuberculosis eradication work conducted by the Quarantine Division, shows as a result of tuberculin tests conducted that year a reduction in tuberculous cattle in the District of Columbia since the work was begun in 1909 from 18.87 per cent to 1.1 per cent.

Work Transferred to Other Divisions

In 1911 the tuberculin testing of cattle for interstate shipment was transferred to the Field Inspection Division, and on May 1, 1917, at which time there was a general reorganization of the Bureau, including the establishing of a separate division—the Tuberculosis Eradication Division—all other activities relating to the tuberculin testing of cattle, except those for importation and exportation, were transferred to the Tuberculosis Eradication Division.* During the last year that the Quarantine Division supervised the tuberculin testing of dairy and breeding cattle for interstate movement, 7,159 cattle were tested in 12 different States. Of this number, 181 animals reacted

* See "Tuberculosis Eradication Division," page 350.

and 32 were considered suspicious, the percentage of reactors and suspicious together being 2.98 per cent.

*Dourine Eradication.**

In June, 1911, dourine, which it was believed had been eradicated from the United States several years previously, was found to exist in Iowa, and prompt measures were immediately taken under the direction of the Quarantine Division for the eradication of the disease in cooperation with State authorities. In July, 1912, the disease was reported among horses in Montana, and as a result of investigations made at that time it was found that the disease had become more or less prevalent in the eastern part of Montana and the western portions of North Dakota and South Dakota. In December, 1913, this work was extended to include an area in northeastern Wyoming, and in October, 1914, into Nebraska. As a result of investigations begun in March, 1914, the disease was traced to the Navajo Indian Reservation in Arizona and New Mexico.

Very fortunately the Pathological Division of the Bureau had found it possible to adopt the complement-fixation test as a diagnostic agent for dourine, and the plan followed in the handling of this work consisted of the round-up of horses in suspected areas and the procuring of samples of blood serum, which were forwarded to the Pathological Division for examination. This was followed by the slaughter of reacting animals and a later retest of the herd. On May 1, 1917, as a result of reorganizing work in the Bureau, the eradication of dourine was taken over by the Field Inspection Division.

Foot-and-Mouth Disease Eradication†

During the outbreak of foot-and-mouth disease in 1914-1915, the Quarantine Division assisted in formulating and was charged with the responsibility of administering regulations of the Secretary of Agriculture covering the interstate shipment of domestic hides, skins, other animal by-products, hay, straw, feed, etc. Much care and judgment were essential in order to place proper safeguards about shipments and at the same time avoid prohibitive requirements upon these essential materials of commerce.

Miscellaneous Correspondence

While the foregoing represent the chief activities of the Quarantine Division, other important duties were assigned to the Division from

* See "Pathological Division," page 66, and "Field Inspection Division," page 279.

† See "Field Inspection Division," page 280.

the time of its inception. Letters received by the Bureau in large numbers pertaining to subjects directly or remotely related to animal diseases, sanitation, etc., were referred to this Division, and for years a considerable part of the work of the Division was devoted to the study of questions raised in these cases and to the preparation of suitable replies to such inquiries, records of which in correspondence files afford much valuable information on veterinary subjects.

SUMMARY OF IMPORTANT EVENTS

- Dec. 18, 1865...First Act of Congress to prevent introduction of disease in imported cattle.
- March 6, 1866...Act amended and Secretary of Treasury directed to make regulations and put into immediate effect.
1878...Same law re-enacted as a part of the Revised Statutes.
- July 31, 1875...First prohibition under above act by Secretary of Treasury.
- Oct. 1875...Prohibition withdrawn.
1875...Exportation live cattle begun.
- Nov. 3, 1875...Prohibition importation of neat cattle and hides of neat cattle from Great Britain and Ireland on account of prevalence foot-and-mouth disease.
- March 16, 1876...Prohibition withdrawn.
- Feb. 26, 1879...Treasury Department issued prohibition on account of contagious pleuropneumonia of cattle in England.
- July 1, 1879...Revoked same year and suspended as to European ports, provided all cattle quarantined 90 days.
- Feb. 6, 1879...British Privy Council issued order requiring slaughter of (effective
March 3, 1879) all American cattle within 10 days on docks where landed on account of contagious pleuropneumonia alleged by English veterinarians to have been discovered among them.
1879...Similar claim by British veterinarians of foot-and-mouth disease in American cattle.
- July, Aug., 1880...United States investigations in England of contagious pleuropneumonia reported in American cattle by English veterinarians.
- June-Aug., 1881...United States investigations in England of foot-and-mouth disease reported in American cattle by English veterinarians.
- July 30, 1883...Secretary of Treasury ordered quarantine of neat cattle at port of entry from any port of world except North and South America, and designated Portland, Me., Boston, Mass., New York, N. Y., and Baltimore, Md., as ports of entry.
1883...Dr. D. E. Salmon called to Washington to establish veterinary division of Department of Agriculture.
- May 29, 1884...Law enacted for establishment of Bureau of Animal Industry.
- May 31, 1884...Dr. Salmon appointed Chief of Bureau and its organization begun.

- July 7, 1884.....Money appropriated by Sundry Civil Bill for establishing and maintaining quarantine stations.
- Aug. 25, 1884.....Transfer of animal quarantine stations from Treasury Department to Department of Agriculture.
- Aug. 25, 1884.....Commissioner of Agriculture issued order requiring permits to import cattle and their landing only at designated ports where cattle quarantine accommodations maintained.
- March 7, 1885.....Norman J. Colman appointed Commissioner of Agriculture.
- Feb. 11, 1889.....Norman J. Colman designated first Secretary of Agriculture.
- March 7, 1889.....J. M. Rusk appointed Secretary of Agriculture.
- Aug. 1, 1890.....Three Bureau inspectors assigned to ports in England. All sailed together.
- Aug. 30, 1890.....Special Act of Congress applying to importations of ruminants and swine.
- Oct. 13, 1890.....Quarantine regulations promulgated similar to those already in effect issued by Treasury Department July 19, 1879.
- Oct. 20, 1890.....Tagging of export cattle begun.
- June 6, 1891.....Vessel inspection inaugurated under Act of March 3, 1891.
- July 1, 1896.....Quarantine Division designated "Miscellaneous Division."
- Nov. 6, 1900.....Inspector sent to Great Britain to test cattle.
- Dec. 1, 1900.....Tuberculin test required for import cattle.
- May, 1900.....Appropriation for purchase of quarantine station property for port of New York.
- April 1, 1901.....Purchase of land at Athenia, N. J., effected and construction of quarantine buildings begun.
- July 1, 1903.....Miscellaneous Division becomes Quarantine Division.
1903.....Additional land purchased for Athenia quarantine station.
1905.....Malta fever discovered in importation of goats.
1906.....Work of accounts taken from Quarantine Division.
1906.....Surra discovered in an importation of cattle from India.
- May 27, 1907.....Tuberculin testing of dairy cattle supplying District of Columbia begun.
- Aug., 1907.....Special investigations made in Porto Rico.
- May 27, 1909.....Special tuberculosis investigations begun.
- May 27, 1909.....System of testing for interstate shipment inaugurated.
- May 27, 1909.....Beginning of cooperative test work with city and Indian school authorities.
- Nov., 1909.....Plan inaugurated for tracing tuberculous cattle and swine from slaughtering establishments to farms.
- Nov. 26, 1909.....Eradication of tuberculosis in District of Columbia cattle begun.
- May 2, 1910.....Treasury Department regulations applicable to import hides, etc.

- Nov., 1910...Special investigations made in Honduras.
- March 4, 1911...Purchase of land at Turner, Md., for quarantine station.
 1911...Purchase of land at Littleton, Mass., for quarantine station.
 1911...Testing cattle for interstate shipment transferred to Field Inspection Division.
 1911...Dourine discovered in Iowa and eradication work begun.
 1912...Dourine found in Montana and North and South Dakota.
 1913...Dourine eradication work extended to sections of Wyoming.
- Nov. 20, 1913...Special investigations made in Mexico.
 1914...Dourine eradication work extended to sections of Nebraska.
 1914...Dourine traced to Navajo Indian Reservation.
- 1914 and 1915...Quarantine Division takes active part in eradication of foot-and-mouth disease.
- May 26, 1914...Tuberculin test required for export cattle.
- June, 1915...Special investigations made in Guatemala.
- July, 1915...Tragic death of Inspector Henry Burke.
- March 10, 1916...Brutal murder of Inspector Harry M. Hart.
- Jan. 1, 1917...Joint Treasury Department and Department of Agriculture regulations issued for import of animal by-products. Orders 1 and 2.
- Jan. 1, 1918.....
- 1917 and 1918...Inspector sent to countries of South America for special investigations.
- May 1, 1917...Tuberculin test work transferred to Tuberculosis Eradication Division.
- May 1, 1917...Dourine eradication work taken over by Field Inspection Division.
- May 1, 1918...Special provision for importation of tick-infested cattle (war measure).
 1918...Four shipments made by Armour & Co. from Costa Rica for immediate slaughter at Jacksonville, Fla., aggregating 1,983 cattle.
 1918...190 head of cattle shipped from Virgin Islands to Porto Rico.
 1919...Belgium removed all restrictions on cattle from United States.
- 1919 and 1920...411 head cattle shipped from Virgin Islands to Porto Rico.
 1920...Approximately 11,000 head dairy cattle accompanied by Bureau tuberculin test certificates shipped to France.
- 1920 and 1921...48,271 cattle shipped to Belgium.
- 1920 and 1921...1,485 dairy cattle shipped to Germany without Bureau inspection and test (under supervision of German authorities).
- March 31, 1922...Dr. R. W. Hickman retired as Chief of the Quarantine Division after 34 years' continuous service in the Bureau.
- April 1-30, 1922...Dr. George W. Pope, who since August 1, 1917, had been Assistant Chief of the Quarantine Division, was Acting Chief.
- May 1, 1922...Quarantine Division merged into Field Inspection Division, Dr. A. W. Miller, Chief.
- Sept. 21, 1922...Tariff Act approved transferring from the Secretary of the Treasury to the Secretary of Agriculture authority to determine and give public notice concerning coun-

tries from which cattle and hides of cattle might be imported.

March 12, 1923.....Two inspectors sent to Guatemala to investigate a reported outbreak of foot-and-mouth disease.

PERSONNEL OF THE QUARANTINE DIVISION (AND
MISCELLANEOUS DIVISION) 1896-1922

Division Chiefs, Miscellaneous Division:

DR. A. M. FARRINGTON.....	July 1, 1896, to Dec. 31, 1898
DR. T. A. GEDDES.....	Jan. 1, 1899, to Oct. 31, 1900
DR. R. W. HICKMAN.....	Nov. 1, 1900, to June 30, 1903

Division Chief, Quarantine Division:

DR. R. W. HICKMAN.....	July 1, 1903, to March 31, 1922
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Assistant Chief:

DR. GEORGE W. POPE.....	Jan. 1, 1913, to April 30, 1922
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Biochemic Division

The Biochemic Division had its origin on January 1, 1890, when Dr. Emil A. de Schweinitz was appointed Chemist to the Bureau. Even at that early date it had become evident that a thorough understanding of the activities of the disease-producing bacteria and of the intricate problems of immunity could be attained only by coupling chemical studies with investigations in pathology and pure bacteriology.

It was natural that the first work of the Biochemic Laboratory should have been directed toward a study of the chemical products produced by the so-called hog-cholera bacillus, which was then believed to be the cause of hog cholera, and of the tubercle bacillus, because in the years immediately preceding the establishment of this laboratory the activities of the Bureau of Animal Industry had been largely concerned with studies of the causes and with methods of prevention and diagnosis of these diseases.

For some years the Biochemic Laboratory served chiefly as an agent for obtaining chemical data relating to problems and investigations by other sections of the Bureau of Animal Industry, but as time went on it was found that really effective results could be best obtained by placing in close contact in the same division trained bacteriologists and chemists. On July 1, 1896, the designation of the Biochemic Laboratory was changed to Biochemic Division with Dr. de Schweinitz as Chief.

About this time certain definite projects were assigned to the Division for study, chief among these being investigation of dips and disinfectants for various animal diseases, the systematic production of tuberculin and mallein, which had already been begun in a small way in the year 1892, the relationship of bovine and human tuberculosis, and the production of a vaccine or antiserum for hog cholera. These lines of work covered the most important of the Division's activities up to the year 1906, and during that period there was accomplished a better standardization of the various substances used in official dipping. Valuable contributions were made to our knowledge of bovine tuberculosis infection in children. The true cause of hog cholera was found to be a filtrable virus, and not *Bacillus cholerae suis* as had previously been thought. This latter discovery proved to be of fundamental importance in the campaign against hog cholera which had been waged by the Department of Agriculture since 1878,

and led shortly thereafter to the discovery of the present widely used anti-hog-cholera serum.*

In 1906, the activities of the Division were increased in many ways. The passage of the meat inspection law on June 30, 1906, made it necessary for the Bureau to organize a force for the chemical investigation of meats and meat food products. This task was allotted to the Biochemic Division, and branch laboratories were established in six different cities outside of Washington.

At the same time the hog-cholera investigations were rapidly approaching success, and in the years from 1906 to 1913 the newly discovered anti-hog-cholera serum was proved, not only experimentally but by tests under farm conditions, to be effective and practicable.

In 1913 extensive field experiments involving a number of counties in the Corn Belt region were inaugurated, the idea being to give an object lesson so as to demonstrate positively the value of the serum. Large veterinary forces were employed, not merely to carry out the work of the immunization of hogs in the selected counties, but also to carry on extension work in cooperation with State agricultural colleges, explaining to farmers and veterinarians generally the methods to be used for the control of losses from hog cholera.

About the same time Congress passed the Virus-Serum-Toxin Act of March 4, 1913, and it became necessary for the Bureau to organize a large force of inspectors to enforce that law.

At about this period of its history the Biochemic Division had grown in the number of its employes from 20 in 1905 to 185 in 1915. Until the year 1906 the activities of the Division had been almost entirely of a research nature, but beginning in 1906 there was a continual and more or less rapid increase in the amount of regulatory work assigned to the Division, and as a consequence there was a marked and unfortunate diminution in its research activities. To correct this condition and to restore the Division to its research character, the field work on hog cholera, which was regulatory or extension in character, the inspection of hog-cholera serum plants, which was entirely regulatory, and the chemical meat-inspection work, which was also routine regulatory work, were all separated from the Biochemic Division to form, in the case of the hog-cholera field work, the Office of Hog Cholera Control, in the case of the inspection of serum plants, the Office of Virus-Serum Control, and in the case of the chemical meat inspection, the Meat Inspection Laboratory of the Meat Inspection Division. At the same time there was established in the Biochemic Division a new

* See "Division of Virus-Serum Control," page 342.

section for meat-inspection research. To this section were referred the meat-inspection problems requiring investigation.

The organization of the Division has been practically unchanged since the reorganization described above, and it has been clear that the changes made in 1914 and 1915 were wise and that they have resulted in the betterment of both the regulatory and the research work.

In order to give a clear idea of the work of the Biochemic Division since its organization, it is desirable to discuss the various lines of endeavor separately, tracing each from its beginning down to the present time.

HOG CHOLERA INVESTIGATIONS*

The investigations of hog cholera by the Department of Agriculture began in 1878. Prior to that year the Department had no funds available for the study of contagious diseases of animals. On June 20, 1878, however, the sum of \$10,000 was appropriated for "investigating diseases of swine and infectious and contagious diseases to which all other classes of domestic animals are subject." With the funds thus appropriated the Commissioner of Agriculture employed a number of scientists to investigate and classify the diseases of swine, the appropriation being renewed from year to year, although a considerable proportion of the available funds was used in the study of other animal diseases.

With regard to the work done and the results obtained during the period from 1878 to 1885, it will suffice to say that laboratories were established in the Department, the Bureau of Animal Industry was organized, and a comprehensive study of swine diseases was carried out. This early work consisted for the most part of studies of the distribution, classification, and mode of transmission of swine diseases, supplemented by laboratory investigations, which were intended to discover the cause or causes of those diseases. These investigations established the fact that one or more plagues of swine existed in practically all sections of the country. They showed further that those plagues were contagious, and led to the suggestion of quarantine and disinfection for preventing their spread. Coincidentally with the field observations rapid progress was made in the laboratory investigations, and in the year 1885 announcement was made by the Department that one of the great causes of losses among swine was a contagious disease designated "hog cholera," caused by a motile bacterium, which was named the "hog-cholera bacillus." These fundamental researches received general confirmation from other institutions.

* See "Hog Cholera," page 21.

The first period of the Department's researches culminated, therefore, in the establishment of the fact that at least a great proportion of the losses of swine was due to hog cholera and in the reported discovery of the micro-organism which caused that disease.

Immediately following the discovery of the supposed cause of hog cholera, the Bureau of Animal Industry began a long series of investigations which had for their object the development of a method of treatment or vaccination that would cure or prevent hog cholera. While all of the early researches were carried out by the first Chief of the Bureau, Dr. D. E. Salmon, or by Dr. Theobald Smith, the first Chief of the Pathological Division, the Biochemic Laboratory was associated with these studies from the time of its organization in 1890, and by 1897 had been given entire control of the investigation of vaccines and serums for hog cholera. These investigations were all based on the belief that the so-called hog-cholera bacillus was the cause of hog cholera, therefore that micro-organism was used for the production of vaccines and serums.

None of these experiments met with success, although at times the results in the laboratory were such as to encourage the belief that the problem had been solved. This was particularly true of a series of experiments in which large animals such as horses, cattle and donkeys were inoculated with the hog-cholera bacillus and its products. The object of these experiments was to cause the development of an anti-toxin in the blood of the horses, cattle or donkeys, so that their blood serum might be used to cure or prevent hog cholera. The serum thus produced was considered to be of such promise that a series of field experiments was begun in 1897 and carried out on a fairly large scale during the years 1898-1901. Though apparently yielding a certain measure of success, this serum was finally proved to be unsatisfactory for practical use.

Discovery of the Filtrable Virus

The uniform failure to produce an effective vaccine or serum, when taken in consideration with the fact that the natural disease, hog cholera, is always followed by complete immunity in recovered hogs, led to the suspicion that possibly after all the true cause of hog cholera was not understood. This suggested possibility that the hog-cholera bacillus was not the only factor involved in the disease gave rise to a series of experiments which resulted, in 1903, in the discovery that there existed in the State of Iowa a fatal disease of hogs, indistinguishable in its characteristics from hog cholera, which was

not caused by the hog-cholera bacillus but by an invisible micro-organism (Bureau of Animal Circular 41, by de Schweinitz and Dorset) which existed in the blood and other body fluids of sick hogs. This invisible micro-organism is either so minute or else of such structure that it can not be discerned by the highest powers of the microscope, nor is it retained by porcelain filters which effectually prevent the passage of all visible bacteria.

These discoveries naturally suggested the idea that this invisible micro-organism might be concerned in all outbreaks of hog cholera, and that the lack of success of earlier attempts to produce an effective vaccine or serum might be due to a failure to recognize the presence of the invisible micro-organism as a factor in the causation of the disease. Practically the entire year 1904 was, therefore, devoted to experiments which had for their object the determination of (1) the true cause of hog cholera; (2) the relationship of the hog-cholera bacillus to hog cholera; (3) the extent of the distribution of the disease found in Iowa and caused by the invisible virus. These experiments were exhaustive and led to conclusions of far-reaching importance.

The results of the investigations of 1904 may be summarized as follows:

1. Hog cholera is caused by an invisible micro-organism which exists in the blood and other body fluids of sick hogs.
2. The so-called hog-cholera bacillus is not the cause of hog cholera and at the most is merely an accessory factor in the disease.
3. Hogs that recover from hog cholera are thereafter immune. Hogs that recover from artificial infection with the invisible virus are rendered immune against the natural disease, whereas infection with the so-called hog-cholera bacillus does not confer immunity against hog cholera.

The importance of these investigations can not be overestimated, for they at once indicated the cause of the earlier failures to produce effective vaccines and serums, and pointed the way for new experiments looking toward the development of reliable methods of prevention and control. The conclusions reached as a result of these experiments have been entirely confirmed by investigators in Germany, France, England, Austria-Hungary and other countries where hog cholera exists.

Development of Anti-Hog-Cholera Serum

In the year 1905 experiments which had for their object the development of a protective serum against hog cholera were begun. Even

before this time suggestions had been made looking to the utilization of hogs themselves as a source of a protective serum, and efforts had been made to prepare a vaccine by using diseased blood which had been subjected to heat and to the action of various chemicals for the purpose of attenuation. Toward the close of the year 1905 it was demonstrated conclusively by Dr. M. Dorset and his assistants that hogs can be protected from hog cholera by the following method:

A hog which is immune against hog cholera, either naturally or as a result of an attack of the disease, is injected with large amounts of blood taken from a pig sick of hog cholera. The injection when properly performed does no material harm to the immune. Within a week or ten days blood is drawn from the immune hog, and this blood, after defibrination, is used to protect susceptible pigs.

Only a few tests were possible in the year 1905, but the results of the experiments were so favorable that they were continued and extended into 1906.

With the satisfactory progress of this method of protecting hogs from hog cholera it appeared desirable to insure that the people of the country should have secured to them the free use of the method developed in the Department's laboratories. Therefore an application for patent was made by Dr. Dorset, who had been made Chief of the Division after the death of Dr. de Schweinitz on February 15, 1904, and a patent was granted by the United States Patent Office, giving to the Government, or any of its officers or employees in the prosecution of work for the Government, or to any person in the United States, the right to use this method without the payment of any royalty thereon.

The experiments carried out in the years 1905 and 1906 are all recorded in detail in Bulletin 102, by M. Dorset, C. N. McBryde and W. B. Niles, of the Bureau of Animal Industry. The facts brought out by these experiments are, briefly, as follows:

1. When hogs immune against hog cholera are injected with suitable amounts of blood taken from hogs sick of hog cholera, the blood serum of the immune acquires the power to protect nonimmune hogs against an otherwise fatal exposure to the disease. This method of producing serum is known as "hyperimmunization."

2. The serum from hyperimmunized hogs may be used to protect susceptible hogs in one of two ways: (a) The serum alone is injected. This confers an immunity lasting from three weeks to two months. (b) The serum is injected simultaneously with a minute amount of blood taken from a hog sick with hog cholera. This is

known as the "simultaneous method," and it produces an immunity which lasts for many months, if not for life.

3. The serum is essentially a preventive. It does not cure hogs already visibly sick, but it may be used successfully as a cure if administered in the very early stages of the disease.

Up to the year 1907 the work with this new serum was conducted entirely on hogs kept in experimental pens on premises controlled by the Department. The results of the tests were so uniformly favorable that arrangements were made to test the effect of the serum when used under field conditions. Therefore a considerable quantity of serum was prepared and applied to approximately 2,000 hogs on 47 different farms in central Iowa. The method of carrying out these practical tests and the results were, briefly, as follows:

Class 1. Healthy herds treated for the purpose of protection against hog cholera existing on near-by farms.—In each herd a certain number of hogs were not treated, but were left to serve as controls. In most of the herds in this class the disease did not appear in either the treated hogs or the controls. In a few of these herds, however, hog cholera appeared, some weeks after vaccination, among the controls, the average loss being 68 per cent of the untreated controls, while of the treated hogs in the same herd associating with the sick control animals none died.

Class 2. Herds exposed to disease through the entrance of a sick hog from a neighboring diseased herd, but at the time of treatment apparently well.—In these exposed herds 4 per cent of the treated hogs died, while more than 89 per cent of the untreated control animals succumbed.

Class 3. Herds in which hog cholera existed at the time of treatment.—In this class the effort was made to treat only those herds where disease had not progressed very far, as past experience had shown that the serum was essentially a protective agent rather than a cure. As a general rule this third class of herds contained comparatively few visibly sick hogs, but yet a sufficient number to show clearly that hog cholera was present, this being confirmed by post-mortem examination in each case. In these sick herds 13 per cent of those that received the serum were lost, whereas of the untreated control animals 75 per cent died.

The success of these practical tests, following the uniformly good results obtained in the previous experimental work, was sufficient to show that in this new serum the Department possessed a means

which could be utilized to reduce, if not ultimately to eliminate entirely, losses from hog cholera. Therefore a notice of the Department's findings was sent to each of the States of the Union, inviting a representative to the small experimental farm maintained by the Department at Ames, Iowa, in order that they might observe the methods of serum production in actual operation and have explained to them the exact methods of application. During the year 1908 representatives of 25 States responded to this suggestion for a conference and were instructed in the Department's methods.

Practical Application of the Serum

During the years immediately following these conferences a number of the Middle Western States began the production of this new serum for the benefit of farmers within their borders. At the same time the Department continued its work, improving the technique of serum production and doing such demonstrational work as could be arranged with the funds available to acquaint stockmen with the value of this serum. Particularly striking were the results obtained in the stockyards at Omaha and Kansas City. At the latter place the Department was much assisted by Hon. Mason S. Peters, who was early convinced of the value of this new method of combating hog cholera. At the same time a few commercial plants were organized for the production and sale of this hog-cholera serum. By the year 1913 the serum was being produced on a large scale by the States of Ohio, Indiana, Missouri, Kansas, Minnesota, Michigan, North Dakota and California and by a large number of commercial plants as well.

On March 4, 1913, Congress passed the Virus-Serum-Toxin Act, which required that all viruses, serums, toxins and analogous products intended for use in the treatment of domestic animals, before being shipped interstate or imported into the United States, should comply with the regulations which the Secretary of Agriculture was empowered to make. The sum of \$25,000 was set aside for enforcement of this law. At the same time Congress for the first time appropriated a definite sum (\$75,000) for demonstrating the best method of preventing and eradicating hog cholera.

For carrying out the provisions of the last-named appropriation, field experiments were inaugurated in four selected areas, and the work of controlling hog cholera was begun in Dallas County, Iowa, on July 1, 1913, with Dr. O. B. Hess in charge; in Montgomery County, Indiana, on July 15, 1913, with Dr. U. G. Houck in charge;

in Pettis County, Missouri, on August 1, 1913, with Dr. B. W. Murphy in charge; and in an area comprising portions of Gage and Johnson Counties, Nebraska, on November 1, 1913, with Dr. S. E. Cosford in charge. The object of this work was first of all largely through the cooperation of the State colleges to instruct farmers concerning the methods of preventing hog cholera; secondly, to enforce, with the cooperation of the State Live Stock Sanitary Board and State Veterinarian, the necessary sanitary quarantine regulations; and thirdly, to apply the hog-cholera serum produced by the Bureau at its plant at Ames, Iowa, Dr. W. B. Niles in charge, in such a way as to prevent disease and curtail losses from hog cholera.

The work in each of these areas was so signally successful that on February 23, 1914, Congress appropriated the sum of \$450,000 for continuing and extending this project, so that during the year 1914 similar work was begun in the following areas: Renville County, Minnesota; Branch County, Michigan; Maury County, Tennessee; Allen County, Ohio; Marshall County, Kansas; the irrigated district in the neighborhood of Twin Falls, Idaho; Henderson County, Kentucky; Clark County, Iowa, and Kankakee County, Illinois.

During the same year, in addition to this intensive control work, there was organized a system of demonstrations among farmers generally throughout the various States, this being carried out in cooperation with the county advisors and farm demonstrators already employed in various parts of the country. The cooperating State representative was generally the president or dean of the Agricultural College, and the plan was in conformity with the principle laid down in the Lever Bill.

This great increase in the work necessitated setting up in the Biochemic Division separate sections, one to supervise the area control work and the other to have charge of the educational work. Dr. O. B. Hess and Dr. U. G. Houck were called to Washington to assume immediate direction of these activities.

By January 1, 1916, the intensive control work and the hog-cholera educational work, which had both been begun in an experimental way to determine the results that might be accomplished by certain definite plans of field work and of education, had reached a stage where they were no longer of a research character. The effectiveness of the serum and the possibility of controlling losses from hog cholera had by that time been thoroughly demonstrated; consequently, in accordance with the policy of the Department to segregate the research work, a new office known as the Office of Hog Cholera Control was established

under the direction of Dr. O. B. Hess, and the field work previously carried out under the direction of the Biochemic Division was transferred to that office.

THE VIRUS-SERUM-TOXIN ACT OF 1913.*

As stated above, the Virus-Serum-Toxin Act of 1913 was approved by the President on March 4, 1913, and became effective on July 1, 1913. The first regulations for the enforcement of this act were issued in June, 1913, and the supervision of the enforcement of the law was divided between the Biochemic Division and the Pathological Division, the Biochemic Division being allotted the supervision of the manufacture of hog-cholera serum and virus and tuberculin and mallein, while the preparation of all other veterinary biological products was supervised by the Pathological Division. The first inspector assigned to this work was Dr. F. A. Imler, who was transferred from the Meat Inspection Division on October 31, 1913, and was given headquarters at Kansas City, and the force was increased as rapidly as men could be trained for the work. Dr. H. J. Shore, of the Biochemic Division, was placed in charge of a section in the Division which devoted its time entirely to the supervision of this inspection work. By July 1, 1916, there had been licensed to manufacture anti-hog-cholera serum 89 plants, which during the calendar year 1915 produced 208,571,232 cubic centimeters of anti-hog-cholera serum.

After this work had been completely organized, about February, 1917, in conformity with the policy of segregating the regulatory and research work, a separate office known as the Office of Virus-Serum Control was established, with Dr. H. J. Shore as Chief, and all of the work of enforcing the Virus-Serum-Toxin Act was allotted to that office. However, the laboratory work, including the testing of samples and such research as was necessary, has remained in charge of the Biochemic and Pathological Divisions.

LATER RESEARCHES ON HOG CHOLERA

While the work on hog cholera during the period from 1906 to 1916 was devoted for the most part to practical tests of the newly discovered hog-cholera serum, to extension work designed to familiarize hog raisers with the value and methods of the use of this product, and to the control of interstate commerce in the serum, assuring thereby a more uniform and more reliable product, much research work was

* See "Division of Virus-Serum Control," page 342.

also done along minor lines. The hyperimmunization, which was at first done by subcutaneous injection, was found to be accomplished more expeditiously and more economically by intravenous injection of the virus blood. The method of drawing serum from the tail of the immunized hog was developed, and it was found that carbolic acid had comparatively little effect on the virus of hog cholera in blood obtained from sick hogs. This latter observation made practical the wide general use of the simultaneous process of immunization, for it was found that hog-cholera blood preserved with one-half of 1 per cent of carbolic acid would keep in good condition for some weeks without rendering the virus impotent.

Other researches showed that the immunizing properties of the anti-hog-cholera serum resided in the serum portion of the defibrinated blood and not in the red cells, and that the antibodies of this serum could be separated from the remainder of the serum along with the globulins. Up to this time the hog-cholera serum of commerce was prepared exclusively in the form of carbolated defibrinated blood. This was done because of the fact that in hog's blood it is difficult to separate the serum completely and economically from the red cells.

In 1914 and 1915, when foot-and-mouth disease was widespread among cattle and hogs in the United States, certain batches of virus and serum prepared by two commercial establishments located in the vicinity of the Chicago stockyards became contaminated with the virus of foot-and-mouth disease and served to cause outbreaks of foot-and-mouth disease among hogs treated with such contaminated lots. This occurrence brought home forcibly the necessity for producing a hog-cholera serum which could be rendered free of all danger of foot-and-mouth disease in cases of emergencies such as those of 1914 and 1915.

On May 29, 1916, M. Dorset and R. R. Henley, of the Biochemic Division, described in the *Journal of Agricultural Research* a method for producing clear and sterilized anti-hog-cholera serum, the process being based on the fact that an extract made from navy beans had the property of causing an agglutination of the red blood cells of hogs. It was also found that by the addition of a certain amount of salt at the same time a decided contraction of the red cells could be brought about. It was thus that the bean-salt method of producing clear anti-hog-cholera serum came into existence. The bean extract and a small amount of saturated salt solution are added to the defibrinated hog's blood or to the citrated hog's blood and this mixture is centrifugalized. The red cells are agglutinated and become firmly packed in the

centrifuge so that perfectly clear serum can be poured off. This clear serum can then be heated to a temperature sufficient to destroy foot-and-mouth disease virus and other infectious agents without materially diminishing the potency. This method has been put into practical use by commercial firms and clear anti-hog-cholera serum is now obtainable on the market. The process and the product were patented by Dorset and Henley, the rights to use the process being assigned to the Government or any person in the United States in the usual manner.

New processes were devised for refining, clarifying and sterilizing old hog-cholera defibrinated blood serum. Among these the process devised by R. R. Henley and published in March, 1922, deserves especial mention. By the combination of chloroform with the bean-salt method a perfectly clear and almost colorless anti-hog-cholera serum can be prepared from old defibrinated blood. The process serves to remove practically all hemoglobin, together with the cell debris, and bacteria.

Aside from these studies on hog-cholera serum, much time has been given since 1916 to a study of the ways in which hog cholera is spread. It was shown that the virus contained in the meat of diseased hogs might survive the ordinary process of brine curing, inducing the disease in susceptible pigs when fed to them. Pens occupied by cholera pigs were found in the summer months, in Iowa, to become quickly noninfectious, whereas during the colder months in the same latitude the disease persisted in the pens for a number of weeks. It was found possible to convey hog cholera by means of house flies and biting flies, but experiments left the impression that flies were probably not the most important factor in conveying the disease. Birds likewise were found not to convey the disease readily on their feet. In fact most of these researches pointed to the diseased hog and to the meat from diseased hogs as being the principal sources of danger.

During this period several individuals appeared with what were claimed to be new and improved methods of preventing hog cholera or of cultivating the filtrable virus of the disease. In no case were these claims found to be well founded.

During the entire period from 1906 to 1924 there has been maintained by the Division a field station consisting of a rented farm of about 50 acres, with temporary buildings, in the vicinity of Ames, Iowa. At this station most of the practical tests have been carried

out. The station throughout this period has been in charge of Dr. W. B. Niles.

TUBERCULOSIS INVESTIGATIONS

Very soon after the organization of the Biochemic Laboratory, researches of various kinds were begun on tuberculosis, and in 1894 de Schweinitz described an attenuated tubercle bacillus which he had cultivated and with which he appeared to secure immunity in guinea-pigs against virulent cultures of tuberculosis. De Schweinitz followed this work with the attenuated tubercle bacillus by attempting to produce antituberculosis serum by injecting horses, mules and donkeys with emulsified cultures of the attenuated germ. This serum was used extensively in the Loomis Sanitarium but was finally discontinued.

In 1895 the first results of chemical studies of the bodies of human tubercle bacilli were published by de Schweinitz and Dorset, the results dealing mainly with the ether-soluble portions of the bacilli, which were found to approximate 35 per cent of the dry weight. Later similar analyses were made of bovine, swine, horse, and avian tubercle bacilli, and the mineral constituents of tubercle bacilli were also determined by analysis (*Journal of the American Chemical Society*, August, 1898). The interesting part of these later chemical studies was the observation that the ash of tubercle bacilli consisted largely of salts of phosphoric acid. This observation led to a change in the method of cultivating the tubercle bacilli in the laboratories of the Bureau. Acid potassium phosphate was substituted for sodium chlorid, which was found not to be utilized.

Dr. Theobald Smith, then Chief of the Pathological Division, was the first to call attention, in 1894 and 1895, to difference in types of tubercle bacilli. This observation was followed in 1901 by the statement of Dr. Robert Koch, at the London Tuberculosis Congress, that bovine tuberculosis is not a matter of importance to human health. This statement of Koch aroused scientific interest and started investigators to work in all parts of the world. The Biochemic Division, among others, began a study which was intended to cast light on this subject. One of the greatest obstacles to such work, however, was the difficulty in isolating the tubercle bacilli from animal tissues, the bacillus being extremely difficult to grow and the only successful method being that of Koch, who used coagulated blood serum. The work of isolating cultures of tubercle bacilli from natural cases in man was assigned to Dorset, who, finding great difficulty in obtaining

satisfactory results with blood serum, successfully employed coagulated hens' eggs as a medium. This method not only proved successful in the work of the Biochemie Division but has found favor generally in bacteriological laboratories everywhere.

In carrying on the study of the relation of bovine tuberculosis to tuberculosis in man, a number of cultures of tubercle bacilli were isolated from the diseased tissues of children who had died of tuberculosis in Washington hospitals. Among these cultures three were found which were capable of producing generalized disease in cattle and which possessed a virulence for rabbits known only in bovine types of the tubercle bacillus. Since those researches it has, of course, come to be well recognized that the bovine bacillus is a serious source of infection in children, and the work of the Division on this line, although carried out on a small scale as compared with that of other investigators, may be regarded as one of the factors that contributed to this conclusion.

The results of these tuberculosis investigations were published as Bulletin No. 52, Parts I, II and III, of the Bureau of Animal Industry, the authors being E. A. de Schweinitz, M. Dorset, E. C. Schroeder and W. E. Cotton.

TUBERCULIN

Tuberculin, discovered by Robert Koch in 1890 and 1891, was first used in the United States for the diagnosis of tuberculosis in cattle on March 3, 1892, by Dr. Leonard Pearson, the distinguished veterinarian of the State of Pennsylvania. A very short time afterwards, in the year 1893, the Bureau of Animal Industry, through its Biochemie Laboratory, began the preparation of tuberculin for the use of its inspectors in enforcing the quarantine regulations, and it was decided at the same time to supply the substance free of charge to properly constituted health officers and official veterinarians of the various States and Territories, the object being to cooperate with State officials in their efforts to restrict and eradicate tuberculosis under the authority conferred by Act of Congress. The tuberculin produced by the Bureau of Animal Industry was furnished to State, county and municipal officials on condition that they should supply the Bureau of Animal Industry with records of all tests and with the results of autopsies on all animals slaughtered. It was further required that all tests should be conducted under official supervision by skilled veterinary practitioners. The tuberculin produced was always of the form intended for subcutaneous use until the year 1918,

when the manufacture of intradermic and ophthalmic tuberculin was begun. The demand for tuberculin increased steadily and in the year ending June 30, 1906, there were distributed 103,510 doses of subcutaneous tuberculin.

The inauguration in 1917 of the country-wide campaign for the eradication of bovine tuberculosis served to increase greatly the demand for tuberculin, so that in the fiscal year ending June 30, 1922, there were distributed to officials of the Bureau of Animal Industry and to State officers cooperating with the Bureau in the eradication of tuberculosis 619,306 doses of subcutaneous tuberculin, 5,133,725 doses of intradermic tuberculin and 1,577,880 discs.

It is worthy of record that tuberculin in disc form for the ophthalmic test was prepared first in the laboratories of the Biochemic Division, where the method of making these discs was worked out. Prior to the preparation of these discs the ophthalmic testing of cattle was on an uncertain footing. The results obtained had been conflicting and at times confusing. Now, however, the ophthalmic disc has become an important and necessary instrument in the tuberculosis eradication campaign.

MALLEIN

The production of mallein was begun in 1893 coincidentally with the production of tuberculin, and its distribution has been carried out on the same plan as that used for tuberculin. During the World War the Bureau laboratories supplied all the mallein used by the American Expeditionary Forces in France, 3,464,702 doses being furnished to the War Department for the use of the Army. At the present time glanders is not widely prevalent in the United States and the use of mallein is consequently not so extensive as in years past. It is employed now chiefly for the testing of horses being imported into this country or being exported to Canada.

LABORATORY MEAT INSPECTION

Even as early as 1896 the Biochemic Division was doing some chemical work on meat products for the Inspection Division of the Bureau. Studies were made of lards, imported sausages and other like products. It was not, however, until the passage of the Meat Inspection Law, June 30, 1906, that the Division took up the laboratory study of meats and meat products as a definite and regular part of its activities.

When the decision was made, about August 1, 1906, to have carried

out by the Bureau the necessary laboratory inspection of meats and meat food products under the Meat Inspection Law, this work was naturally assigned to the Biochemic Division. Not only was it necessary to arrange for the regular laboratory inspection of meat products subsequently to 1906, but it was necessary to sample and examine chemically all meats or meat products on hand in the United States at that time, because these could not be shipped interstate under the law until the examination had been completed. The force of chemists already employed in the Division was wholly inadequate to take care of this new work without seriously impairing the researches along other lines. It was found very difficult to procure the necessary number of adequately trained chemists in so short a time. Furthermore, it was evident that the routine inspection of meat food products produced after October 1, 1906, could not be carried out in one central laboratory in Washington, but that it would be necessary to install and equip laboratories at a number of the more important packing-house centers in different parts of the country. Notwithstanding these obstacles, a central meat-inspection laboratory was established in Washington and branch laboratories in Chicago, Ill., New York, N. Y., Kansas City, Kans., Omaha, Nebr., and San Francisco, Calif., and all were ready for work prior to October 1, 1906. Shortly thereafter a seventh laboratory was installed in Cincinnati, Ohio. This last-named laboratory was transferred about March 1, 1907, to East St. Louis, Ill.

The inspection of meat food products prepared prior to October 1, 1906, resulted in the refusal of the Department to permit the shipment in interstate commerce of more than 100 different varieties of meat food products on the market, which were found to conflict with the meat-inspection regulations.

This laboratory inspection work, which now became a regular part of the Division's activities, steadily increased in efficiency and became wider in scope. The water supplies of all packing houses were investigated, and in many cases it was found necessary to require the installation of purification plants or an entire change in the source of water used in preparing meats. Bacteriological investigations were undertaken with the idea not only of determining the proper disposal of spoiled cans but also of devising methods for preventing serious losses which resulted therefrom. The number of samples examined by the seven laboratories gradually increased in number until in the fiscal year 1914 they reached a total of 31,839 samples.

On July 1, 1914, in conformity with the order of the Secretary of Agriculture previously explained, the research and the regulatory work were separated. This resulted in the transfer, on the date mentioned, of the meat-inspection laboratory work to the Meat Inspection Division, the research work relating to meat inspection being left in the Biochemic Division.

MEAT INSPECTION RESEARCH WORK

A certain amount of research work was necessary to improve the efficiency of the laboratory meat inspection as well as to aid the Bureau in deciding various questions which arose from time to time.

At the time the meat-inspection law was passed, all meats which were officially inspected were marked by means of a label known as the Howard label, this being printed in a transferable ink on soluble gelatin. These labels were not wholly satisfactory because they frequently failed to leave an imprint and at times could be removed and applied for a second time if any one was inclined to do so. Furthermore, the Department in the year ending June 30, 1907, expended more than \$158,000 for these labels, which were manufactured by a private firm. It was estimated that if the Department continued to use labels at the price it was at that time paying, it would, owing to the very greatly increased scope of the inspection, be forced to expend approximately \$500,000 per annum for marking all inspected meats. In the year 1906 Dr. Dorset, Chief of the Biochemic Division, devised an ink which was non-poisonous and which could be applied to meats when either wet or dry, warm or cold, to produce a legible, indelible inspection mark. It was but a short time before this ink completely replaced the Howard label. The saving effected in this way has certainly exceeded \$1,000,000.

Research work which is deserving of especial mention may be epitomized as follows:

A study of the coloring matter of salted meats which was begun in 1907 by Ralph Hoagland led to a better understanding of the changes that take place in the hemoglobin of meats which have been cured in brine containing saltpeter. A practical method for detection of beef fat in lard was developed by James A. Emery in 1908. Bacteriological studies by C. N. McBryde led to a better system for handling defective cans found during the process of canning meats and also led to a discovery of the cause of ham souring, indicating ways for preventing this trouble, which was the source of considerable loss to the meat industry.

Certain harmless colors were permitted to be added to meats and meat food products, but where these were present in mixture their separation and identification were extremely difficult. A method was worked out by T. M. Price for the separation and identification of the various permitted colors.

Chemical studies of the effect of fats and oils on metals were made by James A. Emery and R. R. Henley, and the effect of these metals on the rancidity of fats was also the subject of a publication. The same workers published an important paper on "Meat Extracts; Their Composition and Differentiation." Special investigations were made by Robert H. Kerr on the detection of vegetable fats in mixture with lards.

In 1913 the meat-inspection research work, which up to that time had dealt largely with methods of analysis designed to facilitate the inspection work, was segregated and carried on as a distinct project, though always in collaboration with the routine laboratories. One of the chief lines of activities begun at that time was a study of the changes which take place in meat during storage. This work was undertaken by Ralph Hoagland, W. C. Powick and C. N. McBryde, and the project was completed in 1916. The results showed that fresh beef could be held in cold storage at temperatures above freezing for as long as 77 days, but it was not thought possible to hold it in many packing-house coolers for longer than about 55 days. This difference is due to the relatively greater humidity of some packing-house coolers, so that evidently the length of time during which fresh beef can be held in storage is dependent upon a number of factors, among which are temperature and humidity of the storage room and the character of the beef when placed in storage. Storage tended to render the beef more tender and to change its flavor in certain respects. Bacteria and molds which grow on the surface of cold stored meats do not penetrate the muscular tissue to any great depth, and the increased tenderness in the stored meats can not be attributed to the direct action of bacteria, but is probably due largely to enzymotic action. The chemical changes in the stored beef appeared to be without appreciable effect on either the nutritive value or the wholesomeness of the muscular tissue, but in the case of the longer periods of storage the changes in the kidney fat and external fatty tissue seem to render them unsuitable for human consumption. A bulletin on the subject was published, with Ralph Hoagland, W. C. Powick and C. N. McBryde as authors. This work led to the publication of a number of papers as bulletins and in the scientific journals.

During the period of the World War the meat-inspection research was turned largely toward a study of subjects which appeared to be of importance at that time. A survey was made of the curing materials used in meat-packing establishments, as well as of the wastage of curing materials in discarded pickling solutions. A résumé of rapid and reliable methods for detecting poisons in meats was prepared. A study of glucose as a substitute for cane sugar in meat curing was completed and published.

Substitutes for lard oil in signal oil were given extensive investigation. In 1919 there was begun an important project which is leading to valuable results. This project consisted in a study of the composition and nutritive value of the edible viscera of cattle, sheep and swine. Coupled with this was a study of the biological value of the proteins of the edible viscera and muscle and a study of the vitamin content of the flesh and viscera of cattle, sheep and swine. The first portion of this work, namely, the vitamin B content of the muscular tissue and edible viscera of cattle, sheep and swine, by Ralph Hoagland, has been published, and the other portions are approaching completion. Special investigations are under way on the nature of the changes which take place in rancid fats. Investigation of the chemistry of the edible tissues of emaciated carcasses as compared with that of normal healthy carcasses is also nearing completion.

DIPS AND DISINFECTANTS

The work of the Biochemic Division with dips and disinfectants was developed from very small beginnings, such as the analysis of dipping fluids, which began about the year 1896. These early analyses dealt with the composition of dips intended to destroy the Texas-fever cattle tick and the mites which cause scabies in cattle and sheep. The work during this period was carried out in cooperation with the Pathological Division and with the Zoological Division, which investigated the effect of the dips on the different parasites as well as on the cattle and sheep.

Dips for Texas Fever *

About the year 1893 the use of petroleum oil as a dip for ticky cattle was proposed, and special attention was given to the crude oils which contained sulphur, since sulphur was regarded as being endowed with particular insecticidal properties. The Division conducted many analyses of crude oils from various parts of the country, and the crude

* See "Zoological Division," page 93.

oil dips, both in the form of a layer of oil on the water in the dipping bath and also in the form of an emulsion made with soap, were used extensively. This crude oil continued to be the chief dipping agent up to about the year 1910, when studies were first begun by the Biochemic Division, in cooperation with the Zoological Division, on arsenical cattle dips, the work of the Bureau being actuated by the reports of successful work carried out in other countries with a dip composed of sodium arsenite and a special grade of pine tar. The results of these investigations led to the adoption of the arsenical dip for Texas fever, crude oil being found to be much less satisfactory in a number of respects.

The first arsenical dip was made from white arsenic, soda and pine tar, and is described in B. A. I. Bulletin 144. It was first permitted for use in official dipping by Bureau of Animal Industry Order 178, in 1911. About the same time a proprietary dip which contained arsenite of potash and other ingredients in very concentrated form was permitted for use in official dipping after field experiments observed by the Zoological and Tick Eradication Divisions had shown it to be effective.

In the latter part of the year 1916 another firm produced an arsenical dip which was found to be satisfactory and which was permitted for use in official dipping. Other manufacturers have since entered the field, so that at the present time the greater part of the dipping is done in solutions prepared from these concentrated proprietary dips. They appear to be effective, with the advantage of being very simple to use, and the farmers and inspectors are not required to go through the troublesome process of manufacturing the dip themselves. All of the permitted proprietary dips are required to meet a standard of composition prescribed as a result of work by the Biochemic Division and they are controlled by chemical analyses of samples taken by inspectors from time to time.

Even in the experimental period of arsenical baths, in 1910, it became evident that something was happening to the arsenic. The analyst frequently found much less arsenic than was positively known to be present. The question was assigned to A. V. Fuller, who, in 1911, discovered the phenomenon of oxidation of arsenic by the growth of micro-organisms in the bath (B. A. I. Circular 183). It was later found that Brännich in Australia had already observed the occurrence of oxidation, but Fuller was first to suspect that micro-organisms were the important cause of it. In 1913, Laws, of South Africa, suggested that there might also be reducing organisms sometimes present. This

afforded a clue to some puzzling phenomena, and the question was studied by Chapin in 1913 and 1914, Fuller having left the Bureau. The work is covered by Department Bulletin 259, and showed the effects which might be expected in the field under varying conditions, and that in fact these could be explained only through the presence of organisms of both kinds. No attempt was made to identify the micro-organisms involved.

The idea of a field test came from Dr. C. J. Becker in a letter in August, 1911. He suggested that hydrometers be supplied so that inspectors "could at any time test the strength of the solution in the vat, and have a definite way to add enough of the concentrated arsenical solution to bring it up to the required standard." Though a hydrometer was not practical, once the necessity appeared a practical field test was devised by Chapin in 1911, thoroughly tested the following spring, and put into immediate use. Soon after Dr. Becker's suggestion was received, a published note regarding a method of test already devised and patented by Watkins-Pitchford in South Africa was received. But the details of the mechanism of the test were too meager to be of assistance, so the Bureau's test was developed independently. When full details of Watkins-Pitchford's test were later obtained, it was found that the Bureau's test was far superior in accuracy and convenience. The test, by securing the use of baths of definite strength, has been a tremendously important factor in expediting the progress of tick eradication. The outfits and chemicals for making the tests have been supplied to field inspectors by the Biochemic Division to meet yearly demands which amounted to 960,000 tests in 1922.

Dips for Sheep Scab

While the Bureau of Animal Industry had for some years been engaged in a study of sheep scab and methods for preventing it, and the Biochemic Division had carried out chemical work relating to the problems, it was not until August 10, 1899, that specific dips for scabby sheep were approved. These dips were the tobacco and sulphur dip, which contained 0.05 of 1 per cent of nicotine and 2 per cent flowers of sulphur, and the lime-sulphur dip, which was made with 8 pounds of unslaked lime and 24 pounds of flowers of sulphur to each 100 gallons water. B. A. I. Order 38 was the first order approving certain dips. This order was superseded by B. A. I. Order 108, dated April 3, 1903, but the dips prescribed remained unchanged until the issuance of B. A. I. Order 143, which went into effect April

15, 1907. This order permitted the use in official dipping of the following dips: (1) Nicotine and tobacco dips with sulphur, provided, however, that the sulphur could be omitted at the first dipping if the amount of nicotine present in the solution was increased from 0.05 to 0.07 of 1 per cent. (2) Lime-sulphur home-made dips, as in the past, on the basis of the 8-24 formula. In addition there were provisions for permitting proprietary lime-sulphur solutions on the basis of 2 per cent sulphid sulphur in the dipping bath. (3) Cresol dips, consisting of a mixture of cresylic acid with soap, which, when diluted for use, which were required to contain $\frac{1}{2}$ of 1 per cent cresylic acid. (4) Coal-tar creosote dips, consisting of a mixture of coal-tar creosote or coal-tar oils and cresylic acid with rosin soap in varying proportions. These dips were required to contain, when diluted ready for use, certain specified amounts of coal-tar oils and cresylic acid.

In this Order 143 specific provisions were made for the first time for permitting in official dipping the use of proprietary products, and special rules were laid down to govern their use in official dipping. Manufacturers were required to standardize their products and submit a standard sample, and to recommend on their labels a dilution found to be permissible after analysis of the standard sample in the Biochemic laboratories.

The admission of new dips and the recognition of proprietary articles, all of which required examination and analysis before they could be used in official dipping, made it necessary to make a great number of analyses of proprietary dips submitted by manufacturers as well as of samples sent in by inspectors from the field. The methods then available for the analysis of coal-tar creosote dips as well as of tobacco extracts and nicotine solutions were far from satisfactory. It was difficult for two chemists working in different laboratories to obtain concordant results, hence special investigation was given to these problems and there were developed in the laboratories of the Biochemic Division new methods which not only aided greatly in standardizing dips but which have been since generally adopted by analysts in this country as standard procedures.

The methods for the analysis of coal-tar creosote and cresylic sheep dips were published as B. A. I. Bulletin 107 and B. A. I. Circular 167, both being prepared by Robert M. Chapin. The new methods for the analysis of nicotine solutions and tobacco extracts were published as B. A. I. Bulletin 133. The use of flowers of sulphur as an addition to nicotine and tobacco dips was abandoned by the Bureau on May 1, 1911. (Amendment 5 to B. A. I. Order 143).

Analyses of samples of dips prepared and used in the field showed conclusively that the dipping baths in practice could not under continued use be maintained at standard strength without some means of determining at the vat side the actual amount of active substances in solution. Consequently a method for the field testing of lime-sulphur baths was devised. This field test is of such a nature that the inspector, even though he does not possess chemical knowledge, can yet make a quick and sufficiently accurate chemical determination of the strength of the dipping bath by using the portable outfit and chemicals furnished by the Bureau and described by Chapin in Department Bulletin 163 in 1915. The necessary simple apparatus and chemicals have since that time been prepared in the laboratories of the Division in sufficient quantity to meet the needs of the Field Inspection Division. There have been shipped yearly a varying amount of the supplies for testing lime-sulphur dips. In some years the amount was sufficient to make 4,000 tests, while in others sufficient for 20,000 tests has been supplied.

With the establishment of the field test for the lime-sulphur dips the required strength of sulphid sulphur in the bath was reduced to $1\frac{1}{2}$ per cent on July 1, 1914 (B. A. I. Order 210). The Bureau, having become convinced that successful dipping could be carried out only by a careful chemical field control of the dipping solutions, discontinued the use of the cresol, coal-tar creosote and nicotine dips, the principal reason being that no means was available for testing such dips in the field. This action by the Bureau stimulated research on the part of the more important manufacturers of nicotine preparations, and by the year 1915 a satisfactory field test for the nicotine dips was developed by R. H. Mewborne, who had the cooperation of the Bureau of Animal Industry in his work. The development of a field test for the nicotine dip resulted in Amendment 4 to B. A. I. Order 210, effective March 1, 1915, by which the use of the nicotine dips in official dipping was again permitted. The addition to this dip of 2 per cent of flowers of sulphur was required. The use of sulphur was abandoned October 1, 1917 (Amendment 2 to B. A. I. Order 245), since which date the requirements for all sheep dips have remained unchanged. The necessary supplies and apparatus for testing nicotine dips have been supplied by the Division and have been shipped in quantities sufficient to make from 3,000 to 7,500 tests annually.

About this period rather extensive studies were made of methods for the analysis of lime-sulphur solutions and of the composition of dips made according to various formulas (Department Bulletin 451, December 14, 1916).

Dips for Cattle Scab

Active investigations relating to dips for cattle scab were not undertaken by the Bureau until about the year 1902, and the first order requiring official dipping prior to interstate shipment of infected cattle was issued in March, 1904 (B. A. I. Order 123). The dips for cattle scab, for the most part, from that time on, have followed the general plan for dips for sheep scab. Laboratory work on the sheep dips was equally applicable to cattle dips, and the field test outfits developed for sheep dips were likewise applied to dips used for cattle scab. B. A. I. Order 143 permitted the use in official dipping for cattle scab of (1) lime-sulphur; (2) nicotine and sulphur; (3) oil emulsions. The provisions for analysis and standardization of proprietary products were similar to those for sheep dips. Sulphur was eliminated as a required constituent of nicotine dips by Amendment 9, B. A. I. Order 143, August 18, 1913, and on July 1, 1914 (B. A. I. Order 210) all dips for cattle scab were discarded in official dipping except lime-sulphur dip, this being due, as in the case of sheep scab, to the lack of suitable field-test methods for the other classes of dips. After the development of the field test for nicotine that dip was again permitted by Amendment 4 to B. A. I. Order 210, on March 1, 1915. Flowers of sulphur was omitted from the nicotine cattle dip on October 1, 1917, Amendment 2 to B. A. I. Order 245, since which time there has been no change in the methods.

Disinfectants

It was natural that the Biochemic Division, as the only chemical organization then existing in the Bureau, should have begun at an early date a study of the various disinfectants used in combating animal diseases and in enforcing the various quarantine regulations of the Bureau of Animal Industry. In the beginning this work consisted almost entirely of routine analyses, though some study was given to the development of new methods for the analysis of disinfecting solutions, those available being far from satisfactory.

In January, 1904, in a paper before the Sioux Valley Medical Association, Dr. George A. Johnson, of Sioux City, Iowa, inspector of the Bureau of Animal Industry, who had taken part in the eradication of the 1902 outbreak of foot-and-mouth disease in New England, published a description of a simple method for generating formaldehyde gas, which consisted practically of mixing formaldehyde solution with permanganate of potash. This paper was published in the *Medical Herald*, St. Joseph, Mo., in March, 1904. This was the first published

description of this method of generating formaldehyde gas, which is now employed almost universally by health officers. It is not known whence the first suggestion for such a method came, but Dr. Johnson, to whom belongs the credit for the first published description of such a method, obtained his information while in New England, as the method was used in connection with the eradication of the 1902 outbreak of foot-and-mouth disease. The Biochemic Division promptly gave considerable study to the question in order to determine the most favorable proportions in which to use the permanganate of potash and the formaldehyde solution. It was found that the proportions recommended by Dr. Johnson were not favorable, as a comparatively small quantity of the formaldehyde was given off in the form of vapor. The most favorable proportions were found to be 6 ounces of 40 per cent formaldehyde solution to 5 ounces of pure crystals of potassium permanganate. This resulted in the vaporization of 51 per cent of the formaldehyde present in the solution. These results were published in 1905.

B. A. I. Order 143, effective April 15, 1907, provided for the use of (a) pure carbolic acid, 5 per cent solution; (b) a solution of pure carbolic acid mixed with lime; (c) a solution of chlorinated lime; and (d) a solution of cresol, 2 per cent and soap. By Amendment 3 to that order (April 1, 1908) coal-tar creosote dips permitted for sheep were also permitted for disinfection when used at five times the dipping strength, but when the use of coal-tar creosote dips for sheep scab was discontinued their use as disinfectants was also abandoned.

In B. A. I. Order 210, July 1, 1914, the disinfectants prescribed for use in official disinfection covered by that order were limited to solutions of pure carbolic acid and solutions of compound solution of cresol, U. S. P., the latter product appearing very satisfactory except with respect to the cost. Some research carried out by the laboratories showed that the cost could be materially reduced by substituting a lower grade of cresol, thus making a less expensive but fully as effective a disinfectant. This was provided for by Amendment 5 to B. A. I. Order 210, October 1, 1915. In cases of disinfectants not conforming to the U. S. P. standard, manufacturers were required to submit samples for a laboratory examination before the use of their products was permitted. Solutions of chlorinated lime were again permitted by this amendment.

Continued efforts to decrease the cost of disinfectants resulted in the demonstration that linseed oil, which was used as a basis for the soap in the disinfectants, could be reduced from 35 per cent to 28 per

cent, and that potash, which was also previously required, could be replaced by a smaller proportion of the less expensive caustic soda. Official approval of these changes was contained in Amendment 6 to B. A. I. Order 210, issued February 1, 1916. Further work along this same line showed that the cheaper soy-bean oil could be substituted for linseed oil and that the still cheaper fatty acids of the soy-bean oil could be used. Therefore, disinfectants in which the soy-bean oil and soy-bean fatty acid were employed were permitted in official disinfection by Amendment 1 to B. A. I. Order 263 in July, 1919. Finally in B. A. I. Order 273, on July 1, 1921, the use of compound solution of cresol, U. S. P., was discontinued because experience had shown that this product was frequently labeled incorrectly. After this date all manufacturers were required to submit samples and to receive special permission for the use of their products in official disinfection.

As previously indicated, during all of this period much research work was done on disinfection and disinfectants. This work covered not only the disinfectants used on railway cars and for public stock-yards, but also disinfectants used on hides, skins and other untreated animal products. An extended bacteriological study of methods for the disinfection of hides infected by anthrax spores was completed by F. W. Tilley and published in 1915. This study showed that the Seymour-Jones method, involving the use of mercuric chlorid and of formic acid, was not sufficient for disinfecting hides against anthrax unless considerably greater quantities of mercuric chlorid were used. It showed that the hydrochloric acid method of Schattenfroh was apparently entirely effective. Following this work attempts were made to determine the practicability of the use of this method for disinfecting hides and skins. The results were such as to lead to grave doubt as to the safety of either process. In other words, there seemed to be a possibility that not only would the ordinary routine of the tanneries be interfered with and not only were the disinfecting processes quite expensive, but there was also danger of injury to the hide substance.

A comprehensive study of the germicidal value of chlorine disinfectants was completed and published in 1920 (F. W. Tilley). This study was interesting in showing that the different chlorine disinfectants, such as Dakin's solution, Eusol and mercuric chlorid, varied greatly in their effects on various micro-organisms, one being very much more effective, for example, against *Staphylococcus aureus* than the others, and that one being perhaps much less effective against *Bacillus pyocyaneus* (*Pseudomonas pyocyaneæ*). It was shown fur-

ther that the chlorine disinfectants are apparently of little value for destroying *Bacillus tuberculosis* (*Mycobacterium tuberculosis*), which is quite resistant to all of the chlorine disinfectants.

Studies have also been made of the various processes for determining the phenol coefficients of disinfectants, and these have rather led to the conclusion that the methods employed for determining phenol coefficients are quite artificial, that they do not represent conditions met with in practice, and that instead of depending upon coefficients it is perhaps wiser to determine whether or not any given disinfectant is effective under the conditions in which it is used. Decision as to what disinfectants to use should be governed by such data rather than by arbitrary laboratory tests.

ENFORCEMENT OF THE INSECTICIDE ACT OF 1910

By an order dated December 22, 1910, the Secretary of Agriculture created the Insecticide and Fungicide Board and appointed four members, one each from the Bureaus of Animal Industry, Plant Industry, Chemistry and Entomology. Dr. M. Dorset was designated as the representative of the Bureau of Animal Industry on the board, and he was at the same time appointed chairman of the board by the Secretary of Agriculture. Regulations for the enforcement of the Insecticide Act were prepared and promulgated and the work of the board was organized. This required a large amount of executive work by the Bureau representative.

There was organized in the Biochemic Division about January 1, 1911, a special laboratory charged with the examination and analysis of insecticides and fungicides used for the treatment of diseases of cattle, sheep, swine and goats. Three chemists were assigned to this work, R. M. Chapin being in charge. The work of this laboratory consisted of the analyses and the preparation of charges to be presented to the courts in cases where insecticides and fungicides were found to be in conflict with the Insecticide Act of 1910.

In the fall of 1912 Dr. Dorset resigned his membership on the board in order that more attention might be given to the research work of the Bureau of Animal Industry. Dr. J. A. Emery, of the Biochemic Division, was designated to represent the Bureau of Animal Industry in place of Dr. Dorset.

In 1916 Mr. Chapin, who had previously directed the insecticide and fungicide laboratory work of the Division, relinquished his connection with it, and the supervision of the laboratory work was taken over by Dr. Emery, with the direct assistance of Dr. H. H. Custis.

This section of the Division, although concerned almost wholly with regulatory work, has published several papers of value relating to methods of analysis. In 1921 a veterinarian was added to the force of this laboratory to deal with questions which concerned primarily the effect of insecticides on animals. The work and organization of this section have remained unchanged since that date.

OTHER WORK

The preceding account of the activities of the Biochemic Division is in reality but a brief résumé of the most important accomplishments. On account of lack of space, much valuable work could not even be mentioned. For example, the story of the researches on hog cholera gives hardly more than a suggestion of the large amount of work done on diseases allied to hog cholera, such as swine plague and "hog flu." The extensive studies of the chemical composition of anti-hog-cholera serum are barely mentioned, and only accomplishments which are of outstanding importance in the technique of producing that serum have been selected from among the many important observations which have been recorded in the literature. Valuable contributions have been made to the metabolism of bacteria and to the methods of analysis of foods, disinfectants and dips. Studies of the bacterial content of the milk supply of Washington were conducted before the Dairy Division took up that line of work. Study was made of the water supplies of dairy farms and of problems relating to the handling and storage of eggs. Furthermore, the Division carried out a number of tests of drugs and biological products which were claimed to be remedies for hog cholera, and innumerable samples of disinfectants and medicines proposed for use against animal diseases have been analyzed.

It goes without saying that the accomplishments of the Division are the direct result of the high attainments and unswerving devotion of those who have made up the personnel, encouraged, as they have always been, by the sympathetic support of the Chief of the Bureau. They, like many others in the Department of Agriculture, have found their greatest reward in the consciousness of work faithfully done and of service rendered.

SUMMARY OF IMPORTANT EVENTS

- Apr. 1, 1890. Establishment of Biochemic Laboratory in old Museum Building, Department of Agriculture grounds.
Inauguration of chemical studies in bacterial metabolism.
1891. Laboratory moved to 1362 B Street S. W.
Preparation of mallein begun.
1892. Preparation and distribution of tuberculin begun.

- Aug. 1, 1894. Chemical study of tubercle bacilli begun.
Use of attenuated tubercle bacillus to produce immunity in guinea pigs.
- July 1, 1896. Biochemic Division established.
1897. Continued investigations of hog cholera, tuberculosis, and of methods for preparing nicotine and lime-sulphur dips.
Treatment of experimental tuberculosis with antitoxic serum (de Schweinitz).
1898. Determination of mineral constituents of tubercle bacilli.
Production of serum for hog cholera by injecting cattle and horses with cultures of *Bacillus cholerae suis*. Began experiments with serum in Page County, Iowa.
1899. Hog-cholera eradication experiments continued in Page County and extended to include Fremont, Mills and Montgomery Counties, Iowa. John McBirney, W. B. Niles, A. M. Adams and H. B. Waldron, respectively, in charge of work in these counties.
1901. Continued studies of hog cholera, further studies of tubercle bacilli, development of egg medium for cultivating *Bacillus tuberculosis* (Dorset). Comparative study of human and bovine tubercle bacilli begun.
Special field experiment station for hog-cholera studies established at Sidney, Fremont County, Iowa, W. B. Niles in charge.
1903. Discovery that disease of swine in Iowa was caused by filtrable virus.
1904. Dr. de Schweinitz died in Washington, February 15.
Experiments concerning tuberculosis completed. Filtrable virus proved to be cause of hog cholera.
Digestion experiments with poultry completed as B. A. I. Bulletin 56.
1905. Experiments looking to production of anti-hog-cholera serum by use of filtrable virus completed. Serum proved to be effective. *Bacillus cholerae suis* shown to play role of secondary invader only. Hog-cholera field station transferred to Ames, Story County, Iowa.
1906. Cooperative experiments with Zoological Division and South Dakota Experiment Station to determine value of cresol and coal-tar creosote dips for sheep scab.
Discovery of new serum for hog cholera officially announced. Method patented by M. Dorset, all rights being dedicated to the public.
Laboratory meat inspection organized October 1, 1906. Laboratories established in New York, Cincinnati, Chicago, Kansas City, Omaha and San Francisco.
1907. Branding ink for use of meat inspection service devised (M. Dorset). Use of Howard label discontinued.
Meat-inspection laboratory at Cincinnati transferred to East St. Louis.
Experiments with coal-tar dips in South Dakota completed and these dips permitted for use in official dipping.
Successful practical test of anti-hog-cholera serum on farms in central Iowa.
1908. Establishment of laboratory of dips and disinfectants.
Demonstration of new hog-cholera serum to representatives of fifteen States.
1909. Discovery of cause of ham souring (C. N. McBryde).
1910. Additional demonstrations of effectiveness of hog-cholera serum.
Production of hog-cholera serum begun by the various States.
1911. Dr. Dorset appointed chairman of newly created Insecticide

- and Fungicide Board of Department and designated as representative of Bureau of Animal Industry on that board.
- Additional studies on hog cholera and field demonstrations of effectiveness of serum.
- First arsenical dip for Texas fever permitted in official dipping.
1912. Dr. Dorset resigned as chairman of Insecticide and Fungicide Board and as Bureau representative. Dr. J. A. Emery, Assistant Chief of the Biochemic Division, chosen to represent Bureau of Animal Industry on that Board. Field test for arsenical dip devised.
1913. Inauguration inspection of hog-cholera-serum plants, Dr. H. J. Shore in charge of section.
- July 1. Inauguration of hog-cholera-control work in Dallas County, Iowa.
- July 15. Similar work begun in Montgomery County, Ind.
- Aug. 1. Hog-cholera-control work begun in Pettis County, Mo.
- Nov. 1. Hog-cholera-control work begun in Johnson and Gage Counties, Nebr.
- Establishment of laboratory for meat-inspection research, Ralph Hoagland in charge.
- July 1, 1914. Use of cresol and coal-tar dips for sheep scab discontinued. July 1. Meat Inspection Laboratory transferred to Meat Inspection Division.
- Field tests for lime-sulphur and nicotine dips devised.
- Apr. 1. Field work on hog cholera divided into (1) control work (O. B. Hess in charge); (2) demonstrational and educational work (U. G. Houck in charge).
1915. Substitute for U. S. P. compound solution of cresol permitted in official disinfection.
1916. Development of bean extract and salt method for producing clear anti-hog-cholera serum (Dorset and Henley).
- Jan. 1. Hog-cholera field work transferred to new Office of Hog Cholera Control, under direction of O. B. Hess.
1917. Regulatory inspection of hog-cholera serum placed in new Office of Virus-Serum Control (H. J. Shore in charge).
- Disinfection of tannery effluents by chlorine instituted.
1918. Completed studies on salvage of pickling materials and on substitutes for sugar in meat curing.
- Supplied U. S. Army with mallein.
- Began supplying field inspectors with ophthalmic tuberculin discs and intradermic tuberculin.
1919. Publication of studies on immunity of young pigs from hog cholera.
1920. New method for refinement of anti-hog-cholera serum developed (R. R. Henley).
- Spread of hog cholera by insects investigated.
- Study of hog "flu" begun.
1921. Effect of feeding on hog cholera "breaks" investigated.
- Vitamin content of various kinds of animal tissues studied.
1922. First portion of vitamin studies of meats completed.

PERSONNEL OF THE BIOCHEMIC DIVISION

Division Chiefs:

- E. A. DE SCHWEINITZ, Chief of Biochemic Laboratory, from Jan. 1, 1890, to July 1, 1896.
- E. A. DE SCHWEINITZ, Chief of Biochemic Division, from July 1, 1896, to Feb. 15, 1904.
- MARION DORSET, Chief of Biochemic Division, from Feb. 15, 1904, to date.

Assistant Chiefs:

MARION DORSET, from Jan. 1, 1900, to Feb. 15, 1904.

JAMES A. EMERY, from Feb. 15, 1904, to date.

Scientists in charge of sections:

Hog Cholera Field Station, Sidney, Iowa:

W. B. NILES, from 1901 to 1906. Ames, Iowa, 1906 to date.

Chemical Meat Inspection Laboratory:

T. M. PRICE, Oct. 1, 1906, to July 1, 1914.

Meat Inspection Research Laboratory:

RALPH HOAGLAND, 1913, to date.

Dip and Disinfectant Laboratory:

J. A. EMERY, July 1, 1905, to Jan. 1, 1908.

R. M. Chapin, Jan. 1, 1908, to date.

Insecticide and Fungicide Laboratory:

R. M. CHAPIN, Jan. 1, 1911, to July 1, 1916.

J. A. EMERY, July 1, 1916, to date.

Hog Cholera Control Section:

O. B. HESS, April 1, 1914, to Jan. 1, 1916.

Hog Cholera Educational and Demonstrational Section:

U. G. HOUCK, April 1, 1914, to Jan. 1, 1916.

Inspection of Hog-Cholera-Serum Plants:

H. J. SHORE, Jan. 1, 1914, to Feb. 17, 1917.

Tuberculin and Mallein Laboratory:

E. A. DE SCHWEINITZ, 1893 to Aug. 1, 1894.

MARION DORSET, Aug. 1, 1894, to Feb. 15, 1904.

JAMES A. EMERY, Feb. 15, 1904, to date.

Dairy Division

While dairying has been an important industry in this country since the first settlements, it was not until near the close of the Nineteenth Century that the pressure of foreign competition and the desirability of improving our cattle and products made it necessary to establish a central agency to aid and encourage this rapidly growing industry.

In 1890 the annual total value of dairy products produced was estimated at \$411,000,000, and in the classification of annual farm crops covering the years between 1859 and 1889 dairy products ranked sometimes third and sometimes fourth in value, being surpassed by meat products and by corn and in some years by hay.

By the year 1894 there were more than 16,000,000 dairy cows in the United States and the number was increasing rapidly each year. Since 1850 there had been an increase of about 10,000,000 cows, and between 1880 and 1890 the rate of increase had been especially great, amounting to about 4,000,000 cows in 10 years.

The average annual production of these cows was low. Statistics show that there had been a gradual improvement during the previous two or three decades, but the progress was too slow and the average production per cow was estimated at less than 3,000 pounds of milk in a year. Classified by sections, the North Atlantic States had the highest average production per cow, which amounted to 3,681 pounds; the North Central States were second with 2,821 pounds; the South Atlantic followed with 2,081 pounds, and the South Central, with 1,574 pounds. Among States and districts, however, the District of Columbia led with 4,584 pounds, while New Mexico stood last with a little more than 327 pounds per cow.

That these averages were rather low and that the need for improvement was recognized, was shown by the growing interest in purebred cattle and the large increase in the number registered between 1885 and 1895. This increase is shown in the following table:

Breed.	Cattle registered	
	1885.	1895.
Ayrshires	12,867	18,750
Brown Swiss .....	.....	1,930
Guernseys	4,947	12,547
Holstein-Friesians	21,138	90,325
Jerseys	51,000	150,000

At this time also the production of butter had reached enormous proportions. More than one billion pounds of butter were being made

each year on the farms alone, and the production of factory butter, which, by the way, was increasing very rapidly, had reached the 300 million mark. Much of this butter, and especially that made on the farms, was of inferior quality and there was a very apparent need for more information and its application in improving the quality of our butter.

The cheese industry grew steadily and by 1894 about 270 million pounds were being made each year, but our export trade was rapidly declining. As a result of foreign competition and prejudice against American cheese our exports decreased from nearly 150 million pounds in 1880 to about 75 million pounds in 1894. This prejudice was caused largely by the exportation of large quantities of filled cheese. It is interesting to note that as our cheese exports fell off Canada's exports of this product increased. Formerly cheese from the United States was preferred on the London market to Canadian cheese and brought a higher price. The Canadian Government, however, inaugurated systematic efforts to educate the dairymen of that country. Printed information was distributed, practical men were sent to demonstrate improved methods, and the importance of making high grade cheese was emphasized. As a result Canadian cheese was greatly improved and it soon came to be preferred on the London market. This was a pointed lesson for our own people.

The market milk business in the cities had also developed to large proportions. Little attention, however, was being given to the handling of milk from a sanitary standpoint, or to the inspection of milk supplies and plants, and no uniformity existed in the methods of handling the product in different cities. Regulations and ordinances were in force in only a few cities, which is not surprising when it is remembered that the first instance of regulation of milk supplies occurred in 1856, when laws were passed in Massachusetts relating to watering and skimming. It was some years after this that the first regulations in regard to sanitation were passed. One of the greatest needs, therefore, for the protection of consumers and for the welfare of the industry was the introduction of more sanitary methods and the standardization of methods of handling milk in the different cities and towns. This, it was believed, could best be accomplished through the leadership of a national agency or organization.

It was obvious that improved dairy methods were needed in the United States. They were needed to secure better products at home and to recover and retain foreign markets.

DAIRY DIVISION ORGANIZED.

As an aid to bringing about improvements in our dairy industry, the Dairy Division of the Bureau of Animal Industry was organized on July 1, 1895, with Major Henry E. Alvord as Chief. Some idea of the purpose of this new division may be obtained from a statement of the Chief of the Bureau of Animal Industry in his Annual Report for 1895. After stating that the original scientific investigations must be postponed until a foundation had been laid and facilities acquired, he continues as follows:

There is, however, a vast amount of information of the greatest value to the dairyman which may be secured by observation and correspondence. This relates to the condition of the industry, statistics of production and trade, markets, and improvement in the manner of producing and handling dairy products. The present is an era of rapid changes, and the dairyman on this account needs a reliable source from which to obtain a knowledge of the latest modifications in the trade and the most desirable improvements which have been suggested. The great dairy interest has so long been neglected by the United States Department of Agriculture that a special effort should now be made to press forward the work outlined above and to establish intimate relations with the dairy organizations of the country.

This, then, was the purpose for which the Dairy Division was organized.

EARLY WORK OF THE DAIRY DIVISION

The early work of the Division was largely confined to collecting and disseminating information relative to dairying as carried on in the United States and foreign countries. It was hoped by those in charge of the work that the Division would prove to be of great educational advantage to the farmers of the country, but it was believed that it was not the province of the Division to do more than instruct people plainly how to help themselves.

The first year's work of the Division included a survey of the dairy industry of the United States and collecting such information as was needed for forming an intelligent idea of the magnitude, condition, and needs of the dairy industry. A number of bulletins were issued, for which there was a great demand, and much satisfaction was expressed by those interested in dairy matters that the Department of Agriculture had established this Division.

The Department Yearbook for 1897 included a series of articles for the farmer on the work of the Department. Under this heading the following statement is made about the Dairy Division:

The milk supply and service of large cities has been made a special subject of investigation, with the object of assisting in the im-

provement of the quality of milk and its condition upon delivery to the consumers.

The depressed condition of the exports of dairy products for a number of years emphasizes the desirability of active measures to assist and encourage this branch of the foreign trade. With a view to this, a number of experimental shipments of carefully selected butter from creameries in the great butter-producing sections of the country were made during the last year. These have furnished much information concerning the difficulties that are encountered by the trade and as to the requirements of foreign markets. They have also convinced English merchants of reputation and influence of the high quality of butter obtainable in this country, and of the practicability of placing it in British markets without appreciable deterioration. It is proposed during 1898 to repeat these trial shipments and to extend them to a wider field.

The experimental exports of butter, begun May 5, 1897, were continued on a larger scale in 1898. The butter sent abroad was of the best quality and a decided gain was evident in the favorable impression made by United States butter upon the best class of trade in London and Manchester, England.

In 1899 the possibilities of building up an export trade in Great Britain, France, Germany, China, Japan, the Hawaiian Islands and the Philippine Islands were investigated. These countries were visited by a representative of the Division, and trial shipments of dairy products to Germany and France demonstrated that for choice products these markets were by no means so good as those of Great Britain. Regular shipments were continued to Manchester, England, for more than a year and a steady market was created. Such a good reputation was built up for American butter that when the shipments were discontinued the English merchants attempted to buy direct from American producers. The price received in this country for choice butter, however, was so high as to preclude exports on a commercial basis.

In 1900 a study of dairy sanitation was begun which resulted in the publication of a bulletin on the milk supplies of 200 cities of this country. This was the first work done by the Division with market milk.

Comprehensive exhibits were made at the Paris Exposition in 1900, at the Pan-American Exposition at Buffalo in 1901, and at the Louisiana Purchase Exposition at St. Louis in 1904. Major Alvord, Chief of the Dairy Division, died at the latter Exposition October 1, 1904.

After 1902 the scope of the work began to broaden to such an extent that from time to time it was necessary to create special subdivisions or sections in the Division to handle the different lines of work. In 1902, for instance, the dairy research laboratories were

established to study research problems. In 1905 Ed. H. Webster, who was appointed Chief of the Division in January of that year, organized sections to conduct dairy farming extension and market milk investigations. In 1906 investigations in dairy manufacturing were also organized. B. H. Rawl became Chief of the Division in January, 1909. In 1910 the Division acquired its Experiment Farm at Beltsville, Md. Investigations in dairy cattle breeding were begun in 1911.

All of these sections are still functioning, and as the work of the Division has become so definitely divided it would perhaps be more advantageous to discuss the work of the Dairy Division under these classifications.

DAIRY EXTENSION

The section dealing with dairy extension is interested in cow-testing associations, bull associations, cottage cheese work, utilization of dairy products, community development and demonstration farms.

Extension Work in the South

The first large piece of dairy extension work was carried on in the Southern States, and the real beginning of this work was in the winter of 1905 when Mr. Webster, Chief of the Division, attended a meeting of the South Carolina Livestock Association and later offered B. H. Rawl, secretary of the association, a position with the Department to take charge of dairy work in the South.

There was a desire to do something of a broad, fundamental nature in the interest of dairying in the South, and after Mr. Rawl accepted the position he made a tour of the southern agricultural colleges to study conditions and formulate plans for definite extension work. An appropriation of \$20,000 was obtained for this project and work was immediately begun in the States of North Carolina, Tennessee, Mississippi, Texas, South Carolina and Georgia, when extension men were assigned to work in each State. The Dairy Division bore all the expense of the work with the understanding that if it proved profitable the States would gradually assume the expense and eventually relieve the Department of this project.

Up to this time very little had been done in these States for dairying and the industry was in its infancy. Dairying centered around the cities, where there was a market for milk and cream, and occasionally there was found a farmer in an outlying district who was making butter or shipping cream. The principal agricultural crop was cotton, and the agricultural colleges were therefore confining a

large part of their efforts to this crop. Dairying had not been thought of sufficient importance to warrant extension work, and the colleges were therefore skeptical as to any practical results which might be obtained. This attitude was greatly modified as year by year the work grew more successful, and the colleges finally became so thoroughly convinced of its value that they took over all the work when the Department withdrew in 1920. This awakening of the colleges to the possibilities of dairying in the South is believed to be one of the greatest accomplishments of the Department's extension work.

The early work of the extension men was centered around better methods of feeding, building silos, keeping herd records, and encouraging the breeding of better cattle. At first a large amount of personal work was done with the individuals in order to have definite accomplishments. These accomplishments served as examples in their respective communities and the better methods of dairying soon began to spread. This acquaintance with individual farmers also opened the way to problems such as the raising of calves, remodeling of barns, improvement in the quality of butter, and heading herds with purebred bulls.

With the growth of interest in dairying on the part of the farmers the attention of the State authorities was attracted to the benefits of the practical lines of work conducted. North Carolina and Mississippi in a very short time showed their appreciation by financial contributions. The original appropriation by Congress of \$20,000 was never increased, consequently the only increase in the work that could be made came from money provided by States to assist in supporting the work.

In 1914 extra funds were secured for carrying on livestock improvement work in areas which had been freed from cattle ticks. This work proved very successful. One of the greatest single accomplishments has been the inauguration of the silo movement and the feeding of silage to herds in Southern States.

An interesting epoch in the work was the development of creamery promotion activities in 1909. Promoters organized seven plants in Georgia, although conditions were such at the time that there were few if any places in that State where creameries could successfully operate. The promoters were forced to withdraw, and the failure of these creameries proved detrimental to the development of creameries later on. As time went on and the development of dairying in certain sections of the South made it possible to support creameries,

efforts were made to establish them where conditions warranted. The establishment of cooperative creameries at Hickory, N. C., in 1910, and at Lebanon, Tenn., exerted a wide influence in encouraging the dairy industry and supplying a market for dairy products. Since that time the development of creameries has been rapid, and for the year ending January 1, 1920, more than one and one-half million pounds of butter were made in 93 creameries in the South. In 1924 the creameries had increased to 217 with an especially rapid development in the State of Mississippi.

The inauguration of the cheese work in 1914 must be regarded as one of the epochs in the Dairy Division's work in the South. The condition in the mountain regions seemed to be favorable for making cheese, and an extension man of the Dairy Division began work in cheesemaking in 1914. In 1915 the first cooperative cheese factory was organized. In 1920 there were 54 factories in operation, all producing a uniform type of American Cheddar cheese. Thirty of these factories alone turned out 481,000 pounds of this product in 1920.

The bull association movement, which gained enthusiastic support in the South, was the first organized effort to head herds with pure-bred bulls. There are now 70 bull associations in operation in the Southern States, and the enthusiasm for better cattle which these associations have created makes this movement rank among the most important. Incidentally, it might be added that the number of milk cows in the South has increased 50 per cent since 1907, and that the improvement in quality is very marked.

Cow testing work was also carried on in the South with favorable results. Testing associations have generally been organized in the territories where individual herd record work was carried on in earlier years. There are now 24 such associations.

The work of establishing dairying in the sections where the boll weevil had impaired the cotton raising industry is especially important. A territory in Mississippi which in 1912 was floundering for some means of livelihood has been transformed into one enthusiastic for dairying. The farmers have been led from primitive methods of handling cows to a point where they are now engaged in dairying on a profitable and reasonably modern basis.

Southern extension work, except that with cheese factories and creameries, was discontinued on July 1, 1920, due to decreased appropriations of funds. A gratifying testimonial to the effectiveness of the work is found in the fact that with one exception all extension

men in the employ of the Division when the work was discontinued were taken over by the agricultural colleges of the States in which they worked.

Extension Work in the West

The growing importance of dairying in the Western States, the lack of a market for large quantities of alfalfa and grains, and the opening up of irrigation projects caused the Dairy Division in 1910 to begin extension work in the Pacific Coast and Rocky Mountain States. The object of this work was to improve and develop the business of dairying in the Western States by introducing better methods of dairying through personal work among the farmers, by carrying on educational work to improve the quality of market milk, and to introduce better methods of manufacturing dairy products. Silo building and improved feeding and breeding were given particular attention, and assistance was given to creameries and cheese factories in improving their products, and to State and city boards of health and State dairy commissions in improving methods of inspection of milk supplies.

The field men in dairy farming work cooperated with the county agents in developing their projects, including the development of cow-testing associations and bull associations. This work, carried on in cooperation with the various State agricultural colleges, was conducted in Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, Oregon, Utah, Washington and Wyoming.

In 1912 the work had progressed to a point where it seemed advisable to create a separate office for its supervision, and the western office of the Dairy Division was therefore established at Salt Lake City, Utah. This arrangement was in force until September 4, 1917, when the office became a part of the dairy extension section under the name of western dairy extension.

The first bull association in western territory was organized in Oregon in 1915. Since that time other States have been added to the list until there are now a total of 45 associations in 7 States, Idaho leading with 29 associations.

The cow-testing work has been making steady advances since the first association was organized in California in 1909. There are now 68 associations in the Western States, California leading in the number organized with a total of 27. Some of these California associations are unusually large. The one at Ferndale, which includes 100 herds of 4,400 cows, is the largest cow-testing association in the

United States. Some of these associations have shown remarkable improvement in average production and in economy.

In the market milk work the surprise milk contests have been extensively and effectively used. In these contests, carried on in cooperation with city health authorities, the milk of various companies is sampled without previous notice and tested for bacteria count, sediment, etc., and each given a rating. This has created a spirit of friendly rivalry to produce the best milk. Where poor milk is found the specialists aid the milk plant to trace the cause to its source and remedy the fault. Often this leads to work among the producers in better methods of handling milk and in the use of cooling tanks and sterilizers. As a result of this work with market milk, very noticeable improvement in the quality of the milk supply of many western cities has been reported.

Specialists in cheesemaking for some years have been making personal visits to cheese factories, as an aid to improving the quality of cheese produced. Short courses of instruction in the methods of making cheese have been given from time to time in cooperation with the State agricultural colleges. These have been effective also in standardizing both the output and the methods of production.

On February 12, 1920 a creamery specialist was detailed to the West to assist in improving the quality of butter made there. In late years cream-grading systems of buying cream have been installed in several creameries, and sweet-cream butter is also being made at some points as a result of the specialist's efforts. As a better quality of butter often depends upon obtaining a better quality of cream from the producers, it was found necessary to give considerable attention to the creamery patrons. Cooling tanks have been installed on many farms and more attention is now being given to farm sanitation.

In 1915 cooperative relations with the Northern and Middle Western States in the maintenance of extension field work were begun, and by the following year these cooperative relations had attained considerable extent, mostly on the half-and-half basis. The organization of cow-testing associations was the principal line of work, though market milk and creamery work were also done and in some States were made the principal activity. The practice was to work through community organizations rather than directly with individual farmers, as had been the rule in the South and the Far West, where dairying conditions were less advanced.

Cow-Testing Associations

The cooperative cow-testing association work was begun on May 1, 1908, when Helmer Rabild accepted appointment in the Dairy Division. These associations consist of groups of dairymen who cooperatively hire an expert to assist them in determining which cows are profitable and which are unprofitable. In order to do this the milk produced by each cow is tested and weighed against the amount of feed consumed. The results have been very encouraging and the number of cow-testing associations has become so large as to exert a decided influence on improving the dairy herds of this country.

At first only one man was assigned to the work in the entire country. The movement was new and untried on this continent, so his time was largely devoted to explaining to those in charge of dairy extension in the several States the purpose of the association and the method of operation, and to organizing communities that were willing to undertake the work. From one association organized in Michigan in 1905 the movement has grown until at present there are 627 associations in active operation in 39 States, including more than 16,500 members owning approximately 280,000 cows.

All cow-testing association work is now carried on in cooperation with State extension forces or other agencies within the States that have the work in charge. The number of Dairy Division extension men engaged in cow-testing work was reduced to four in 1920. That the cow-testing associations actually improve the herds is shown by the fact that the average yearly production of butterfat of cow-testing association cows is 247 pounds, as compared with 160 pounds which is the estimated average production of all cows in the United States. Since 1920 this work has largely developed into a study of cow-testing association records.

Bull Association Work

In 1908 the Michigan Agricultural College organized a bull association which was the first in this country. The year 1911 marked the organizing of the first cooperative bull association in the United States by the Dairy Division. This association was composed of breeders of Guernsey cattle in the vicinity of New Windsor, Md. The need of some method whereby the smaller dairymen could obtain good purebred bulls at a small cost for the purpose of improving their herds had long been recognized. The bull association seemed to be the solution of this problem.

In 1911-12 two associations were organized, and in 1915 an extension man was assigned to this branch of the work. Since that time the number of associations has increased rapidly so that at present there are 218 active associations in 37 States. Included in this number of associations are 6,881 members owning 45,445 cows, of which 8,551 are purebred.

In 1921 the number of dairy specialists on bull association work was increased to three and work was begun in the South, the Middle West and the northeastern dairy sections. One more man was added in 1922. The movement has been especially well received in the South. About one-third of the bull associations in this country are located in the South, which is a growing dairy section.

Cottage Cheese Work

During the war every effort was made to eliminate waste of food materials. It was ascertained that 29 billion pounds of skim milk were produced annually as a by-product of the butter industry. Much of this was being wasted, and as a means of utilizing it the Dairy Division in 1918 organized a nation-wide campaign to stimulate interest in the making and eating of cottage cheese. Demonstrations in the making of cottage cheese were given in cities and in rural districts, in clubs, kitchens, schools, cafeterias and other places throughout the country. Enormous quantities of cheese were made before the campaign was completed in July, 1919.

Stimulating Consumption of Milk

When the war came to an end in 1918 the dairy industry was confronted with the problem of taking care of the increased production of milk and dairy products. As an aid in utilizing this surplus, and at the same time to decrease the per cent of undernourishment found among children and adults, a project was outlined for stimulating the consumption of milk and dairy products, in both city and rural districts. In the spring of 1919 educational milk campaigns were organized by milk specialists of the Division in several cities, including Detroit, Mich., Boston, Mass., and in some rural communities. In these campaigns the value of milk as a food was emphasized. Aided by the cooperation of local civic associations, schools and clubs, the campaigns proved so successful that the movement spread rapidly to all parts of the country. By 1921 almost all of the larger cities and many of the smaller cities and rural communities had put on milk campaigns. Among the cities which held such campaigns were

Pittsburgh, Detroit, Portland, Seattle, Spokane, Kansas City, Boston, Baltimore, Akron and Madison.

The campaigns lasted about one week and during that time an effort was made to bring before as many citizens as possible a knowledge of the food value of milk. Lectures were given in schools, clubs, and factories; posters, motion pictures, window displays and other means were used to accomplish this end. The increases in the consumption of milk reported from the cities ranged from 5 to 50 per cent, and substantial increases were also reported for other dairy products, such as butter and cottage cheese. The Dairy Division, working with the States Relations Service of the Department, cooperates in these campaigns only when requested to do so by local State agricultural colleges.

Some of the States and also certain national dairy organizations are beginning to take up the work of conducting milk campaigns, and it is hoped that eventually the Department may be relieved of the work, for, as with other extension work, it is felt that the Dairy Division should act only as a leader in introducing desirable movements, and that once they are successfully under way the Division should turn its attention to other new problems.

Dairy Demonstration Farm

In 1907 a project was started to demonstrate the value of dairying in connection with building up worn-out soils. A typical worn-out cotton farm at Denison, Texas, was purchased by a stock company of business men of Denison and stocked with ordinary scrub cows. The Dairy Division furnished supervision but all other expenses were borne by the company. Purebred Jersey bulls were used, with the result that the herd became of more uniform type and the yearly butterfat production was raised from an average of 139 pounds to 241 pounds per cow. The average production of heifers with three lactation periods was 5,208 pounds of milk and 252 pounds of butterfat. The fertility of the soil was greatly increased also, and the excessive erosion formerly present was practically stopped. Having served its purpose, the Denison project was discontinued in 1919.

Community Dairy Development

In 1910 a dairy field man was stationed at Algona, Iowa, to work with the patrons of the creamery to aid the community through the promotion of dairying. Assistance and advice were given by the field man, and the herds were improved by record keeping and the use of

purebred bulls. Proper crop rotations and changes in the feeding of the herds were suggested. Many silos, dairy buildings and a new creamery building were constructed. The work was continued for five years, with the result that in 1915 the same number of patrons of the creamery sold 21,071 pounds of butterfat more than in 1911. While at the beginning of the project there were only 6 purebred dairy bulls in use among the patrons, at its close there were 28 such bulls, and 88 head of purebred dairy cows had been brought into the community. By improving the quality of cream delivered to the creamery a better grade of butter was made, which resulted in the market price for butterfat being increased 2.9 cents per pound.

In 1916 it was thought advisable to unite the community development work with work in a creamery at Grove City, Pa., which was placed at the disposal of the Dairy Division for experiments in creamery management and in various manufacturing processes. The Grove City creamery was erected in 1915. The work there involved concerted action by all the branches of the Dairy Division, involving extension work in dairy farming, market milk, sanitation and creamery management, and also experimental work in various lines of dairy manufacturing, including butter, condensed milk, various kinds of cheese, casein, milk sugar and other by-products. The cooperation of a bank was also obtained in encouraging progressive agriculture in the community.

Before the development work was begun there were no farmers' organizations of any kind in the community and little cooperation between the farmers and business men of Grove City. There were only five purebred cows in the district, barns were far from modern, pastures were poor, and the average milk production per cow was low.

In comparison our latest information shows that 30 of the 200 members of the Grove City Commercial Club were farmers, 120 farmers belonged to local breeders' associations, 100 were members of bull associations, 700 joined the creamery patrons' association, and 47 belonged to the Grove City Cow-Testing Association. The young people also became interested in better farming and now have their own clubs. The farmers of that community now own more than 3,000 purebred dairy cows and heifers and 300 purebred dairy bulls. They own 9,000 tuberculin-tested cattle, and over 350 dairy herds are on the tuberculosis-free accredited list. The farmer patrons of the creamery receive in the neighborhood of \$340,000 a year for their milk

and cream, and since 1915 their bank deposits have grown from one-half million dollars to one and one-half million.

The Grove City community has served as an example for hundreds of other communities, and each year it is visited by representatives from many parts of the United States who have been sent there to study the methods used in bringing the community to its present state of advancement.

MARKET MILK INVESTIGATIONS

The section conducting work relating to market milk is engaged in projects involving score-card inspection systems, dairy sanitary research problems, milk and cream contests, milk-plant management, requirements for milk production, milk transportation studies, machinery efficiency and labor costs, flavors and odor of milk, cleaning milking machines, whipping qualities of cream, etc. It was organized in 1905. Attention at first was given only to sanitary aspects of dairy farm conditions, but later the product was followed to the city and even as far as the consumer's ice box.

Score-Card System

One of the greatest accomplishments of the market milk work has been the development and extension of score-card systems of inspection. Under this system farms, milk plants, milk and cream are graded according to a numerical valuation of the various elements involved, on a scale of 100 for perfect. From 250 to 300 cities have adopted the score-card system. The efficiency of official inspection has been greatly enhanced, resulting in better milk supplies. Uniform efficient inspection has resulted also in improving the sanitary conditions of dairy farms and herds supplying milk to cities.

Sanitary Surveys

The drafting and recommendation of model ordinances for regulating milk supplies in cities and communities has been an important activity. Such recommendations generally follow a survey of the city in regard to quality and method of handling the milk supply. These surveys have been conducted in a large number of cities and towns and involve all factors entering into the handling of the milk. Many dairy farms supplying the milk, transportation agencies and milk-handling plants in cities were inspected. Bacterial counts were made on the entire supply. In addition, studies were made of methods of pasteurization. After the surveys were made the representa-

tives of the Department instructed the inspectors and laboratory men in the technique of inspection work.

In 1917 surveys of the dairy farms, milk plants, transportation facilities and other factors involved in connection with the milk supplied to some of our army cantonments were undertaken. This work resulted in greatly improving conditions through the elimination of undesirable milk and an increase in properly pasteurized milk. So far as can be ascertained, there was not a single case of milk-borne disease at any of the camps or naval bases where such assistance was given.

Milk and Cream Contests

One of the great educational factors in improving market milk supplies has been the holding of milk and cream contests in cooperation with State and municipal health authorities. They were begun in 1906, and since that date many milk and cream contests have been held in cooperation with the Dairy Division. Thousands of samples of milk and cream from all parts of the country have been scored. The samples are submitted and judged on the basis of bacteria, flavor and odor, visible sediment, chemical composition, and the appearance of the package. These contests have been of considerable value in improving the quality of milk. Also, consumers were taught by means of lectures and addresses to appreciate the advantages of clean milk, and of the additional cost of its production.

In 1912 the first systematic work on milk-plant economics was begun. Surveys of the plants of city milk distributors in various parts of the country have been made. This work includes the compilation of data on labor costs, the efficiency of various types of machinery, etc. Circular letters are issued every month to milk-plant operators. These letters deal with various problems confronting the milk dealer and give information relative to increasing the efficiency of handling and distributing milk.

As much assistance as possible is given to dealers who contemplate the building of new plants or the reconstruction of old ones. Information is furnished also in regard to needed equipment, costs, laying out of plans, etc.

Studies in Cost of Production

In 1915 an investigation of the actual cost of producing market milk was first undertaken by the Division, and the inquiry was carried out to include details. Figures on cost of production were obtained

in market milk sections of Indiana, Vermont, Washington, North Carolina, Louisiana, Nebraska and Delaware.

In each section a group of representative farms was selected and intensive studies were conducted on each farm over a period of two years. One entire day out of each month was spent on each farm, studying the kinds and quantities of feeds, milk produced, labor expended and other factors involved in production. At the end of each two years' study these figures were compiled into useful tables and published for the information of dairymen and others interested in cost of production. The field work on this project was completed in 1921.

Milk Transportation Studies

With the development of the market milk business and the ever increasing demand for more milk, it has been found necessary to draw on territories more distant from the cities for milk supplies. This condition brings with it the problem of keeping milk in good condition while being transported.

To obtain reliable data on the best methods of transportation and types of containers, work was begun in July, 1918, on a milk transportation project. As spoilage generally occurs during the hot summer months, the work is done largely at that season. In 1918 shipments of milk were made between cities in both baggage and refrigerator cars, using different types of cans for the milk. Information on temperature of the milk, amount of ice required and time in transit was obtained for study and recommendations. Studies were also conducted with methods of handling milk on the farm prior to shipping. In 1919 and 1920 these studies were continued on a larger scale. The work resulted in recommendations which have been adopted by transportation companies and milk dealers with considerable saving in ice and in decreased losses of milk through spoilage. Further studies are being made of tanks for transporting milk on auto trucks and railway cars.

Care of Milking Machines

The lack of definite information as to the best methods of cleaning and sterilizing milking machines caused the Dairy Division to take up this problem in the spring of 1919. Through a series of practical tests with heat and with chemicals information has been obtained from which there has been evolved a simple, practicable method to be used by the average farmer.

Effects of Feeds on Flavor and Odor of Milk

In 1912 the market milk section began experiments to determine the effect of various feeds and feeding practices on the flavor and odor of milk. For the first few years experiments were conducted on a very small scale with available cows at the Beltsville Experiment Farm. In 1917 a special stable was built at the farm so that the cows undergoing test could be kept under absolutely controlled conditions. The first experiment was to determine the accuracy of a statement frequently made that oats in the ration improve the flavor of the milk. It was found that there is no foundation for this statement. Experiments were also conducted in feeding garlic or wild onion tops to cows at varying periods before milking. This led to a recommendation that cows be withdrawn from garlic-infested pastures at least four hours before milking.

In 1914 studies were made of the effect of wet and dry beet pulp and of high and low protein rations on the flavor and odor of milk.

The largest phase of the flavor and odor work, begun in 1918, is the effect of different silages. The results of these experiments have been brought together and published. Data have also been published in regard to green alfalfa, green corn and turnips.

DAIRY MANUFACTURING INVESTIGATIONS

The work of dairy manufacturing investigations comprises extensive activities with creameries and cheese factories, United States Navy butter work, renovated butter inspection and the operations conducted at the Grove City Creamery.

With the work of dairy extension and market milk investigations well under way in 1906, attention was turned to the manufacturing side of the dairy industry. For some time it had been realized in the Dairy Division that to put these branches of the industry on a more efficient and profitable basis there was need for special work in the cheese factory and creamery field. Inefficient management of many of the creameries was resulting in a lack of profit for the creameries and their patrons. They were getting extremely low overrun, had few records of operation, and were dependent on the dealers to whom they consigned their butter for judgment on its quality and value. The work taken up by the Division in the beginning was mainly centered around the stopping of losses and leaks, and as a means of determining them, creameries were requested to send in monthly reports to the Division for analysis and suggestions. This

type of work was continued until 1917, when the Bureau of Markets took over the marketing work. The field men gave considerable attention to individual creameries. This work, begun in 1907, is still being carried on.

An investigation of the matter of fuel and power costs and the causes of fuel waste was made in 248 creameries. During this investigation it was found that a saving could be made by replacing the steam engine with electric power or with a gasoline or a kerosene engine.

In connection with the southern dairy work, farm buttermaking demonstrations were conducted, and cheesemaking was established in suitable localities. This work is being extended in the Rocky Mountain region.

In 1908 the Dairy Division induced the owners of a cheese factory in Wisconsin to put in equipment for making whey butter and gave personal assistance in starting and developing the work. As a result of this work more than 250 cheese factories in this country skim the whey. The value of the butter made annually from what was formerly a waste product is probably in excess of \$500,000.

U. S. Navy Butter

Each year since 1902 the Dairy Division has supervised, for the Navy Department, the manufacture of from 500,000 to 10,000,000 pounds of butter, all of which is made from sweet pasteurized cream. The butter is made according to specifications, and inspectors under the supervision of the Dairy Division see that all butter made for the Navy meets the required standard.

The specifications for Navy butter were worked out in the Dairy Division with a view to producing a butter which would hold its quality during long periods of storage. The Navy butter has given remarkable satisfaction for the purpose intended, and many samples which were rescored after one year in storage have scored 93 or more.

Renovated Butter

The year 1902 marked the beginning of the renovated butter inspection by the Dairy Division. Inspectors under the direction of the Division continue to make frequent inspections of the factories engaged in renovating butter. All marks and labels must be approved before being used, raw materials are examined and factory sanitation is closely watched. The number of factories making such

butter, and the amount of product made, have been decreasing year by year.

Grove City Creamery

A creamery operated under the direction of the Dairy Division was established at Grove City, Pa., in 1915. The object of the creamery was to provide facilities for conducting investigations which could not be carried on in the laboratories in Washington. These investigations include the factors causing changes in flavor of butter and the utilization of creamery and cheese-factory by-products.

The creamery building was constructed by a stock company organized by the business men of Grove City, and taken over by the Department of Agriculture on a long-term lease. The creamery is operated on the cooperative plan. The principal products manufactured are butter, condensed skimmed milk, and Swiss, Roquefort, Camembert, Cheddar and cottage cheese. Pasteurized milk and cream also are sold.

The creamery began operations in July, 1915, and during that month 11,164 pounds of butterfat and 4,540 pounds of skim milk were purchased from farmers in the vicinity. The total production of butter for the first year was 208,715 pounds. At present approximately 580,000 pounds of butterfat are purchased annually to be made into butter and other products.

DAIRY RESEARCH

The work in dairy research includes investigations in milk secretion, butter production, foreign varieties of cheese, bacteriological and chemical problems with milk, ice cream and the utilization of by-products.

The Dairy Division had not been in existence long before it became apparent that in order to function in the most effective manner, facilities must be provided to carry on original research work in the Department of Agriculture. Some research work was being carried on by certain States, but there were many problems of a broad and fundamental nature which had not been touched. In 1902 L. A. Rogers was appointed in the Biochemic Division to do research work on some of the more pressing problems. During the first three years the work was carried on in the Biochemic laboratories of the Bureau. One of the first projects undertaken was to determine the factors influencing the keeping qualities of butter. The cooperative arrangement with the Biochemic laboratories continued until soon after Mr. Webster became Chief of the Dairy

Division. At this time cooperative arrangements were made with certain State experiment stations for investigational work in their laboratories. Work was undertaken at Storrs, Conn., on soft cheese, at Madison, Wis., on Cheddar cheese, at Columbia, Mo., on milk secretion, and at Iowa State College on butter.

Milk Secretion

The milk secretion work was discontinued for a time after the termination of the agreement with the Missouri station, but in 1915 a physiologist was appointed in the Dairy Division to take up this problem and laboratories were established on the Beltsville farm. While the work at Columbia, Mo., had been concerned chiefly with the influence of breed, feed, individuality and other factors on the composition and yield of milk, the new work was directed more especially toward the actual mechanism of the secretion itself. It was soon found, for instance, that there is a direct relation between the phosphorus and calcium compounds of the blood and the feed on the one hand and the secretion of milk on the other. A continuation of this investigation demonstrated that in many cases the milk yield was limited by the inability of the cow to obtain sufficient minerals from the feed furnished. This could be corrected by changing the quantity or nature of the feed, or even by adding inorganic salts to the ration.

Another contribution to the knowledge of milk secretion has been the fact recently established that the precursors of the casein of milk are the amino acids of the blood. A remarkably rapid removal of these bodies by the mammary gland has been demonstrated.

The work at Beltsville was supplemented by cooperative work at the Pennsylvania State College under the direction of the late Dr. Henry Prentiss Armsby. This work was begun in 1915 and suspended in 1920 on account of a lack of funds. It was resumed in 1922.

Butter Investigations

On the termination of the work on butter at Ames, Iowa, one year after it was begun, investigations on this product were begun on a laboratory scale in Washington. In 1907 arrangements were made through the Minnesota station for the use of a cooperative creamery at Albert Lea, Minn., for experimental purposes, and laboratories were equipped in a rented building on the creamery grounds. On account of the distance from Washington, this arrangement was

not entirely satisfactory, and a similar arrangement was made with a creamery at Troy, Pa., in 1911. This creamery was used by the Division until it was converted into a condensery.

The investigations on butter have demonstrated that many of the deteriorations in butter are chemical in their nature and can be controlled by simple methods. This knowledge resulted in the adoption by the Navy Department, on the advice of the Dairy Division, of the so-called sweet-cream butter for use on shipboard. The results obtained with the butter stored by the Navy have been so striking that the method is gradually coming into general use for making butter for immediate use as well as for storage.

Cheese Investigations

The cooperative work at Storrs, Conn., was confined to a study of the methods of making and ripening Camembert and Roquefort, two varieties of cheese which had never been made successfully in this country. When this work was moved to Washington, provision was made for making and curing cheese in the laboratories under carefully controlled conditions. The milk from cows on the Beltsville farm is used for this purpose. The organisms essential to the development of the required flavor in these varieties of cheese have been isolated and proper methods for their propagation in the cheese developed. Roquefort has presented the greatest difficulties, since this cheese is made in France from sheeps' milk, while to introduce its manufacture into this country required methods adapted to the use of cows' milk. In France Roquefort cheese is ripened in caves through which there flow naturally currents of cold, damp air. In making such cheeses in this country it has been necessary to produce these conditions artificially. This has been done successfully, and both Camembert and Roquefort are now made commercially at Grove City.

The problem of Swiss cheese is somewhat different, since the manufacture of this variety has been established in this country for many years. It was well known at the time that the average quality of the domestic cheese was inferior to that imported from Switzerland and the price was correspondingly lower. When the laboratory was established at the creamery in Albert Lea, Minn., in 1907, facilities were included for making Swiss cheese on a small scale. When this laboratory was abandoned the work was continued at State College, Pa., until provision could be made for it at Washington.

The first advance was the discovery that the abnormal fermenta-

tion which frequently spoiled the cheese could be controlled by the use of an especially active acid-forming culture. In this way home-made rennet by which the Swiss-cheese maker unknowingly propagated this starter could be replaced by the more carefully made commercial rennet and the fermentations of the cheese brought under more perfect control. Later it was found that the "eye"-forming and flavor-forming bacteria of the imported cheese could be inoculated into the domestic cheese by the use of small quantities of the cheese itself. The specific organism was finally isolated and the results can now be obtained with pure cultures.

Bacteriological and Chemical Investigations of Milk

Early in the work the necessity of bacteriological and chemical investigations on some of the fundamental problems confronting the milk producer and dealer was recognized, and in 1908 a bacteriologist was appointed to give his entire time to this question. The force has been increased until at the present time two bacteriologists and two chemists are engaged in these lines of research. When this work was begun there was much difference of opinion in regard to the value of pasteurization, and the majority of physicians opposed it on various grounds. The work of the Dairy Division showed that proper pasteurization left the milk, from the bacteriological standpoint, in the condition of fresh milk produced under sanitary conditions with the danger from pathogenic bacteria eliminated. It also demonstrated that pasteurization by approved methods produced no objectionable chemical changes in the milk.

Extensive studies have been made on the relative importance of various factors in contributing to bacterial contamination. In addition to the results of immediate practical value some important contributions have been made to the knowledge of bacteria in general. This has included an intimate study of some of the groups of bacteria of importance in dairying and their separation into species or varieties with a determination of their origin. An investigation on the influence of hydrogen-ion concentration on the growth of bacteria has attracted the attention of workers in all the biological sciences and has resulted in a distinct advance in bacteriological methods. On the basis of these results a method was developed for making citric acid from sugar by fermentation and is now being used to make citric acid in competition with that imported from southern Europe, where it is made from citrus fruits.

Ice Cream and Condensed Milk Investigations

The rapid development of the ice cream industry has brought forward new problems which the laboratory is helping to solve. One of these is the cause and methods of controlling "sandiness," a defect which has given ice cream manufacturers no little trouble. The investigations have proved that this condition is due to a crystallization of milk sugar, and methods of control are now being worked out.

The condensed and evaporated milk industry has been developed so completely by individual effort that it is only quite recently that public agencies have taken any part in studies on these products. In 1914 a chemist was appointed for this work and condensing equipment was installed in the laboratory. In addition to bacteriological studies on the causes of deterioration, results have been obtained on some of the manufacturing factors influencing the quality of the product.

Utilization of By-Products

The changing economic conditions in the dairy industry have greatly increased the necessity of utilizing all of the milk, not only to conserve the food value but also to augment the returns to the producer and to improve the quality of the major product by making it profitable to bring the whole milk to the factory in good condition. Methods for making casein especially suited to the manufacture of waterproof glue have been perfected, and extensive work has been done on the utilization of skim milk and buttermilk by making cottage cheese and by condensing. The manufacture of some of the hard Italian cheese from skimmed or partly skimmed milk is being studied. Milk powder, one of the newer developments in the dairy industry, is receiving attention.

The equipment and personnel available for the study of these problems are now complete and well suited to the needs of the investigations. In addition to the bacteriological and chemical laboratories, equipment is available in Washington for the manufacture on a small scale of butter, all kinds of cheese, condensed and evaporated milk and milk powder.

The farm at Beltsville, with its complete barns, dairy and laboratories, affords facilities for work on problems requiring contact with farm conditions.

It was early recognized that to complete many of the investigations it was necessary to have means of carrying them through the commercial stage before they could be given to the public. Contracts

with private institutions proved unsatisfactory in many ways, and in 1915 the work was transferred to the Grove City creamery. In addition to its value for experimental purposes and demonstration this creamery has served as a training school for field men in manufacturing work.

DAIRY CATTLE BREEDING

In 1917 an extensive dairy cattle breeding project was undertaken. The object of the work is to determine the methods of breeding that will insure the uniform transmission of large production. In the investigations, which involve a large number of cattle and will extend over a long period of years, line breeding is being compared with outbreeding, and inbreeding compared with outbreeding. The results of these experiments should furnish valuable data for determining the relative merits of these systems of breeding, since the same foundation animals will be the basis of both the inbred and outbred herds. This will make the inbred animals comparable, generation by generation, with the outbred animals. In like manner the same foundation animals will be the basis of both the line-bred and outbred herds, making the line-bred animals comparable with the outbred animals. The use for generation after generation of sires that have proved their ability to transmit uniformly high production to their daughters is also being carried out with the hope of breeding a strain that will be prepotent for high production. Experiments are also under way to determine the reliability of the "nicking" theory, and to test the increased vigor that accompanies outbreeding.

This work is the result of a long-felt need for greater knowledge of the fundamental principles of breeding. The need for this work was recognized for some time, and while experiments had been carried on from time to time by other institutions or individual breeders, such experiments were necessarily limited as to number of animals involved and duration of the experiment. It seems that the Dairy Division, with its facilities for carrying on such an experiment on an extensive scale and over a long period of years, is the logical agency to take up the work.

In 1918 herds of purebred Holsteins were gathered together at Beltsville, Md., Ardmore, S. Dak., and Huntley, Mont., and were used in the comparison of line breeding versus outbreeding and in the project demonstrating the value of the continuous use of proved sires. In 1923 thirty-eight of the Holstein-Friesian cows at Beltsville had completed official yearly records ranging from 415 to 927.8

pounds of butterfat, the average being 597.34 pounds of butterfat and 17,636 pounds of milk. In 1921 a herd of 12 purebred Holsteins was established on a dry-land farm at Woodward, Okla. Four of these cows have broken the Oklahoma State records for production in their respective classes.

A herd of purebred Jerseys was purchased and sent to the Iberia experiment farm at Jeanerette, La., for use in the project on continuous use of proved sires. Another herd of Jerseys was installed at Beltsville, where they are being used in an experiment comparing inbreeding with outbreeding. In this herd also an interesting project has been begun to determine if by mating animals from prominent Jersey families a type of animal can be obtained of greater uniformity in vigor and producing and transmitting ability than has been produced by line breeding or inbreeding within these families. Representatives of eight of the more prominent Jersey families are being mated and the third generation animals will have the combined blood of all the eight families. These representatives consist of cows from the St. Lambert, Oxford Majesty, Fauvic's Prince and St. Mawes families and bulls from the Karnak Noble, Sophie's Tormentor, Golden Glow's Chief and Owl-Interest families. Twenty-nine Jersey records have been completed to date at Beltsville, ranging from 252 to 810 pounds of butterfat with an average of 524.5 pounds of butterfat and 9,320 pounds of milk. These records included eleven 2-year old heifers.

To carry on most of these breeding experiments, proved sires are necessary. Such sires are difficult to find and when found are generally offered at prices that are prohibitive. To obtain such sires, therefore, young animals of exceptional breeding are purchased or bred and tried out for a number of years. By 1922 fifty-eight young bulls had been lent to farmers, institutions and colleges for the purpose of proving their transmitting ability for milk and butterfat production. Those proving to be unusually prepotent sires will be used in the breeding project.

Clemson College (South Carolina), University of Idaho, Washington State College, New Jersey Experiment Station, University of West Virginia, University of Maryland, Michigan Agricultural College, University of California and University of Nebraska are cooperating in the breeding experiments. Promising young bulls are lent to such colleges with the understanding that records of feed and production of all their daughters will be kept. The colleges maintain the bulls and in return obtain the progeny.

DAIRY EXPERIMENT FARMS

In 1910 the Bureau of Animal Industry purchased the farm at Beltsville, Md.,* to provide facilities for carrying on experimental work. One hundred and ninety acres of this farm were assigned to the Dairy Division and are now operated under the superintendence of T. E. Woodward. This farm has been fenced, a large portion of it drained, and the fertility greatly increased by a proper cropping system and liberal applications of manure. As a result of these improvements, land which in 1911 produced 4 tons of corn for silage per acre in recent years produced 12 tons.

Sixteen scrub cows and 1 purebred bull were purchased in 1913. Since that time cattle have been purchased from time to time until there are now 200 head of dairy cattle on the farm.

The farm also makes it possible to carry on work with various forage crops which show promise of being valuable as a dairy feed.

Experiments with silage are conducted and consist in growing different crops under various conditions, the idea being to find out the adaptability of different crops for silage. Extensive investigations have also been completed to determine the nature and extent of the losses which take place in the silo. Efforts are being made to determine the relative merits of wood and concrete as silo-building materials, to find out the best mixture to use in making concrete, and to devise means to protect the concrete from the acids of the silage.

Experiments in the care of dairy cattle included a comparison of the open-shed type of barn with the ordinary closed type and a comparison of different kinds of stable floors. An experiment to determine the influence of the different factors of the bacterial count of milk has also been undertaken. For this work a specially constructed barn was built. The stable, cows and lot are first allowed to become very insanitary, then, by gradually cleaning up, the influence of each factor upon the number of bacteria in the milk is ascertained.

By according extra feed and care, and milking three times a day instead of twice, it has been found possible to increase the production 60 per cent on the average. Stabling the cows in a box stall instead of confining them by a stanchion was found to increase production 5 per cent. Milking three times a day instead of twice resulted in a 12 per cent increase. Milking four times a day instead of twice resulted in 6 per cent more milk.

The experiments on dairy cattle breeding described under that

* See "Animal Husbandry Division," page 219.

heading are carried on largely at the Beltsville farm. The investigations on the physiology of milk secretion described under research work are also conducted there.

At the Iberia experiment farm, Jeanerette, La., experiments and demonstrations with horses, mules, beef cattle, dairy cattle and hogs are conducted for the purpose of bringing before farmers of the South the value of livestock production in the cane-sugar and cotton districts. This work, which was begun in 1914, is carried on under the direction of a committee consisting of representatives of the Bureau of Animal Industry, Bureau of Plant Industry and the Louisiana State Experiment Station. A dairy herd of grade and purebred Jerseys used in the dairy cattle breeding experiments is maintained at this farm. Experiments have also been conducted on the cost of raising heifer calves to the ages of one and two years, and on the amount of profit per cow. The suitability of various silage crops and other feeds easily grown in this section is determined through experiment.

At Ardmore, S. Dak., and Huntley, Mont., experiment farms were established in 1916 to investigate the problems encountered in establishing the industries of dairying and meat production in the semiarid and irrigated sections, particularly with reference to the effective utilization of forage and grain crops produced in those sections. At both of these farms herds of cattle are maintained for the breeding experiments outlined under that heading and for feeding experiments in connection with the crops grown in the localities.

In 1921 the Dairy Division was authorized to take over a farm of 160 acres at Woodward, Okla. A herd of 12 purebred Holstein cows and 1 Holstein bull were placed on the farm. Methods of establishing dairy farming on lands adjacent to Woodward are being investigated with a view to furnishing a profitable means of disposing of dry-land crops produced in the community; also problems regarding the value of various crops as dairy feeds are under investigation.

DAIRY ENGINEERING

Architectural and engineering work was begun in the Dairy Division in 1905, and consisted of the study of the best designs and construction of dairy buildings, including dairy barns, silos, milk houses, creameries, milk plants, cheese factories, etc. At the beginning of 1911 an engineer was appointed and this work has been extended to include equipment, sanitation, water supply and the application of electricity, steam and refrigeration to the dairy industry. While the

architectural work has been transferred to another bureau, the engineering work required for the experiment stations and for the research laboratories of the Division is still being continued, and includes not only the design, construction and equipment of buildings for the Dairy Division but also the preparation of bulletins and answering of correspondence relative to engineering subjects concerning the dairy industry.

DAIRY STATISTICS

In 1915 a study of dairy statistics was begun and has been continued up to the present time. Figures on the production, consumption, imports, exports and prices of dairy products in all countries were compiled and prepared for convenient reference. Studies of the trends of the dairy cattle industry, the butter industry and the cheese industry were made and the results published in bulletin form. The statistics are kept up to date and given to the public from time to time in the form of charts, bulletins and news items.

SUMMARY OF IMPORTANT EVENTS

- July 1, 1895. Dairy Division organized in the Bureau of Animal Industry. Major Henry E. Alvord appointed first Chief, with one assistant and two clerks.
- May 5, 1897. Experimental exports of butter begun for the purpose of building up a market for United States butter in foreign countries.
1899. Experimental exportations of butter extended to England, France, Germany, China, Japan, Hawaiian Islands and Philippine Islands.
1900. Study of dairy sanitation begun and data compiled on milk supplies of 200 cities. Dr. R. A. Pearson inaugurated this work.
1900. A dairy exhibit prepared by the Dairy Division and shown at the Paris Exposition was awarded the Grand Prix and other prizes.
1901. A dairy exhibit prepared and shown at the Pan-American Exposition, Buffalo, N. Y.
1902. Laboratory research work begun, in charge of L. A. Rogers, and a cooperative arrangement made with the Biochemic Division to use the Biochemic laboratories.
- May 9, 1902. Inspection of renovated butter factories authorized, to take effect July 1, 1902, and inspection work begun.
1902. First work done on inspection of butter purchased for the United States Navy.
1904. A dairy exhibit was prepared and shown at the Louisiana Purchase Exposition, St. Louis.
- Oct. 1, 1904. Major Alvord, Chief of the Division, died at the Louisiana Purchase Exposition, St. Louis.
1905. Cooperative arrangements made with State experiment stations for investigational work in their laboratories at Storrs, Conn., Madison, Wis., Columbia, Mo., and State College, Pa. This work was discontinued in 1912, except at Pennsylvania.

1905. Market milk investigations organized and C. B. Lane placed in charge.
1905. Appropriation of \$20,000 for southern dairy development work included in the agricultural bill.
1905. Work begun to collect information on bacteria found in milk, and methods of studying them.
1905. Southern dairy development work begun in North Carolina, Tennessee, Mississippi, Texas, South Carolina and Georgia.
1906. Equipment of the experimental laboratories commenced, and independent laboratories established on B Street S. W., Washington.
1906. Milk and cream contest work begun.
1906. Dairy manufacturing investigations organized, with B. D. White in charge.
1907. Field work with individual creameries inaugurated.
1907. A project to demonstrate the value of dairying in increasing the fertility of the soil begun at the Denison, Texas, demonstration farm.
1908. Cooperative cow-testing association work inaugurated and one worker, Helmer Rabild, assigned to the project.
1908. First students' national contest in judging dairy cattle held in connection with National Dairy Show. (Contest organized in 1907.)
1908. First equipment for making whey butter installed by a Wisconsin cheese factory, as a result of dairy manufacturing extension work.
- Spring, 1908. The experimental laboratories and the entire Dairy Division moved from 1358 B Street S. W. to the east wing of the Department of Agriculture building.
- Sept. 1910. A community development project organized at Algona, Iowa, to raise the economic status of the community through dairying.
1910. Farm of 190 acres at Beltsville, Md., acquired for experimental purposes.
1910. Extension work in Pacific Coast and Rocky Mountain States begun, to promote better methods of dairying and introduce it in newly settled regions.
- March 5, 1912. Dairy work in the boll weevil sections of Mississippi begun and one man assigned to the work with headquarters at Brookhaven.
1912. Studies begun at Beltsville farm on the effect of various feeds on the flavor and odor of milk.
1912. The first systematic work on milk-plant economics inaugurated.
- March 1913. Branch office at Salt Lake City, Utah, established.
1914. Cooperative work on livestock demonstrations in the cane-sugar and cotton area of Louisiana begun on the Iberia experiment farm, Jeanerette, La. This work is conducted under the direction of a committee composed of representatives of the Bureau of Animal Industry, the Bureau of Plant Industry and the Louisiana State Agricultural Experiment Station.
1914. Investigations on milk-condensing problems begun.
1914. An item of \$25,000 included in the tick eradication appropriation, for carrying on dairy work in the tick-freed area of the South, and work begun.

- October, 1914. Cheese factory extension work begun in the mountain sections of the South.
- Spring, 1915. First cooperative cheese factory in the southern mountain section organized at Cove Creek, N. C.
- July 1, 1915. One man assigned to work of organizing cooperative bull associations.
1915. Investigations commenced on the requirements and cost of producing market milk in seven representative dairy sections of the United States.
1915. Grove City, Pa., cooperative creamery, which is used for experimental purposes by the Dairy Division, organized.
1915. Beginning of studies on the physiology of milk secretion under direction of Dr. E. B. Meigs.
- July 1, 1915. Metabolism studies with dairy cows commenced at State College, Pa., under direction of Dr. H. P. Armsby. Completed in 1920.
1916. Dairy experiments in the semiarid and irrigated districts begun at the Ardmore, S. Dak., and Huntley, Mont., experiment farms, in cooperation with Bureau of Plant Industry.
- Sept. 1, 1917. An extensive breeding project, in charge of R. R. Graves, begun for the purpose of determining the best method of breeding for obtaining the higher-producing dairy cattle in large numbers.
1918. A nation-wide campaign for utilization of skim milk as cottage cheese inaugurated.
- Sept. 4, 1917. Name of dairy farming investigations changed to dairy extension, and all extension work was put under latter section.
- Spring, 1919. First campaigns organized for better utilization of milk and dairy products.
- July 1, 1920. A large part of the dairy extension work discontinued, due to curtailment of funds.
1920. Authorization by Congress for the Dairy Division to establish a dairy at Woodward, Okla., to demonstrate methods of dairy farming in that section.

PERSONNEL OF THE DAIRY DIVISION.

Division Chiefs:

- MAJOR HENRY E. ALVORD, July 1, 1895, to October 1, 1904.
 ED. H. WEBSTER, Jan. 1, 1905, to Dec. 31, 1908.
 B. H. RAWL, Jan. 1, 1909, to Feb. 14, 1921.
 C. W. LARSON, Feb. 15, 1921, to date.

Assistant Chiefs:

- R. A. PEARSON, July 1, 1895, to Sept., 1901.
 HARRY HAYWARD, Sept., 1902, to Jan., 1903.
 CLARENCE B. LANE, Nov. 1, 1903, to June 30, 1909.
 C. W. LARSON, July 1, 1919, to Feb. 14, 1921.

Various chiefs of sections acted as Assistant Chiefs of Division between July 1, 1909, and June 30, 1919.

Special Employees, 1895 to 1902:

From 1895 to 1902 dairy experts were employed from time to time for special work. Among these were Prof. E. J. Wickson, of the Uni-

versity of California; V. D. Gilbert, secretary New York State Dairy-
men's Association; Levi Chubbuck, George M. Whitaker and S. M.
Tracy.

Heads of Sections.

Research Laboratories:

L. A. ROGERS, July 1, 1902, to date.

Dairy Farming Investigations (afterwards Dairy Extension):

B. H. RAWL, April 1, 1905, to Dec. 31, 1908.

HELMER RABILD, Jan. 1, 1909, to May 31, 1921.

E. V. ELLINGTON, May 31, 1921, acting to Dec. 31, 1921.

S. C. THOMPSON, Jan. 1, 1922. (Combined with Dairy Manufacturing to
form the Dairy Introduction Section).

Market Milk Investigations:

CLARENCE B. LANE, 1905, to June 30, 1909.

GEORGE M. WHITAKER, July 1, 1909, to Jan. 1, 1912.

ERNEST KELLY, Jan. 1, 1912, to date.

Dairy Manufacturing Investigations:

B. D. WHITE, July 16, 1906, to Jan. 31, 1911.

S. C. THOMPSON, Feb. 1, 1911, to Jan. 31, 1919.

WILLIAM WHITE, Feb. 1, 1919, to Sept. 22, 1920.

S. C. THOMPSON, Sept. 22, 1920, to Dec. 31, 1921. (Combined with Dairy
Farming Jan. 1, 1922, to form Introduction Section.)

Dairy Cattle Breeding Investigations:

R. R. GRAVES, September, 1917, to date.

Dairy Introduction:

S. C. THOMPSON, Jan. 1, 1922, to date

Animal Husbandry Division

After the establishment of the Dairy Division by Congress in 1895, the next development of the Bureau of Animal Industry in studying problems of animal production was suggested in December, 1897, by Director Henry Prentiss Armsby, of the Pennsylvania Experiment Station, who proposed to the Secretary of Agriculture, James Wilson, that work in animal nutrition similar to that done by Atwater on human beings be undertaken by the Bureau. His suggestion was cordially received, and the Bureau of Animal Industry undertook to assist him in developing the institution at State College, Pa., which is now known as the Pennsylvania Institute of Animal Nutrition of the Pennsylvania State College. Dr. Armsby was appointed on the Bureau rolls effective July 1, 1898. In the fall of the same year he planned for the erection of a respiration calorimeter at State College. The first work undertaken with the calorimeter was a study of the influence of age and other factors on the metabolism of beef cattle, and similar work regarding dairy cattle was taken up later. The cooperative work continued until late in 1920. A large number of bulletins and articles were published giving the results of the experiments. Armsby's work has had a decided effect on cattle feeding methods, the methods used by students in calculating energy values being largely based on his publications. Dr. Armsby died October 19, 1921.

The first step to make animal husbandry work an integral part of the Bureau of Animal Industry was taken in 1901, when Secretary Wilson suggested to Dr. D. E. Salmon, Chief of the Bureau, that an animal husbandman be appointed. Dr. Salmon offered the position of Expert in Animal Husbandry to George M. Rommel, a graduate of the Iowa Wesleyan College and Iowa State College, who was then in charge of the experimental farm of the Oregon Railway & Navigation Company at Walla Walla, Wash. Mr. Rommel accepted, and took up his duties July 1, 1901.

In January, 1905, Mr. Rommel was given the title of Animal Husbandman, and as the work under his charge grew it came to be known about 1907 as the Animal Husbandry Office. The name of the office was changed to Animal Husbandry Division by order of Secretary Wilson, effective January 1, 1910, and at the same time Mr. Rommel was given the title of Chief of the Animal Husbandry Division. He continued in that position until October 31, 1921, when he resigned from the Department.

On July 1, 1903, E. G. Ritzman was appointed as student assistant and assigned to assist Mr. Rommel. Mr. Ritzman left the Bureau in 1908.

G. Arthur Bell, a graduate of Cornell University, entered the service as Assistant Animal Husbandman February 1, 1905. Mr. Bell continued as first assistant in the animal husbandry work until his resignation from the Department, October 15, 1920.

BEGINNING OF EXPERIMENTAL WORK AND THE EXPERIMENT FARM

The first specific congressional appropriation for animal husbandry investigations was an item of \$25,000 in the Agricultural Appropriation Act for the fiscal year beginning July 1, 1904. Some of Dr. Armsby's work was done under this appropriation.

The first experimental work in animal husbandry directed from Washington was begun July 9, 1904, with an importation of Barbados sheep. These animals were sent from the quarantine station to the Experiment Station at Bethesda, Md.

On July 15, 1905, experiments were commenced with hogs, to study the effect of cottonseed meal feeding. At the time this work was undertaken the Bureau had no land which could be used specifically for this purpose, but arrangements were made to begin on a small scale at the quarantine station at Halethorp, Md., on the main line of the Baltimore & Ohio Railroad, seven miles southwest of Baltimore. Feeding experiments with poultry were begun at Halethorp on August 6, 1906.

On September 16, 1907, the pigs were transferred to a tract of land leased by the Bureau, adjoining the Experiment Station at Bethesda. The poultry followed a month later, and the work was carried on here until April 17, 1911.

The appropriation act for the fiscal year ending June 30, 1910, provided \$25,000 for the purchase of additional land for experimental purposes. After a rather prolonged search for suitable land in the vicinity of Washington, a location was found in Prince Georges County, Md., less than a mile from the Beltsville station on the Baltimore & Ohio Railroad, 11½ miles from Washington.* This farm comprises 475 acres of tillable and timber land and was purchased on June 30, 1910, for the sum of \$25,000. It was to be developed as an experimental farm to be used by both the Animal Husbandry and the Dairy Divisions. Mr. B. H. Rawl, then Chief of the Dairy Division, suggested that the most effective administration would probably

* See "Dairy Division," page 212.

be obtained by dividing the farm, placing part of it under the supervision of the Dairy Division with the superintendent reporting to the Chief of that Division, and the remainder under the supervision of the Animal Husbandry Division with its superintendent reporting to the Chief of that Division.

The first farm superintendent for the Animal Husbandry Division was Mr. H. H. Reese, who took his station at the farm on January 1, 1911. On December 1, 1912, Mr. Reese was transferred to Front Royal, Va., in charge of the Second Horse-Breeding District, and was succeeded at Beltsville by Mr. Ralph J. Carr, who was in charge of the farm until July 1, 1913, when he was succeeded by Mr. E. L. Shaw. Mr. Shaw was in charge of the farm until April 1, 1917. Mr. Shaw's successor was Mr. B. F. Brandon, a Purdue graduate, who is still in charge.

POLICIES OF THE ANIMAL HUSBANDRY DIVISION

The purpose of Secretary Wilson in encouraging animal husbandry work in the Department was, doubtless, to carry out to its fullest extent the organic act of May 29, 1884, creating the Bureau of Animal Industry. The organization of the Dairy Division in 1895 was a step in this direction. The encouragement given by Secretary Wilson to Dr. Armsby was the second step. The appointment of an animal husbandman in the Bureau was the third.

The development of the Animal Husbandry Division during the last twenty years has been directed along the lines of specialization according to the class of animals studied. It required time for this idea to be put fully into effect. It was not until 1917 that a specialist was definitely assigned to swine husbandry, although work in swine husbandry was one of the first subjects to receive attention after the Bureau inaugurated animal husbandry work. The various offices pertaining to the subject-matter lines of animal husbandry—beef cattle husbandry, horse and mule husbandry, poultry husbandry, sheep and goat husbandry, and swine husbandry—although branches of the Animal Husbandry Division and in the closest contact with one another, have a distinct entity, and the subject of animal genetics, touching every phase of animal production, is recognized on an equal footing.

The development of experimental farms has been recognized as an important feature of the Bureau work. The farm at Beltsville, Md., the Morgan Horse Farm at Middlebury, Vt., and the Sheep Experiment Station at Dubois, Idaho, are among the outstanding in-

stances of a recognition by Congress of the necessity for field stations where research work in animal production may be conducted. Such laboratories as are needed in connection with these stations were provided, notably the laboratories at Beltsville for the study of livestock problems, including genetics, wool, meats, and nutrition.

In addition to the development of experimental farms such as those just mentioned, there has been a considerable development of stations where the land, buildings, equipment and animals are provided by private individuals, such as the station at Lewisburg, W. Va., where work in beef production has been under way for ten years, and the earlier beef cattle stations in Alabama, Mississippi and North Carolina.

Among the most successful attempts at State cooperation are the beef cattle work in West Virginia, in Kansas, at Jonesboro, Ark., and the Coastal Plain Experiment Station at McNeil, Miss., which is conducted on a strictly cooperative basis with the Mississippi Experiment Station. An outstanding instance of successful cooperation with States on a broad regional basis is the soft pork project, which is carried on in cooperation with nearly a dozen experiment stations in the South and in the Corn Belt. Incidentally, the soft pork project includes not only cooperation with State authorities, but with the Association of Southern Agricultural Workers, the National Swine Growers' Association and the Institute of American Meat Packers. All hogs handled in the cooperation are slaughtered at the Beltsville farm abattoir, and each station cooperating has prompt access to the results pertaining to the work and complete freedom of action.

The Animal Husbandry Division is a research institution, the purposes of which are (1) to bring to the Bureau of Animal Industry contacts with the livestock producers of the United States, (2) to study broad regional and national problems pertaining to animal production from the standpoint of the producer, and (3) to articulate with each branch of the Department of Agriculture and with State and National organizations which may be in a position to assist in the solution of these problems.

INVESTIGATIONS IN ANIMAL GENETICS

Research work in animal genetics was begun July 1, 1906, with Dr. E. H. Riley in charge. The specific problem outlined at the beginning was a comprehensive study of the effects of inbreeding, using guinea pigs as material. The work was begun at the Experiment Station of the Bureau at Bethesda, Md., and has been continued since

1910 at the Beltsville Farm. Matings were made from the Bureau's stock, which had already been somewhat closely bred, the entire stock having descended from a small number of animals which had been transferred to Bethesda from the old location near Benning, D. C. Twenty-three separate families were started, each from a single pair, and were maintained exclusively by matings of brothers with sisters. Seventeen of these families were still on hand in 1917, when the number was reduced to permit the extension of other experiments. One of these families has now reached the twenty-fifth generation of inbreeding.

Dr. Riley resigned June 16, 1913. On September 1, 1915, Dr. Sewall Wright (Sc. D., Harvard), took charge of the work in genetics as Senior Animal Husbandman.

The history of the inbred stock as a whole in comparison with that of a control stock is described in Part I of Bulletin 1090 of the Department of Agriculture. A study of the differentiation among the twenty-three inbred families derived from a rather homogeneous foundation stock forms the subject of Part II of Bulletin 1090. Since 1916 an extensive study of the effects of crossing different inbred families has been made and has led to definite conclusions presented in Department Bulletin 1121. In these studies most attention has been paid to such characteristics as rate of growth and adult weight, fecundity as indicated by size and frequency of litters, and vitality as indicated by the death rate at birth and later.

On March 14, 1919, cooperative investigations were begun with Dr. Paul A. Lewis of the Phipps Institute in Philadelphia, for the purpose of studying the importance of heredity and inbreeding on resistance to tuberculosis. A preliminary account of the results has been published (*American Naturalist*, Vol. 55, pp. 24-50, 1921).

Other studies have been made of the heredity of such characteristics as coat color, and the production of monstrosities. Much attention has also been devoted to the development and application of biometric methods in connection with such problems as the relative importance of heredity, external environment and irregularities in development in determining variations in different characteristics and in working out the theoretical consequences of different systems of mating (according to the current theory of heredity) for comparison with those actually observed. Some thirty papers have been published in which the results of these various studies have been presented.

Since the work was begun in 1906 more than 35,000 animals have been recorded.

BEEF CATTLE INVESTIGATIONS

Reference has already been made to the fact that Congress made its first direct appropriation for animal husbandry investigations in the appropriation act for the fiscal year 1905, which contained an item of \$25,000 for experiments in animal feeding and breeding in cooperation with State agricultural experiment stations. The direction of this work was placed under the Animal Husbandry Office.

Southern Beef Production

Among the projects undertaken was the study of beef production under southern conditions. The Alabama Experiment Station was selected as the point at which these studies should begin, and a contract was made with that station effective December 7, 1904. Feeding experiments with steers were carried on at the station at Auburn for three successive winters. Soon after the beginning of the work it was felt to be desirable to conduct experiments under practical farm conditions. The farm of J. S. Kernachan in the Tennessee Valley of Alabama, near Florence, was selected, and the assistant who had been in charge of the feeding experiments at Auburn was stationed on the Kernachan farm to conduct the work and keep the records. This assistant was W. F. Ward, who remained with the Bureau for twelve years, except one year of intermission. Mr. Ward was called to Washington to take charge of beef cattle investigations January 2, 1913. He resigned from the Bureau April 5, 1917, to become manager of a large commercial cattle-raising enterprise in Florida.

Mr. Ward was succeeded on May 1, 1917, by F. W. Farley, who had been the Bureau's beef-cattle specialist in Mississippi for two years. He resigned June 30, 1919, and was succeeded by Professor E. W. Sheets, of West Virginia, who since July 1, 1918, had been employed to stimulate meat production in accordance with an Act of Congress of November 21, 1918. Mr. Sheets was designated Acting Chief of the Animal Husbandry Division at the time of Mr. Rommel's resignation, October 31, 1921. W. H. Black, a graduate of State College of Agriculture, Ames, Iowa, who was employed as beef cattle specialist by the Animal Husbandry Division and the State of Florida from June 16, 1918, to June 1, 1920, was later assigned to act in charge of beef cattle investigations. Mr. Black was transferred to the Washington office June 1, 1920, where he has devoted special attention to beef cattle investigations in the Corn Belt.

In 1907 tuberculosis wiped out the Kernachan herd in Alabama

and it was necessary to find a new location. Accordingly the farm of Cobb and McMillan, in Sumter County, Alabama, was selected. This farm is situated in the limestone alfalfa-growing section of Alabama, a natural livestock country. The work continued on the Cobb and McMillan farm until March 31, 1914, when it was discontinued. On June 1, 1914, the work was transferred to the Canton Stock Farm near Canton, Miss. On July 1, 1917, work was also begun on the farm of Hugh McIntosh near Collins, Miss.

During the fall of 1918 the authorities of the Mississippi Experiment Station proposed that representatives of the Bureau take over the direction of the work of the branch experiment station at McNeill, Miss. This station is situated on the edge of the Coastal Plain. Most of it is cut-over pine country, and the topography is that which is common to the lower part of the brown loam section of the State. It appeared to offer advantages for investigational work superior to those which had formerly been available on privately owned farms. An agreement between the Bureau and the Director of the Mississippi Experiment Station was signed February 21, 1919. Nothing was done in the way of beginning work until November 1, 1919, when S. W. Greene was transferred from the Washington office to take charge of the station, its designation being made the Mississippi Coastal Plain Experiment Station. Mr. Greene represents both the Bureau and the Mississippi Experiment Station. The studies include management, production costs, breeding up by purebred sires, parasite control, and also pasture forage crop investigations in cooperation with the Bureau of Plant Industry. The Forest Service began cooperation in a study of reforestation in its relation to pasture development and grazing in the cut-over pine regions in January, 1923.

Other work in studying livestock problems in the Coastal Plain in which this Division has been interested are the investigations on the Iberia Livestock Experiment Farm, Jeanerette, La., which the Department conducts in cooperation with the Louisiana Experiment Station, and a year's study of range cattle problems in Palm Beach County, Florida. The work in Palm Beach County began May 5, 1919, and was discontinued June 12, 1920.

Beef Production in the Appalachian Region

Beef production has always been a prominent feature of the agriculture of the Appalachian region, particularly south of New York State. In order to study problems in that section, the Division has conducted several years of cooperative work with the North Carolina

State Experiment Station. This work was begun July 9, 1913, on the farm of T. L. Gwin, Springdale, N. C., and was carried on at that point until October 1, 1919, when it was discontinued, as the problems were pretty well worked out.

On December 22, 1914, in cooperation with the West Virginia Experiment Station, work was begun on the farm of David Tuckwiller at Lewisburg, W. Va. During the first two years of the work E. A. Tuckwiller was in charge. In 1916 he was succeeded by R. H. Tuckwiller. One of these projects in the bluegrass area of West Virginia is conducted to determine the growth factors among others which influence beef production. One of the objects was to determine the influence of winter rations and the methods of wintering upon the utilization of pasture by steers the following summer. These results apply wherever bluegrass or similar fattening pastures are produced. Winter feeding for the most efficient utilization of pasture was regarded one of the problems not only of immediate but of growing importance, as it is recognized, first, that the cost of wintering the steer to be fattened on grass the following summer is approximately two-thirds of the cost of keeping him a year; and, second, because pasture in such areas is the cheapest source of beef and is becoming more and more an important factor in economical beef production elsewhere. It is, of course, probably true that the choicest beef will continue to be produced from cattle fed on grain rations made up largely of corn, yet beef will undoubtedly be produced most economically by making the best possible use of pasture. This is only one of the many factors being considered in this and other experiments with growing and fattening cattle, involving cows, calves, and steers of different ages. This work is still in progress.

Beef Production in the Corn Belt

One of the early acts of Secretary David F. Houston was to appoint a committee for the study of the meat situation. This committee was appointed in the summer of 1913 and spent much time and effort in the study of the subject. The Animal Husbandry Division cooperated with the Office of Farm Management in the prosecution of studies of beef production. After this first study was completed there was a lapse of some years. On August 15, 1919, cooperative relations were resumed with the Office of Farm Management and a study of methods and costs of producing beef cattle in the Corn Belt was begun. The object of this work was to study methods and obtain data on the fundamental basic requirements of feed, labor and miscellaneous

cost items pertaining to the various phases of beef production in the Corn Belt, and to study the relations between the beef cattle enterprise and the organization and productiveness of the farm. This work is still in progress. At the close of the winter of 1922-23, records had been obtained of more than 90,000 cattle in the States of Illinois, Indiana, Iowa, Missouri, and Nebraska.

Beef Production on Western Ranges

In January, 1919, a plan was outlined to conduct investigations in beef production on western ranges, and the work was begun with a preliminary survey in June, 1919, when the Division began a study of the methods and costs of growing and handling beef cattle in the Western range area in cooperation with the Bureau of Agricultural Economics. This work consists of an exhaustive study of ranches and farms in representative areas.

Breeding Shorthorn Cattle

One of the early projects planned by the Animal Husbandry Division, and one which requires a long time for its completion, is the study of the breeding of Shorthorn cattle to determine the relationships between milk production and meat production. On September 1, 1906, work was begun in cooperation with the Minnesota Experiment Station. A number of farms were selected in Minnesota on which herds of purebred Shorthorn cattle were maintained. The cows were milked regularly and records were kept of the milk production and feed requirements and also of the steers which became good beef animals. This work brought out interesting data from several of the herds under observation. The cooperation of the Minnesota station was discontinued June 30, 1912.

Two years later Prof. W. A. Cochel, then with the Kansas Experiment Station, outlined an Adams Fund project entitled "Sex Type as Related to Functional Development and Performance." Professor Cochel called attention to the success which had attended the Kansas State Agricultural College with its Shorthorn cattle and outlined his project with the following objects:

1. Is the milking tendency in beef cattle transmitted mainly by the dams through the male line of descent?
2. To what extent does the milk-giving function of the dam influence the beef character of the progeny?
3. By mating thickly fleshed bulls whose dams were heavy milkers and beef cows which transmit beef character to their progeny, is it possible to establish a heavy milking strain of beef cattle within a breed, the female progeny of which will be double-purpose beef and milk animals and the males strictly of the beef type? In other words, is it possible to retain the

typical beef form in the male animals and increase the milking tendency in the females?

4. Is the present standard of selecting beef cows conducive to the production of the best beef type in the breed?

Professor Cochel suggested that if the Department would furnish the foundation cows the station would carry the maintenance expenses. Congress provided \$5,000 for this purpose. The project was approved May 29, 1915, and the money became available July 1 of that year. Professor Cochel and W. F. Ward selected from the leading herds of the Corn Belt twenty heavy milking, thick fleshed Shorthorn cows. While the original cows were selected as nearly as possible from heavy milking dams and as good milkers themselves, they were selected primarily on account of their conformation to modern Shorthorn standards, and it was said of them by good judges that they made one of the best foundation herds of Shorthorn cows which had ever been assembled in the United States. These cows were bred to the college herd bull, which was an outstanding sire of Shorthorn steers and whose dam was a heavy milker. The calves produced have been raised by nurse cows and hand feeding. The foundation cows have been milked and accurate records have been kept of their milk production and feed consumption. Several steers and bull calves from this herd have shown unusual merit and some have been prize winners at livestock shows. Envious Dale, a son of College Emma, with a milk record of 7,061.5 pounds, was first prize junior yearling steer at the International Livestock Exposition held at Chicago in 1919. Several bull calves have been sent to other herds for breeding purposes, and a number of the heifers produced have been found good enough to replace cows in the breeding herd. Six of the cows in the herd have been accepted by the American Shorthorn Breeders' Association for its Registry of Merit. Some of the cows have produced more than 10,000 pounds of milk in one year.

CERTIFICATION OF PEDIGREES

To foster the development of our animal industry the United States Government has encouraged the free importation of animals intended for breeding purposes. One of the earliest tariff acts on the statute books is that of February 27, 1793, which provided "that the several laws of the United States, imposing duties on goods, wares, and merchandise imported into the United States, so far as they may be deemed to impose a duty on horses, cattle, sheep, swine, or other useful beasts imported into the United States, for breed, shall be repealed."

Except for four years, from May 16, 1866, to July 14, 1870, every tariff law enacted since that time has placed breeding animals on the free list. The Tariff Act of July 14, 1870, required the submission to the Secretary of the Treasury of satisfactory proof of pure breeding. This remained unchanged for twenty years, until the passage of the McKinley Tariff Act, October 1, 1890. The Tariff Act of March 3, 1893, provided "that the Secretary of Agriculture shall determine and certify to the Secretary of the Treasury what are recognized breeds and purebred animals," under the provision of the McKinley Act then in force. When the Dingley Act was passed, July 24, 1897, this provision was included in the paragraph regarding the importation of animals for breeding purposes.

On October 14, 1904, the Bureau published B. A. I. Order 130, prescribing regulations for the certification and supervision of books of record and pedigree record associations. Seventeen amendments to this order were issued, and on June 20, 1906, it was superseded by B. A. I. Order 136, to which twelve amendments were made.

Up to 1910 the Department recognized both foreign and American pedigree record associations. Early in 1910, however, owing to a ruling of the Solicitor of the Department that the Secretary was not authorized to recognize American pedigree record associations, because the law applied only to importations, the recognition of American pedigree record associations was withdrawn. Accordingly, B. A. I. Order 175 was issued November 25, 1910, to replace Order 136 and to take effect January 1, 1911. This order provided that the pedigrees of all animals imported for breeding purposes under the provisions of the tariff law should be submitted to the Department of Agriculture and checked with the records, the description in the pedigree certificate compared with the description of the animal obtained by the Government official, usually an inspector of the Bureau of Animal Industry, at the port of entry, and a certificate of pure breeding issued when all papers were found to be satisfactory. This order was published shortly after the Canadian Government had passed its act creating the Canadian National Records, and it signaled the determination of the authorities of the United States Department of Agriculture to have nothing to do of a regulatory character with pedigree record associations unless there was a strong popular demand for it. Six amendments were issued to B. A. I. Order 175. On January 18, 1912, it was superseded by B. A. I. Order 186, of similar tenor, to which four amendments were issued.

Prior to the passage of the Underwood Tariff Act of October 3,

1913, the law provided that the Secretary of Agriculture should certify to the Secretary of the Treasury what are recognized breeds and purebred animals. The Treasury officials were not interested in having the certifications of the Secretary of Agriculture, and nothing was gained by this requirement. The Act of 1913 gave direct authority to the Secretary of Agriculture to recognize breeds and books of record. Accordingly, B. A. I. Order 206, bearing date November 11, 1913, was issued, only horses, dogs and cats being recognized. Four amendments to this order were issued before the passage of the Emergency Tariff Act of 1921. With the passage of this act, under date of May 27, 1921, cattle and sheep became dutiable and it became necessary to restore these breeds and their records to the recognized list, and Amendment 5 to B. A. I. Order 206 was issued, effective on and after July 15, 1921, placing various foreign books for cattle and sheep on the recognized list. On October 4, 1921, the Canadian National Records were recognized for foxes as well as other animals.

The Solicitor of the Department early in 1922 rendered an opinion that the Secretary may legally recognize American studbooks in connection with the administration of the provisions of the Tariff Act. Inasmuch as such recognition relates only to importations, the Bureau considers the recognition of American societies only in connection with actual importations of animals, and when the requirements of the Bureau in connection therewith are fully met.

With the passage of the Tariff Act of 1922, which became effective September 22, 1922, B. A. I. Order 278, dated October 9, 1922, was issued. The provisions of this order are similar to those of the previous order governing the recognition of breeds and purebred animals imported for breeding purposes under the provisions of the Tariff Act of October 3, 1913, except that books of record for cattle, sheep and hogs were added and the recognition of the Canadian National Records for black and silver foxes was withdrawn. Amendment 1 to B. A. I. Order 278 became effective January 10, 1923.

HORSE AND MULE INVESTIGATIONS

The Division's work in horse husbandry was begun during the fiscal year beginning July 1, 1904, when the first direct appropriation for animal husbandry investigation became available. This appropriation was obtained largely through the activity of E. H. Grubb, of Carbondale, Colo., and W. L. Carlyle, then connected with the Colorado Experiment Station. In the beginning the horse husbandry investigations were conducted by the Chief of the Division. With the

Division's growth, however, it became necessary to delegate the horse husbandry investigations to others, and G. Arthur Bell was placed in charge. He continued in this position until the time of his resignation, October 15, 1920, when he was succeeded by John O. Williams, who is in charge of the work at the present time. Mr. Williams had been connected with the horse work of the Department for several years.

Breeding American Utility Horses

When the appropriation became available it was decided after some discussion to undertake studies to determine the practical utility of horses of trotting blood. At that time carriage horses were a special feature of every horse show, and some of the most notable horses in the show rings at that date were trotting bred. Some of them were Standardbred and registered. It was not the intention at the beginning to confine the breeding operations to registered stock, but to attempt to develop by suitable matings a type of horse which would be serviceable under western conditions for general purposes, the best of which would make high-class carriage horses. This work has been continued along the lines which were originally proposed, although less emphasis is now placed on the carriage feature than formerly.

The first purchase was made by Prof. W. L. Carlyle in Wyoming on December 28, 1904, and included six mares from the Diamond ranch, then owned by W. S. Rainsford of New York City. This ranch has always been famous for its horses, which are a blend of Thoroughbred, Morgan and trotting blood. The first mares purchased were in foal to a French Coach stallion, but all these colts were discarded. In February, 1905, the Standardbred stallion Carmon and 12 mares were purchased in Chicago. Carmon had been famous as one of the "Glorious Four" exhibited by Thomas W. Lawson of Boston, Mass. The mares were show mares of good type. Carmon remained in service until his death September 26, 1921, at 26 years of age.

On this foundation a stud of extremely high-class horses has been developed. Albion, the best sire yet bred in the project, was by Carmon out of Arizona, one of the Rainsford mares.

The work was carried on at the Colorado Experiment Station until July 1, 1919, when the cooperation of the station was discontinued and cooperation with the State of Wyoming was begun. The horses were transferred to the old Fort McKinney military reservation near Buffalo, Wyo. Since July 1, 1923, this horse-breeding work has been located at Laramie, Wyo., where it is being conducted in cooperation with the University of Wyoming.

Stallions have been distributed among ranchmen in Wyoming and adjoining States. The stallions used in the stud are Albion and the Standardbred stallions Wilmering and Harvest Aid. The number of mares maintained varies from 20 to 25. E. B. Krantz is the Animal Husbandman in charge of this project.

Breeding Morgan Horses

Work on the breeding of Morgan horses was begun in Vermont with the signing of a contract with the Vermont Experiment Station, September 6, 1905. The first purchase of horses was made June 6, 1906. The Vermont Experiment Station contributed the services of Cassius Peck, one of its staff, who acted as advisor in the work and continued in that capacity until his death, July 12, 1913. The barn at Burlington was ready for the horses in the spring of 1906, and the first purchase was made June 6, 1906. At the same time W. F. Hammond, a native of Vermont, was appointed Expert in Animal Husbandry and assigned to supervise the Morgan horse-breeding project.

In the fall of 1906, Joseph Battell, then owner of the American Morgan Register and a prominent breeder, informed the Department that he would be glad to donate some of his Addison County lands in the town of Weybridge, Vermont, along Otter Creek, to be used as a farm where the breeding could be carried on. He made his first donation of 280 acres on February 1, 1907. Other donations followed until the total amount reached 435 acres. On April 1, 1907, Mr. Hammond was transferred to the new location. The farm was first designated as the Battell Farm, but on account of strenuous objection from Mr. Battell the name was changed to U. S. Morgan Horse Farm. Mr. Hammond continued with the service until March 31, 1920, when he resigned. He was succeeded by H. H. Reese, a graduate of Purdue University.

On October 1, 1921, a beautiful bronze statue of a Morgan horse was unveiled at the U. S. Morgan Horse Farm, with ceremonies befitting this memorable occasion. This handsome life-size statue stands on a magnificent Vermont granite pedestal, which bears the following inscription:

1921
Given by
The Morgan Horse Club
to the
U. S. Department of Agriculture
in memory of
JUSTIN MORGAN
who died in
1821

It was quite fitting that this enduring memorial to the founder of a great breed of American horses should be unveiled by Miss Elizabeth Stillman, the daughter of C. C. Stillman, Secretary of the Morgan Horse Club. It was presented in an address by E. A. Darling, President of the Club, and received on behalf of the Department of Agriculture by Dr. J. R. Mohler, Chief of the Bureau, who has always shown a deep interest in the rehabilitation of the Morgan horse.

In June, 1923, the investigational work at the Morgan Horse Farm was organized into definite projects having the following objectives in view:

1. To develop under New England conditions a uniform type of horse suitable for general farm work, riding and driving, and to fix this type so that stallions produced will be suitable for improving the light horse stock in sections where such type is desired.

2. To test the endurance and stamina of purebred and grade Morgans and to demonstrate the proper methods of training and conditioning horses for long, severe tests.

3. To determine correlation of period of pregnancy with season of foaling, and to determine the prevalence of specific breed characters in Morgan horses, such as the five lumbar vertebræ and the effects of these characters within the breed.

The number of mares maintained at the farm is about 25, but varies slightly from time to time.

That superior Morgans are being produced is attested by the fact that the demand for surplus animals far exceeds the supply, and many have been sold at good prices for saddle purposes, and horses bred at the farm, sired by Government-bred stallions, have been conspicuous winners whenever shown in open competition, or whenever they have participated in endurance tests. The gelding Castor, by General Gates, dam by Bob Morgan, successfully participated in three of the annual 300-mile endurance rides. He was placed fourth in the 1921 ride, which terminated in Washington, and was one of the two horses which went sound on the morning after the ride was finished. The gelding Gladstone, by General Gates, dam by Troubadour, has participated in two of the rides, being awarded second prize in the 1922 ride in competition with 17 other horses. Bennington, by General Gates, a stallion produced at the Morgan Horse Farm, was champion Morgan stallion at the Eastern States Exposition, Springfield, Mass., in 1923, and Troubadour of Willowmoor, premier stallion at the farm, was champion Morgan stallion at the International Live-stock Exposition in 1919.

Military Horse Breeding

In 1910 the Secretary of War suggested to the Secretary of Agriculture that the difficulty in obtaining horses for the mounted service, particularly the cavalry, was such that it seemed desirable for the Government to begin the consideration of measures designed to encourage the production of horses for that purpose. In the Appropriation Act for the fiscal year 1913 \$50,000 was appropriated by Congress to begin the work. Various public-spirited horsemen, notably August Belmont of New York, President of the Jockey Club, presented to the War Department Thoroughbred stallions to be used in this work. Notable among Mr. Belmont's donations were the stallions Henry of Navarre and Octagon. Both stallions remained in the remount work until their death. Octagon in particular proved to be a remarkable sire.

The War Department transferred these stallions to the Agricultural Department on March 1, 1912. The appropriation for the Department of Agriculture became available July 1, 1913, and the work was organized into three districts. The first district had headquarters at Middlebury, Vt., with W. F. Hammond in charge; the second at Front Royal, Va., with H. H. Reese in charge, and the third at Lexington, Ky., with Dr. R. G. Lawton in charge. Department stallions as well as the Belmont stallions were used. The work of the Department clearly showed definite possibilities for the production of horses for the mounted service by the use of properly selected sires, and the public became interested in the matter of supplying horses for the mounted service.

On July 1, 1920, an appropriation of \$200,000 became available to the Army for horse breeding, on the strength of which the Army has, through the Remount Service, placed stallions throughout the country. To avoid unnecessary duplication of work, the Department of Agriculture transferred to the War Department, on September 1, 1920, as much of the material and as many of its horses and personnel as the War Department desired.

Farm Power Studies

Early in 1919 an important project in the horse husbandry investigations, the study of farm power, was begun in cooperation with the Office of Farm Management and the Bureau of Public Roads and Rural Engineering. At the suggestion of the Department and in cooperation with the Horse Association of America, agricultural colleges and tractor and farm implement interests, a public conference

was held at Chicago to consider the whole question of the power supply for farms. The conference worked diligently for two days and drew up a report which was submitted to the Secretary of Agriculture, the essence of which was published in March, 1920, as Circular 149 of the Secretary's Office. As a result of the recommendations of the conference, the Secretary appointed a committee on January 16, 1920, which has been designated the Farm Power Committee. This committee at present is composed of Dr. H. C. Taylor, Chief of the Bureau of Agricultural Economics, Chairman; E. W. Sheets, of the Bureau of Animal Industry, and Thomas H. McDonald, Chief of the Bureau of Public Roads.

A survey was made in the Corn Belt in 1920 to study the relative efficiency of horse-drawn and tractor-drawn machinery and in the winter wheat belt in Oklahoma, Kansas and Nebraska in 1921. This work was conducted with the assistance and advice of the State agricultural colleges in the respective States visited and is not yet completed.

Zebra Hybrid Breeding

One of the projects of the Animal Husbandry Division which at the time attracted considerable attention, and in which certain interesting scientific and practical results were obtained, was the experiment of crossing Grévy zebras with mares and asses, which was begun in the spring of 1905. The original Grévy zebra Dan, a beautiful specimen which had been presented to President Roosevelt by the King of Abyssinia, was transferred from the National Zoological Park to the Bureau Experiment Station in the fall of 1906, and, with other Grévy zebras procured later, was used in the breeding. The experiment was described in the *American Breeders' Magazine*, volume 4, No. 3, published at Washington, in 1913. The project was terminated June 30, 1913, when the mare hybrid Juno and the male zebra Jerry were turned over to the National Zoological Park. One ass hybrid had previously been turned over to the Park, and the other ass hybrids had been sold to circus organizations for exhibition in their shows.

POULTRY INVESTIGATIONS

The importance of the poultry industry was recognized by the authorities of the Bureau of Animal Industry before the appointment of a poultryman. A number of Farmers' Bulletins had been written by various persons. When animal husbandry activities began to develop in the Bureau, work with poultry was soon taken up. The first Assistant Animal Husbandman appointed, G. Arthur Bell, undertook

as his first task the preparation of a bulletin on poultry management, which was issued as Farmers' Bulletin 287 and has enjoyed long popularity and a large distribution.

Investigations in poultry breeding figured in the first work done under the appropriation for the fiscal year 1905. The Maine Experiment Station had attracted a great deal of attention with its studies of poultry breeding, and the Bureau offered its cooperation. The station accepted, and the cooperation was begun August 1, 1904, and continued until June 30, 1913. A poultry assistant was appointed July 16, 1906, in the person of Rob R. Slocum, a graduate of Cornell University. Mr. Slocum continued in charge of the poultry work up to December 31, 1911, when he resigned. He was reappointed August 5, 1914, as scientific assistant, and again resigned October 11, 1921. He re-entered the service of the Department in the Bureau of Agricultural Economics, where he is now Assistant in Poultry Marketing. During his service in the Bureau of Animal Industry Mr. Slocum wrote several publications which attained wide popularity, notably the series of Farmers' Bulletins on Standard Varieties of Chickens.

On April 18, 1910, Harry M. Lamon, of New York, entered the service as Junior Animal Husbandman in Poultry Husbandry and was immediately assigned to the field in Kansas, to study the possibility of improvement in methods of handling eggs on the farm so as to prevent loss in storage and in transit. Two years' work was done in Kansas by Mr. Lamon and his associates, and the outcome has been the development of the trade in infertile eggs throughout the United States. Two bulletins were published, B. A. I. Bulletin 141, "The Improvement of the Farm Egg," and B. A. I. Bulletin 160, "The Care of the Farm Egg." Extensive studies were also made at this time at the poultry fattening stations of Kansas, the results of which were published in B. A. I. Bulletin 140, "Fattening Poultry," and Department Bulletin 21, "Commercial Fattening of Poultry." On June 1, 1912, Mr. Lamon was called to Washington to take charge of the Division's work in poultry husbandry. He continued in charge until February 28, 1922, when he resigned to take up commercial poultry work. Alfred R. Lee, who had been associated with the Bureau's poultry work for several years, was the acting head of the poultry work from the time of Mr. Lamon's resignation until July 1, 1923, when Dr. M. A. Jull was appointed Senior Poultryman and placed in charge of the poultry investigations.

Poultry Breeding

Experiments in poultry breeding and feeding on a large scale have been carried on at the Beltsville Farm beginning in 1912, when Mr. Lamson began with entirely new stock. Two thousand laying hens are maintained there and four thousand or more chicks are hatched annually.

At the inception of the breeding experiments the policy was adopted of mating only birds that displayed qualifications under the American Standard of Perfection, and it was decided that the selection of the birds kept for breeding purposes should be made not only in accordance with their conformation to breed type, but according to utility for egg production as well. The success of this policy and of the work which has been done at Beltsville has been demonstrated repeatedly at the leading shows of the country. Birds of the Single Comb White Leghorn, Single Comb Rhode Island Red, Barred Plymouth Rock and Dark Cornish breeds exhibited at the Madison Square Garden Show have been good enough to win in the open classes if they were shown in competition. Many of the male birds shown, particularly of the White Leghorns, are out of 200-egg hens and have 200-egg hens for granddams. A record is kept of each individual produced, together with the necessary data concerning weight, growth and other peculiarities.

Experiments are being conducted in which the effects of close inbreeding on egg production are being studied. Two years' work has been completed in the study of the selection of fowls by external characters, especially late molting. Stock is produced from these specially selected birds, and a big improvement has been made by this method of selection without the use of trap nests.

A laboratory building has been erected and the necessary equipment purchased to begin experiments in the incubation of eggs by calorimeter studies, in which all changes occurring in eggs during incubation will be obtained. The primary need for this work is to find out why so many chicks die in the shell during incubation.

One of the features of the poultry breeding work at Beltsville has been the development of the Lamona breed, named, with the approval of the Secretary of Agriculture, for its producer, Mr. Lamson.

Poultry Feeding

In the fall of 1912 the Division began experiments at Beltsville to note the effects of feeding on egg production, using 6 pens of 30 pullets each. The object of these tests was to find out what feeds gen-

erally available on farms throughout the country would give the most economical production when combined in simple rations. The Division has also tried out at different times a number of feeds which are waste by-products or grains that are relatively cheap products in certain sections of the country. The poultry-feeding investigations have grown steadily each year until they are now carried on with 32 pens of 30 fowls each. These tests have yielded an abundance of data on the amount of feed required to produce a dozen eggs both for the general-purpose and the egg breeds. Extensive experiments also have been conducted with high vegetable and animal protein feeds, to determine the relative values of these feeds for poultry, including the use of various commercial milk products. These animal protein feeds are the most expensive part of the poultry ration and add very materially to the cost of feeding.

*Vitamin Studies**

In the summer of 1922 this Division began its cooperation with the Biochemic Division in studying the vitamin content of poultry and eggs. It is expected that the results of these studies will be published during the coming year.

Pigeon Breeding

A small loft of pigeons for squab production was purchased in 1918 and this work has been increased so that it now includes four lofts, one of each of the most popular breeds used in squab breeding work. Extensive data have been obtained on the cost of producing squabs, the best feeds for squab production, and the average returns which a loft will produce. A loft of Racing Homing pigeons was built up during the late war, in which birds making very excellent records in competitive flights were produced, one of the birds flying from Chicago to Washington making the best record in speed for a long-distance flight that has ever been made in this country. This Racing pigeon loft has been materially reduced since the close of the war, but a small breeding nucleus of the best stock has been retained.

Poultry Studies in the Southwest

In the appropriation act for the fiscal year 1914 appeared an item of \$2,500 for experiments in the feeding and breeding of ostriches. For some years previous to that time the ostrich industry had been carried on in the Southwest, especially in Arizona, but it showed decided signs of decadence, and Congress listened to the appeal for

* See "Biochemic Division," Page 174, and "Animal Husbandry Division," page 246.

studies to determine whether the industry had a place in southwestern agriculture. Arrangements were made to cooperate with the Arizona Ostrich Breeders' Association, which provided a location for an ostrich experiment station in the Salt River Valley in Arizona. The first year's work was devoted to making a study of the situation. A choice collection was made of some of the finest birds in the Southwest, and work was begun in December, 1914. It was eventually clear, however, that there were much more remunerative forms of farming in the Southwest than ostrich raising, and interest lagged to such an extent that the Division's flock was left almost "alone in the desert."

With the decline in the ostrich industry came an increasing demand for poultry investigations on the site of the ostrich station. Accordingly, work with chickens was begun at this station, and the work with ostriches was discontinued. The best of the ostriches remaining on hand were sent to the National Zoological Park, Washington, D. C.

The collapse of the cotton boom in 1920 increased tremendously the interest in the chicken industry in the Salt River Valley. The Division had sent to Arizona on July 1, 1920, Nat. E. Luce, who gave material assistance to those farmers interested in poultry raising in the community and carried out experiments at the station, the results of which were eagerly studied by poultrymen.

In the winter and early spring of 1921 the people in the vicinity of Glendale, Ariz., raised a fund of \$2,500 to buy 10 acres of land near that town to be used as a permanent United States Poultry Experiment Station. The Glendale citizens promptly proceeded with plans for the celebration of "Chicken Day" on May 20, 1921, when the deed to the land for the new station was tendered to the Department representatives. Some of the buildings on the first location were transferred to this new station, and a well-equipped plant has now been established, where experiments are being conducted with different breeds of poultry.

A new line of work begun at this station in 1922 was the raising and management of turkeys, which work is not conducted at any other station of the Bureau. The time of laying and the production of the turkey hens, and the amount of feed consumed by the growing poults, as well as the weight of the poults, have been carefully recorded. Pedigree records are being kept on these young turkeys.

SHEEP AND GOAT INVESTIGATIONS

Sheep industry was the first branch of the Animal Husbandry Division to possess animals used in official animal husbandry investigations

directed by the Washington office. Sheep husbandry investigations as we have them today began in September, 1906, when the range sheep breeding project was commenced with the purchase of ewes to be used in cooperation with the Wyoming Experiment Station. E. L. Shaw, an animal husbandman formerly on the faculty of the New Hampshire Agricultural College and a graduate of the Ohio State University, was appointed to take charge of the sheep husbandry branch on July 1, 1907. From October 15, 1910, to October 30, 1911, he was furloughed to the United States Tariff Board and conducted the Board's investigation of the sheep industry in the range States. He was again placed in charge of the sheep and goat investigations from the latter date until his transfer of the Beltsville Farm, July 1, 1913. F. R. Marshall, a graduate of Ontario Agricultural College and Iowa State College, was in charge of the sheep and goat investigations from September 1, 1913, to April 1, 1920. Mr. Marshall was succeeded on July 1, 1920, by D. A. Spencer, the present occupant of the position, who for two and a half years previously had been the Division's sheep extension specialist in Missouri.

Range Sheep

The project in range sheep investigation was begun with the signing of a contract with the Wyoming Experiment Station on September 1, 1906. Fifty-five Rambouillet ewes and four Delaine ewes were bought in time to be bred in 1906 to leased bucks, and the Rambouillet rams were bought in June, 1907.

This was first planned to be essentially a breeding project, and until the time that the United States Sheep Experiment Station in Idaho was occupied, breeding problems were studied largely to the exclusion of problems of management and range utilization. The project was originally planned to study the possibility of developing a breed of sheep which would combine the factors for wool and mutton production and which would stand flocking in large numbers. The Wyoming Experiment Station had no range where this work could be conducted, and arrangements were made to run the sheep on the ranch of the F. S. King Brothers, near Laramie, Wyo. On June 30, 1910, the cooperation with the Wyoming Station was discontinued, but the Bureau continued the investigations on the King ranch until October 22, 1917, when the sheep were transferred to the United States Sheep Experiment Station in Idaho.

This station was established on October 30, 1915. It is located on the rolling grazing lands northeast of Idaho Falls and comprises

28,000 acres. In addition to this land, 16,650 acres of summer grazing land were set aside from public domain in December, 1922, for the use of this station. This land is about 20 miles northeast of the original area and is in the State of Montana. In the fall of 1916, V. O. McWhorter was placed in charge of the new station. Mr. McWhorter resigned September 12, 1922, and was succeeded by William A. Denecke.

Four principal lines of investigation were inaugurated: (1) The breeding of a heavy-shearing type of Rambouillet sheep, with desirable mutton form; (2) the study of the different types of cross-bred sheep for the purpose of producing that type best suited to western ranges; (3) the comparative study of different methods of supplying water on dry ranges; and (4) the production of crops on arid lands that may be utilized for the winter feeding of sheep.

Some years before the transfer of the work from Wyoming, steps were taken to begin studies of cross-breeding for range sheep production. The appropriation act for the fiscal year beginning July 1, 1914, carried an item of \$10,000 for the importation of Corriedale sheep from New Zealand. The first shipment of 9 bucks and 65 ewes arrived January 1, 1915, and were carried through the winter in California and sent to Wyoming in the early spring. This was one of the first importations of Corriedale sheep into the United States. The remainder of the importation, consisting of 12 ewes, arrived in San Francisco April 21, 1915.

In addition to the Corriedale project, crosses of Rambouillet ewes were made with bucks of the Lincoln, Leicester, Cotswold and Romney-Marsh breeds. This work was begun in the fall of 1912. One of the Lincoln bucks selected was a remarkable individual, known on the project records as Lincoln 39. When Mr. Marshall took hold of the project in the fall of 1913 he conceived the idea of using the offspring of this buck and Rambouillet ewes to determine the possibility of improving on the methods ordinarily used by range sheep men in cross-breeding. The selection in three crosses showed a definite type, which, of course, increases in uniformity with each succeeding mating. The name Columbia has been given to these sheep.

The grazing studies were begun so recently that definite results are not yet available. However, it has been found that the 17,000-acre fenced area on the station has been reseeded and is furnishing much more feed than the unfenced range outside.

Watering the sheep on the range is also being studied. The water supplied to the sheep during the spring, fall and winter, when they

are kept on the station reserve, is taken largely from the well at the main headquarters. Records are kept of the amount supplied to the livestock and of expense of utilizing dry range by fencing and artificial watering.

The experiments in crop production on arid lands has been confined largely to sunflower production. In 1920 thirty acres of sunflowers were produced and stored in a silo. The silage was fed to a range band of ewes with very good results. The first year of experience in the production and feeding of sunflowers on the high, arid land at the station indicates that sunflowers are an efficient and economical crop under those conditions.

Farm Sheep

In November, 1909, E. L. Shaw, who was then in charge of sheep and goat investigations, selected from the Huntleywood flock of Sir George Drummond in Canada, which was regarded as one of the best of the breed in North America, 29 purebred Southdown ewes and 1 ram to establish a flock of sheep at the Morgan Horse Farm, Middlebury, Vt. These ewes were mated with two rams at the Huntleywood farm and with the ram Babraham Hercules purchased there. The Division's flock has sustained the reputation of the parent flock. In 1917 a wether bred in the Morgan Horse Farm flock was grand champion of all breeds at the International Live Stock Exposition, and since then, in 1918 and 1920, two grand champions have been fitted from this flock.

On November 26, 1915, 43 Southdown ewes were shipped to Beltsville from the Morgan Horse Farm, and subsequent shipments were made in 1918 and 1920. In August, 1920, the remainder of the Southdown flock, consisting of 15 ewes and a ram, was transferred to the Beltsville Farm, and the Morgan Horse Farm flock was continued as a grade flock, Southdown and Shropshire bucks being used on ewes selected from western stock.

The sheep breeding work of the Beltsville Farm, designed to study the possibilities of farm sheep production under intensive conditions, was commenced in 1916. Approximately 100 acres of the farm were set aside for the sheep studies, and have been designated "Sheep Acres."

The Beltsville flock was at first exclusively Southdown except for the Barbados and Karakul projects, which will be mentioned later. In 1919 eight Shropshire ewes were added and in 1920 four Hampshires were purchased from the McLaughlin flock in West Virginia,

and six Corriedales were sent from the Sheep Experiment Station via the Morgan Horse Farm. Further additions were made to both the Shropshire and Hampshire flocks at Beltsville during the summer of 1921, when 12 imported Shropshire ewes of Cooper and Duke of Westminster breeding, selected from the Glimmerglen Farms flock at Cooperstown, N. Y., 12 imported Hampshire ewes selected from the flock of Lowell Huntington, Oneonta, N. Y., and 10 Hampshire ewes selected from the flock of Earl D. Brown, Ilion, N. Y., together with a Hampshire ram imported from the famous flock of Alfred Blackwell, were purchased for use at that station. An imported Shropshire ram bred by the Duke of Westminster and an imported Southdown ram bred by Sir Jeremiah Colman were added to the Beltsville flock in 1922.

Karakul Sheep

The production of Persian lamb fur in the United States presents commercial possibilities. Karakul sheep, in addition to their fur value, appear to have great resistance to drought and severe climatic conditions, especially in arid regions, and many authorities believe that they would be extremely valuable to use in the improvement of the native sheep of the Southwest.

In 1909 fifteen head of Karakul sheep were imported into the United States from Bokhara, Asia, by Dr. C. C. Young, then of Texas. The results obtained with these sheep and their descendants and with others imported in 1913 and 1914 have made it appear that the production of Persian lamb fur can be made a profitable commercial enterprise in the United States.

On account of the difficulty of importing Karakul sheep in sufficiently large numbers, the future of the industry in this country will depend largely on the results obtained by mating Karakul rams with ewes of our native breeds.

Recognizing this fact, the Animal Husbandry Division began experiments in 1911 planned to show the value of lambs by Karakul sires out of dams of a number of well-known breeds. This project also included the rearing of stock from successive matings of Karakul sires with ewes having various proportions of Karakul blood. Serious delays were occasioned by the fact that the Division owned none of the Karakul sires used. In 1911 and 1912 two crops of half-bred Karakul lambs were born and two sets of three-quarters-bred Karakuls were born in 1913 and 1914. All but four head of the sheep retained in the experiment were lost through the burning of the barn at the Experimental Farm at Beltsville in March, 1915.

Barbados Sheep

The first project of the Division in animal breeding began with the importation on July 9, 1904, of four ewes and one buck from the Island of Barbados in the West Indies. These sheep were brought to the attention of the Department by Sir Daniel Morris, then Imperial Commissioner of Agriculture for the West Indies. They were represented as being extremely prolific and producers of mutton of very fine quality. After being kept during the summer at the quarantine station at Athenia, N. J., the sheep were sent to the Experiment Station at Bethesda, Md., arriving there on October 19, 1904, and were kept there until transferred to Beltsville, Md., in April, 1911. One of the first crosses made with these sheep was with Delaine Merino ewes purchased in Ohio. After the Southdown flock was established at Beltsville, a definite project was undertaken to blend these crosses with down blood, and to cross Southdown and Barbados sheep directly. The project had for its object the development of a breed of sheep similar to the Southdown in conformation, with the fecundity of the Barbados and the habit of breeding at any time of the year. The project was well on the road to successful completion when the loss of the sheep barn at Beltsville by fire in March, 1915, caused the destruction of practically all the sheep in this project as well as in the Karakul project.

Wool Studies

Another project of importance at the Beltsville Farm in connection with the sheep investigations is the studies of wool. At each shearing a 12-ounce sample of wool is taken from the side of the fleece. These samples are sent to the laboratory at Beltsville, where each one is scoured by an original process and the net yield of scoured wool determined. Separate determinations of grease and dirt content are also made. This work is done for its genetic value. It is believed that the wool laboratory at Beltsville is the only one of its kind in existence and that the Division's records on net yields of wool and separate percentages of grease and dirt are the first of this sort to be obtained on a large experimental scale.

Goats

In the Department Yearbook for 1898 Captain Almont Barnes, then connected with the Bureau of Statistics of the Department of Agriculture, published an article on the Angora goat. This article attracted so much attention that the Department soon became somewhat

embarrassed for means to answer the correspondence resulting from it. Someone suggested to George Fayette Thompson, Editor of the Bureau of Animal Industry, that he undertake the task of handling this correspondence. It was only a short time until the Department discovered that Mr. Thompson was rapidly becoming known as an authority on Angora goats. He served on the jury for sheep and goats at the Louisiana Purchase Exposition in 1904.

It was only natural that Mr. Thompson should be drawn into the field of the milking goat, and here, too, he made his influence felt. In 1905 he was commissioned by the Department to proceed to Europe to select a flock of milk goats for the inauguration of investigations by the Department. The result of his journey was the ill-fated importation of Maltese milk goats, all of which were eventually destroyed.* There is reason to believe that the consumption of milk from these goats on the voyage was responsible for Mr. Thompson's untimely death in January, 1906.

The Division maintains at the Beltsville Farm a small flock of milk goats. These goats are bred up from a foundation of native stock, obtained in the hills of Alabama and other Southern States in 1909. The first stock was sent to the Experiment Station at Bethesda, and was transferred to Beltsville with the rest of the stock in April, 1911. Some hope was held out that it might be possible by selection to develop a profitable milking breed of goats from native material, but this was found to be too slow, and after two years' experimentation of this sort, purebred Saanen and Toggenburg bucks were used in grading up the native material on hand.

At present the Bureau's herd consists largely of does having seven-eighths and fifteen-sixteenths blood of the pure breeding. A few of the younger does are thirty-one thirty-seconds pure, which is the purity required for registration as an American purebred milk goat. The grading up has resulted in increased milk production, and there is a great demand for does of the Bureau's herd. The milk is being used primarily for studies of its use in the diet of infants and invalids.

SWINE INVESTIGATIONS

Swine husbandry investigations were begun July 15, 1905, at the Bureau's quarantine station at Halethorpe, Md. For several years the swine investigations were largely confined to studies in feeding. Attention was given to the effect of cottonseed meal in pig feeding. One of the most interesting facts discovered was the resemblance between cottonseed poisoning in pigs and beriberi in human beings.

* See "Pathological Division," page 67, and "Quarantine Division," page 135.

The work in swine husbandry was under the personal supervision of the Chief of the Animal Husbandry Division, until April 1, 1918, when E. Z. Russell assumed charge of the swine investigations. His first task was to establish a purebred herd at the Beltsville Farm, and to broaden out the work to include studies in breeding and management as well as studies in feeding.

The herd of hogs at Beltsville includes first-class representatives of the Poland China, Chester White, Duroc Jersey, Hampshire and Tamworth breeds.

Swine Breeding

Experiments in swine breeding are being conducted for the purpose of determining the value of purebred sires when used on sows of inferior breeding and scrub sows from the standpoint of gains in weight from the usual hog feeds. Another line of experiments is to determine the effects of close inbreeding among hogs on the size and vitality of litters and on the feeding qualities of the progeny. This work is being conducted at the Experiment Farm, Beltsville, Md.

By-products of Fisheries

The experimental work on fishmeal as food for swine, which was begun on January 19, 1915, developed information of much practical importance to the swine industry, particularly in States adjoining the sea coast. These investigations show that fishmeal has a value equal to that of tankage as a corn supplement, and that the common practice of using fish waste solely as fertilizer does not return the fullest possible value of this product. The work was conducted in cooperation with the Bureau of Chemistry of this Department and the Bureau of Fisheries of the Department of Commerce. New sources of supply have been discovered and the investigations have been broadened to include a great variety of forms of fishery by-products which might be used for pig feeding, including shrimp cannery wastes. Experiments at the Beltsville Farm have proved that fishmeal does not impart a fishy flavor to the pork.

Soft Pork

The cause of soft pork is a problem of great economic importance to swine producers in some sections of the country. To enable the Division to take up the study of the subject and determine if possible how to obviate the objectionable features occasioned by lack of firmness of carcasses in some market hogs, Congress provided \$20,000 in the Appropriation Act for the fiscal year 1920. This fund became

available July 1, 1919, and steps were taken without delay to organize the work on a national scale. The Division asked and obtained the cooperation of the State Agricultural Experiment Stations in North Carolina, South Carolina, Georgia, Alabama, Mississippi, Louisiana, Texas, Oklahoma, Arkansas, Kentucky, Indiana and Pennsylvania, also the Association of Southern Agricultural Workers, the National Swine Growers' Association and the Institute of American Meat Packers. Arrangements were made for complete chemical studies in the laboratories at the Beltsville Farm, and all hogs used thus far in the experiments at the cooperating stations have been shipped to the Beltsville abattoir for slaughter and examination.

Three main questions are involved in this work: (1) Can hogs that have been made "soft" by feeding peanuts, rice meal or soybeans be made "firm" by changing the feed to corn, tankage, barley, cottonseed meal or some other feed? (2) Can soft-pork-producing feeds be fed in limited quantities and supplemented by other feeds so as to produce a firm, marketable carcass at slaughtering time? (3) Do so-called soft hogs show a greater or less dressed percentage when slaughtered than firm hogs, and will the meat from these hogs show a greater or less shrinkage in the processes of curing, smoking and storage than firm hogs?

At a meeting of representatives of the agencies cooperating in the soft-pork investigations, held in Atlanta, Ga., April 24, 25 and 26, 1923, the following statement was formulated and adopted for issuance to the press on May 15, 1923:

Three years of continued investigation of the soft-pork problem by the North Carolina, Georgia, Mississippi and South Carolina Experiment Stations in cooperation with the United States Department of Agriculture showed that when hogs started at a weight of approximately 100 pounds were fed on peanuts for a period of 60 days a soft carcass was produced, and that it was impossible to produce a hard carcass by feeding corn and tankage or corn and cottonseed meal to these soft hogs for a subsequent period of 60 days.

Since the four years' work has been summarized the results show that 100-pound pigs softened on peanuts during a period of 60 days are made firmer by subsequent feeding of hardening feed. However, it is yet impossible from these data to recommend a practical method of producing a strictly hard carcass from such hogs.

*Vitamin Studies**

Investigations have been carried on jointly by the Animal Husbandry and Biochemic Divisions since July 12, 1923, to determine the effects of feeds on the vitamin content of the flesh and edible viscera of hogs.

* See "Biochemic Division," page 174, and "Animal Husbandry Division," page 237.

Preliminary investigations have been made to determine the variety of vitamins present in the flesh, fat and organs of hogs through the examination of samples of meat and tissues obtained at the abattoir at Beltsville, Md.

*Immunization of Sucking Pigs**

The Animal Husbandry Division has cooperated with the Biochemic Division since November 21, 1922, in hog cholera research to determine the minimum and most favorable age at which swine can be successfully immunized against hog cholera by the serum-virus treatment and the duration of such immunity; the effects of immunization at different ages on young pigs in their growth and development.

In addition to the work being carried on at the Beltsville Farm, the studies have recently been extended to include all pigs at the following field stations: Huntley, Mont., Newell, S. Dak., Ardmore, S. Dak., McNeill, Miss., and Jeanerette, La. These pigs have been vaccinated at varying ages from less than 24 hours old to the recommended weights of 50 and 60 pounds at ages of 6 to 10 weeks. Of those pigs immunized from 4 days old to weaning ages large numbers have been subsequently tested at periods varying from 4 to 14 months, through the injection of active hog cholera virus, while untreated or "check" pigs have been subjected to similar doses.

ANIMAL HUSBANDRY EXTENSION WORK

Extension work in the Department began in the Bureau of Plant Industry. With the development of the work, however, animal specialists became necessary, and the Bureau of Animal Industry was requested to furnish men trained in animal husbandry who could be used as extension specialists and organizers of animal clubs.

The first boys' pig club in the United States was organized in 1910 in Caddo Parish, Louisiana, by E. W. Jones, Superintendent of Rural Schools, and numbered 59 boys. In 1911 the Louisiana State University appointed W. H. Balis, a graduate of the University of Illinois, to devote his entire time to club work in animal husbandry, especially to pig club organization. In the fall of 1912 Dean W. R. Dodson of the Agricultural College of the Louisiana State University requested the cooperation of the Bureau in the organization of pig clubs among the farm boys and girls of that State. This request was approved and the Bureau began paying part of Mr. Balis's salary on October 2, 1912. From the beginning made in Louisiana, animal club work

* See "Biochemic Division," page 165.

among boys and girls on farms has spread all over the United States and into foreign countries.

The Bureau of Animal Industry can not claim to be the pioneer in animal club work, as that honor belongs to the Louisiana State University. The Bureau was the pioneer, however, in the poultry club work when it sent J. W. Kinghorne, a graduate of the Maryland Agricultural College, to Virginia, March 1, 1913, to devote his entire time to the organization of poultry clubs among the boys and girls of that State.

F. W. Farley, while on the extension staff of the Mississippi Agricultural and Mechanical College, organized the first baby beef club in this country in the fall of 1914.

When the appropriation bill for the fiscal year ending July 1, 1914, was passed, the tick eradication item carried a provision for the expenditure of \$50,000 for livestock demonstration work in the areas that had been freed from ticks. This was divided evenly between the Dairy and Animal Husbandry Divisions. It inducted the Animal Husbandry Division into southern livestock extension work and resulted in the placing of what became known as beef cattle specialists in the Southern States. The first beef cattle specialist placed under the provisions of this appropriation was C. J. Goodell, a graduate of Purdue University and an Illinois livestock farmer, who was sent to Georgia December 1, 1914. After a service of some years in Georgia Mr. Goodell was transferred to Washington.

With the passage of the Smith-Lever Act and the growth of appropriations to the agricultural colleges under its provisions, Congress began to manifest a decided feeling that appropriations should not be made to "subject-matter bureaus" in the Department for the conduct of extension work. In the Appropriation Act for the fiscal year beginning July 1, 1919, the \$50,000 item for livestock demonstration work in areas which had been freed from ticks was dropped. The Animal Husbandry Division was thus left without funds to carry its southern beef cattle specialists, and it was necessary to discontinue their services June 30, 1920. The States, however, arranged to take over these men in order to continue the work.

As time went on it became apparent that still further reductions in the extension work would be necessary, and the Division was forced to choose between extension work and research work. The situation was frankly laid before the extension directors at their convention in Washington on February 2, 1921, who were told by Mr. Rommel, Chief of the Division, that it was apparent that Congress did

not seem inclined to support extension work in "subject-matter bureaus" and that it would probably be necessary to discontinue at the termination of June, 1921, the services of all extension specialists in animal husbandry and poultry husbandry then working in cooperation with the Animal Husbandry Division. It was finally necessary to take this action. Except for the small amount of work which the Division is doing in certifying the pedigrees of animals imported for breeding purposes, its efforts are now devoted to research work.

COOPERATION WITH THE BUREAU OF PLANT INDUSTRY

On September 22, 1913, Dr. W. A. Taylor, Chief of the Bureau of Plant Industry, addressed a memorandum to the Assistant Secretary, Dr. B. T. Galloway, calling attention to conferences between B. H. Rawl, Chief of the Dairy Division of the Bureau of Animal Industry, and E. C. Chilcott, in charge of Dry Land Agriculture in the Bureau of Plant Industry, concerning the advisability of cooperation in dairying at the Ardmore, S. Dak., station of the Bureau of Plant Industry. Dr. Taylor stated that there was need of work of this character not only at Ardmore but also at other points where the Bureau of Plant Industry maintained field stations, especially those for studies of dry land agriculture and western irrigation agriculture, and added that "in any case the inclusion of livestock in the agriculture will be necessary to the productivity of lands." Consequently a joint committee was appointed September 26, 1913, consisting of Mr. Chilcott as chairman, Mr. Rawl, Mr. Rommel and C. S. Scofield, in charge of Western Irrigation Agriculture of the Bureau of Plant Industry.

The committee drew plans for the inauguration of this work, and as a result of these recommendations Congress appropriated \$40,000 for the fiscal year 1917. The work was established on the dry-land station at Ardmore, S. Dak.; in the Belle Fourche reclamation project at Newell, S. Dak.; in the Huntley reclamation project at Huntley, Mont., and in the North Platte reclamation project at Mitchell, Nebr. Studies under the direction of the Animal Husbandry Division were confined to pork production at Huntley, Newell and Mitchell, and to beef production at Ardmore. The committee continued in charge of this work until March 17, 1921, since which time the work has been continued as a cooperative project between the two bureaus.

THE ANIMAL HUSBANDRY DIVISION AS AN EMERGENCY ORGANIZATION

Two features of the Animal Husbandry Division's history in emergency work are noteworthy. The first is the work conducted during

the war; the second, the relief work conducted in 1917, 1918 and 1919 to move livestock out of the drought-stricken areas of the West to farms and ranches elsewhere.

War Pork Production Campaign

The first appropriation by Congress for war work by the Department provided \$254,220 for activities intended to stimulate pork and poultry production. This appropriation became available August 10, 1917, and allowed very little time for the promulgation of a program for increasing pork production that year. It was recognized that a larger number of pigs should be farrowed during 1918 than had been produced in 1917, in order to meet the urgent needs of the United States and the allied countries. After consulting officials of the Food Administration it was decided that an increase of 15 per cent over 1917 should be asked for, which increase should be prorated among the different States in proportion to the size of their corn crops. The program was finally prepared and given to the country in time to be used during the fall breeding season. The campaign was given tremendous impetus and force through the action of the Food Administration, affecting the price of hogs, and resulted in an increase of at least 15 per cent in the number of pigs farrowed in the spring of 1918, and probably an increase of 25 per cent in the total quantity of pork and lard produced. Plans for a further increase in 1919 were carefully formulated, but the close of the war made it unnecessary to carry them to completion.

War Poultry Program

The poultry program during the war was carried out on a different basis from the meat animal programs. The first effect of our entrance into the war and the restriction on food consumption was a blow to the poultry industry. Wheat could not be used for feeding poultry, and the increase in the price of all feed caused poultry production on farms to decline seriously. The breeders of standardbred poultry were especially hard hit. Many poultrymen were left without occupation. The entire situation contributed to the success of the Bureau's campaign. The fact that so many poultrymen were unemployed gave the Bureau an opportunity to employ poultrymen of greatest skill and wide experience throughout the country, many of whom had had journalistic experience, to assist in the campaign. These men were willing to serve at small salaries, partly because many of them were out of employment, but mainly because of the opportunity to

perform a patriotic service. A poultry program was drafted without any limitation on volume of production. This program was based on the following principles:

1. Keep better poultry.
2. Select vigorous breeders.
3. Hatch the chicks early.
4. Preserve eggs for home use.
5. Produce infertile eggs.
6. Cull the flocks.
7. Keep a back-yard flock.
8. Grow your poultry feed.
9. Eat more poultry and eggs.

An organization was rapidly built up in Washington. Effective publicity was undertaken and attractive publications were prepared. The response of the country to the poultry campaign was instantaneous and effective.

The total war emergency appropriation for animal husbandry for the fiscal year 1919 was \$544,600. On account of the cessation of hostilities this money was not all needed, and \$225,167.75 was turned back into the Treasury.

Studies in Livestock Economics

After the armistice the committee of the Animal Husbandry Division which drafted the war programs was allowed to lapse. With the development of the acute situation surrounding the livestock industry on account of the depression in 1920 and 1921, it seemed desirable to revive the activities of the livestock committee. This was done at the suggestion of the Chief of the Bureau on June 24, 1921, and the committee was enlarged to include not only other branches of the Bureau but other bureaus of the Department as well.

Drought Relief Work.

The drought relief work is an example of what the National Government can do to assist private enterprise in an emergency. A drought which affected the entire Southwest, especially Texas, began in 1916 and continued without interruption until the fall of 1918. A drought in Montana began in 1918 and lasted until the fall of 1919, when it was most disastrous. Both droughts necessitated the sacrifice of cows and calves and brought severe hardships to farmers and ranchmen in the localities affected. The Texas drought was brought to the attention of the Animal Husbandry Division in the early part of June, 1917. At this time feed conditions in the South, east of the Mississippi River, were exceptionally good. It seemed that an effort

to bring together the owner of starving cattle on the one hand and the owner of surplus pasture and feed on the other would be a conservation measure of much practical value. An organization was put into effect with great rapidity. S. S. Jerdan was ordered from his Mississippi station to Fort Worth to get into immediate touch with ranchmen, to determine how serious the situation was, where cattle were being sacrificed and to what extent, and to determine prices at which cattle were offered. C. J. Goodell was ordered from Washington to take the road up and down the Coastal Plain and through other parts of southern territory, to determine every possible location where cattle might be sent and the probable number of cattle wanted. Goodell's information was sent to Jerdan and Jerdan's information to Goodell, and also to extension directors in the eastern territory. The Railroad Administration was interested and stationed a man at Fort Worth to supervise the supply and movement of motive power and cars. As the result of this effort 150,000 cattle were sent from Texas into Eastern States, some as far as Florida. The cost of this work to the Department was less than 8 cents a head of cattle moved.

In 1919, when the drought situation became acute in Montana, northern Wyoming and other parts of the Northwest, Texas and other parts of the Southwest were covered with a wealth of grass. The drought of three years' duration in the Southwest, however, had so depleted cattle stocks that there were not sufficient cattle for the grass at hand. The first rush of Montana and Wyoming ranchmen was into the Dakotas, where pastures were soon filled to capacity. The Department's problem, therefore, was to look farther for feed supplies. These existed in the Southwest, in western Oklahoma, Kansas and Nebraska, in the Corn Belt and in the cut-over lands of Minnesota, Wisconsin and the Upper Peninsula of Michigan.

On July 15, 1919, a public conference under the Department's auspices was held at St. Paul, Minn., attended by more than 100 men interested in the situation. Every railroad traversing the drought area sent its general freight agent. Reduced freight rates on feed shipped in and on livestock shipped out to be returned later were later announced by the Railroad Administration. The Department appointed a committee with E. W. Sheets as chairman and set up an organization which centered in the different livestock markets of the Middle West and reached out into the drought territory. As a result of this effort, in cooperation with the other agencies interested, at least 300,000 cattle and between 500,000 and 600,000 sheep were moved out of the drought area to other sections where feed was available.

SUMMARY OF IMPORTANT EVENTS

- July 1, 1901. George M. Rommel appointed as expert in animal husbandry.
- July 1, 1904. First direct appropriation by Congress (\$25,000) for animal husbandry investigations became available.
- July 9, 1904. Importation of Barbados sheep arrived at New York and was sent to the Bureau Quarantine Station at Athenia, N. J.
- July 28, 1904. Contract signed with Pennsylvania Experiment Station for cooperative investigations in animal nutrition. Cooperation between the Bureau and the State in this work had already been under way since July 1, 1898, and had been paid for out of miscellaneous funds of the Bureau.
- Aug. 1, 1904. Contract signed with Maine Experiment Station for cooperative investigations in poultry breeding.
- Oct. 19, 1904. Barbados sheep arrived at Bureau Experiment Station, Bethesda, Md.
- Dec. 7, 1904. Contract signed with Alabama Experiment Station for cooperative investigations in southern beef production.
- Dec. 28, 1904. Contract signed with Colorado Experiment Station for cooperative investigations in horse husbandry.
- July 15, 1905. Swine husbandry investigations begun at Halethorpe, Md.
- Aug. 6, 1906. Poultry husbandry investigations begun at Halethorpe, Md.
- Sept. 1, 1906. Contract signed with Wyoming Experiment Station for cooperative investigations in range sheep breeding.
- Apr. 1, 1907. Department took possession of U. S. Morgan Horse Farm, Weybridge, Vt.
- Sept. 16, 1907. Poultry transferred from Halethorpe, Md., to Bureau Experiment Station, Bethesda, Md.
- Oct. 15, 1907. Hogs transferred from Halethorpe, Md., to Experiment Station, Bethesda, Md.
- Jan. 1, 1910. Animal Husbandry Division established by order of Secretary Wilson. (Designation changed from Animal Husbandry Office.) George M. Rommel made Chief of Division.
- June 30, 1910. Farm at Beltsville, Md., purchased.
- July 6, 1910. First horses and mules transferred from Bethesda to the new Experiment Farm at Beltsville. Between this date and October 21 the remaining horses, the zebra, the donkeys and the zebra hybrids were transferred from Bethesda to Beltsville.
- Apr. 17, 1911. Sheep, goats, hogs, guinea pigs and poultry equipment transferred from Bethesda to Beltsville, Md.
- Aug. 10, 1912. Appropriation of \$50,000 became available for experiments in breeding horses for military purposes.
- July 1, 1914. Appropriation of \$10,000 for importation of Corriedale sheep became available.
- Oct. 30, 1915. U. S. Sheep Experiment Station at Dubois, Idaho, established by Executive Order of the President.
- July 1, 1917. Appropriation of \$15,000 became available for the purchase of additional land for U. S. Morgan Horse Farm.

- Mar. 1, 1921. "Sheep Acres" at Beltsville Farm designated by order of the Secretary.
- Apr. 23, 1921. Secretary officially approved the name "Lamona" for the new breed of chickens developed at the Beltsville Farm.
- May 20, 1921. "Chicken Day" held at Glendale, Ariz., and site donated to the Department for Southwestern Poultry Experiment Station.
- June 18, 1922. Provisions for nutritional and meat investigations, including the employment of specialists and the arrangement of laboratories, approved by the Chief of the Bureau, under appropriation in Act of Feb. 26, 1923.
- Apr. 15, 1924. President Coolidge signed the bill transferring jurisdiction over the Fort Keogh Military Reservation, Mont., to the Department of Agriculture for experiments in stock raising and growing of forage crops.

PERSONNEL OF THE ANIMAL HUSBANDRY DIVISION

Expert in Animal Husbandry:

GEORGE M. ROMMEL, July 1, 1901, to Jan. 7, 1905.

Animal Husbandman (in charge of Animal Husbandry Office):

GEORGE M. ROMMEL, Jan. 7, 1905, to Jan. 1, 1910.

Chiefs of Division:

GEORGE M. ROMMEL, Jan. 1, 1910, to Oct. 31, 1921.

Dr. LEON J. COLE, July 2, 1923, to date.

Acting Chief of Division:

E. W. SHEETS, Nov. 1, 1921, to July 1, 1923.

Assistant Chief of Division:

E. W. SHEETS, July 2, 1923, to date.

Assistants in Charge of Sections:

G. ARTHUR BELL, first assistant animal husbandman, Feb. 1, 1905, to Oct. 15, 1920.

Dr. E. H. RILEY, specialist in animal genetics, July 1, 1906, to June 30, 1919.

ROB R. SLOCUM, poultry, July 16, 1906, to Dec. 31, 1911.

E. L. SHAW, chief husbandman, July 1, 1907, to June 30, 1921.

HARRY M. LAMON, in charge of poultry husbandry, June 1, 1912, to Feb. 28, 1922.

W. F. WARD, in charge of beef cattle husbandry, Jan. 2, 1913, to April 15, 1917.

F. R. MARSHALL, in charge of sheep and goat husbandry, Sept. 1, 1913, to March 31, 1920.

Dr. SEWALL WRIGHT, in charge of investigations in animal genetics, Sept. 1, 1915, to date.

E. Z. RUSSELL, in charge of swine husbandry, April 1, 1918, to date.

E. W. SHEETS, in charge of beef cattle husbandry, July 1, 1919, to date.

D. A. SPENCER, in charge of sheep and goat husbandry, July 1, 1920, to date.

JOHN O. WILLIAMS, in charge of horse and mule husbandry, Oct. 16, 1920, to date.

Dr. M. A. JULL, in charge of poultry husbandry, July 2, 1923, to date.

Meat Inspection Division*

The first legislation providing for Federal meat inspection was passed by Congress in August, 1890. That act, however, was but a feeble attempt to satisfy the appeals of our livestock interests and the packing industry for a service that would inspect and certify to foreign governments the healthfulness of our animals and the wholesomeness of our meats. Application of the law very soon demonstrated its ineffectiveness, and, on March 3, 1891, Congress passed a law of sufficient force and breadth to enable the establishing of a meat-inspection service of real value and which would command the confidence of the European purchasers of our products. Meat inspection primarily is a service in hygiene and sanitation, but the arguments which moved Congress to its first enactments on the subject were based wholly on economic considerations.

The period of the eighties of the last century was marked by wide expansion in our livestock industry, and there was great need of free access to foreign markets in which to dispose of the growing surplus of food animals and meats. Further, the industry faced the fact that various European governments had imposed prohibitions or serious restrictions against the importation of our animals and products, chiefly as follows: In 1879 Great Britain put into effect an order which required that imported American cattle be slaughtered within a limited time on the docks where they were landed. That order was issued on the ground that contagious pleuropneumonia in cattle existed in the United States. In the same year Italy and Austria-Hungary issued decrees against admitting American pork, alleging the presence of trichinæ. Similar decrees against American pork were issued by Germany and Spain in 1880; by France, Turkey and Rumania in 1881; by Greece in 1883, and by Denmark in 1888.

The existence of contagious pleuropneumonia in cattle and of trichinæ in pork could not be denied, and the governments concerned were within their rights in setting up the restrictions which they deemed necessary for their own protection. However, the extent to which the alleged conditions existed in the United States was the subject of exaggeration so gross and of reports so sensational as to work great injustice to the reputation of American meat, and there is substantial ground for believing that the exaggerations and sensational reports originated in quarters whose interest lay in preventing

* See "Export Trade in Cattle and Meats," page 8 and "Meat Inspection," page 27.

the competition of American products. This comment on the matter should not be read as implying that the governments concerned were moved by other than proper motives in issuing their prohibitory decrees; its purpose is to point out that their prohibitions served well the purpose of those who desired the elimination of American competition in their markets.

The facts of the situation forced the American producers to face the fact that measures satisfactory to the foreign governments would have to be adopted if the bars set up by them against American products were to be lowered. Widespread and active discussion of the matter led to the conclusion that Congress should be urged to provide for the inspection and certification of meat and meat products destined to foreign markets.

In response to appeals from meat packers, livestock producers and others, the first Federal meat-inspection law was passed August 30, 1890. That act provided for the inspection of salted pork and bacon intended for exportation when the laws, regulations or orders of any foreign government required inspection, or when any buyer, seller or exporter of such meats requested inspection; and it also provided for the inspection of all cattle, sheep, other ruminants and swine for export. It was provided that the inspection should be made at the place where the meats were packed or boxed, and that the meats should be stamped after inspection. The inspectors were authorized to issue certificates of inspection to the shipper of the meat and to the consignee. It will be noted that the act provided only for an inspection of cured meats and of certain live animals, and did not accomplish the more important object of determining whether or not the animal from which the meat was derived was sound or diseased at the time of slaughter.

The inadequacy of the law soon became apparent, and the foreign governments refused to recognize the inspection certificates issued thereunder. The Secretary of Agriculture called the attention of Congress to the situation and suggested a more effective enactment. In accordance with that suggestion Congress passed the Act of March 3, 1891. That law provided that the Secretary of Agriculture should cause to be made a careful inspection of all cattle intended for export as live animals, and also of cattle the meat of which was intended for exportation, the inspection to be made at such times, places and manner as the Secretary might deem proper; and for this purpose he was authorized to appoint inspectors to make the necessary examina-

tions and to give official certificates stating the condition of the animals or of the meats. It was further provided that no clearance could be given any vessel having on board cattle or meats for exportation to a foreign country unless the owner or shipper thereof had an official certificate stating that the cattle or the meats were sound and free from disease. The law also provided that an inspection should be made prior to slaughter of the cattle, sheep and hogs which were the subjects of interstate commerce, and that in addition to an inspection of the live animal the Secretary could, whenever he deemed it necessary or expedient, cause to be made a post-mortem examination of the carcasses of cattle, sheep and hogs about to be prepared for human consumption and interstate commerce. The act made it unlawful to transport in interstate commerce the carcasses of any cattle, sheep or swine or the food products thereof which had been examined in accordance with the law and found to be unsound or diseased, and violation of the law was made punishable by a fine not exceeding \$1,000 or imprisonment not exceeding one year, or both. Animals slaughtered by a farmer upon his farm were exempted from the operations of the law.

The regulations issued under the law of 1891 provided for an examination before and at the time of slaughter by veterinarians of all animals slaughtered for export or interstate trade, the condemnation of all animals found to be diseased, and the proper identification of the carcasses and other products entering into these two classes of commerce. Each establishment was given an official number. The first inspection under the regulations was in New York City at the plant of Eastman & Co., May 12, 1891, and was confined to the inspection of their export dressed beef. In June, 1891, inspection was inaugurated in Chicago and soon thereafter at South Omaha, Kansas City, Milwaukee, Jersey City, and at Hammond, Ind.

The regulations also provided for a microscopic examination of hogs after slaughter to determine their freedom from trichinæ and to certify them accordingly. The microscopic examination of pork for trichinæ was commenced at Chicago, on June 22, 1891, and was gradually extended to the meat-packing establishments doing export business in the following cities: Buffalo, Boston, Cincinnati, Cleveland, Kansas City, Omaha, Indianapolis, Milwaukee, Ottumwa, Cedar Rapids, Sioux City and South St. Joseph.

The inspection and the carrying out of the regulations were carefully observed by representatives in this country of foreign govern-

ments, and the first result of the microscopic examination of pork was an order by the German Government, on September 3, 1891, removing its prohibition against the importation of American pork products. Within a short time similar action was taken by Denmark, Italy, France and Austria. With the removal by Germany of the prohibition against American pork the exports from this country increased largely, and in 1892 there were exported 38,152,874 pounds of inspected pork.

The benefits arising from meat inspection as carried on under the law of 1891 made it apparent that the inspection should be extended. In his report Secretary Rusk pointed out the need for extending the inspection to cover all animals slaughtered for human food, in order, first, to secure for the American consumers the most healthful meats, and to maintain the reputation of American meat products abroad.

By 1894 meat inspection had become the most important and extensive part of the work of the Bureau of Animal Industry. At first the inspection of hogs consisted of the microscopic examination for trichinæ, but in the year above mentioned the ante-mortem and post-mortem examinations were extended to hogs at the various abattoirs where inspection had been established, thus greatly increasing the field of this service. In that year inspection was carried on at 46 abattoirs in 17 cities. In the first year of meat inspection 22 abattoirs had inspection.

Pursuant to the suggestions and recommendations of Dr. D. E. Salmon, Chief of the Bureau of Animal Industry, Congress, on March 2, 1895, amended the law of March 3, 1891, and conferred upon the Secretary of Agriculture authority to make such rules and regulations as he deemed necessary to establish more complete control in respect to the condemned carcasses or parts of carcasses of cattle, sheep or swine which had been inspected in accordance with the provisions of the law.

In 1897 the Committee on Agriculture presented to the House of Representatives a bill proposing that the Secretary of Agriculture should charge for the inspection of meat at specified rates according to the species inspected. It was claimed for this proposal that the expenses of the Bureau of Animal Industry had increased and that the beneficiaries of the service should pay at least a portion of this expense. It was contended that the packers who had inspection were the beneficiaries because they enjoyed market advantages not possessed by the owners of meats not so inspected and certified. The bill failed, and no further legislation affecting meat inspection, other than the annual appropriations, was enacted by Congress until the passage of the Meat Inspection Act of June 30, 1906.

The authority conferred by the laws of 1891 and 1895 was not sufficiently broad to control sanitation and to provide that inspection and supervision of the preparation and labeling of products which is essential to a comprehensive or well-rounded system of inspection. Nevertheless it was ample to establish and maintain an efficient ante-mortem and post-mortem inspection on a scale sufficient to cover a very considerable per cent of the animals slaughtered for domestic consumption, and also for maintaining a well-guarded export certification for meats and animals exported. Although Federal inspection was primarily established to meet economic needs, its hygienic benefits were not limited to the foreign consumer of our products. In fact, the natural and proper development of the service logically made it a national service in hygiene, and this has long been its dominant value, while its importance from the economic viewpoint remains undiminished.

As showing the growth and magnitude of Federal meat inspection and as indicating its value as a national health agency even in its earlier years reference is made to the official reports covering the animals given inspection under the laws of 1891 and 1895. In the fiscal year 1892, the first full year under inspection, 3,809,459 animals were inspected, and in the fiscal year 1906, the last full year of operation under the above laws, the number of animals given post-mortem inspection totaled 42,901,284. In the latter fiscal year alone 194,151 animals were condemned on account of disease or other condition which rendered them unfit for food. These figures suffice to show the growth and importance of the service at that time.

The Meat Inspection Act of 1906 was the culmination of the agitation created early in that year by a widely read novel entitled "The Jungle." The story was laid in Packingtown (the stockyards district of Chicago, Ill.) and pictured working abuses and grossly insanitary conditions as existing in all the large packing plants. It was apparent to all who were acquainted with the facts that the book was extremely sensational and misleading as to the essential facts and conditions. The book stirred the public and aroused a strong sentiment for legislation extending Federal supervision of operations and for definitely establishing sanitary control. The force which did most to translate this sentiment into legislation was the energetic support given it by President Theodore Roosevelt. The resulting legislation, at that time referred to as the Beveridge Amendment, was passed and approved June 30, 1906. That enactment, now officially referred to as the Meat Inspection Act, enlarged the authority of the Secretary of Agriculture

and required that inspection, reinspection and supervision of the processing, preparation and labeling of meats and products be provided and that rigid sanitary control be exercised. The act made mandatory many things not contemplated in the previous enactments. The law took effect July 1, 1906, but the provisions relating to the transportation of meats did not go into effect until October 1, 1906. However, there was no change nor had there been any proposal to change the agency through which the new law would be administered. The Bureau of Animal Industry was designated by the Secretary of Agriculture to take on the enlarged duties and responsibilities.

In this connection it should be added that the act grants a qualified exemption from inspection to retail dealers and butchers supplying their customers, and exempts from inspection the meats derived from animals slaughtered by a farmer on the farm. Control of the shipments made under exemption is maintained through requiring such dealers to operate under certificates issued by the Department, and by requiring that the character of each shipment of meat or product, regardless of kind or origin, be declared through the use of prescribed forms and certificates.

The service required by the new law called for a very great expansion in the meat-inspection personnel. The following brief comparisons of the fiscal years 1906 and 1908 (the last full fiscal year under the old laws and the first full fiscal year under the new one) indicate in some measure this expansion. In 1906 inspection was maintained in 163 establishments located in 58 cities; in 1908, 787 establishments in 211 cities. In 1906 the total number of cattle, sheep, calves and swine slaughtered under inspection was 42,901,284, and in 1908 this total was 53,973,337. The meat-inspection force in the fiscal year 1906 consisted, approximately, of 760 employees, of whom about 300 were veterinary inspectors, while in 1908 the total had risen to 2,280 employees, of whom 620 were veterinarians.

The new law, it will be noted, brought within the scope of the inspection a very great number of small slaughtering and processing establishments which previously had operated without inspection. The largest sum ever expended for meat inspection in any one year before the passage of the new law was \$800,000. The new law provided for a permanent annual appropriation of \$3,000,000. This annual appropriation was ample for the regular needs and extension of the service for a time, but within a few years the point was reached through normal growth of the service, and necessary increases in the salary

rates for inspectors, where the fixed appropriation was inadequate, and from that time to the present writing (1924) additions to the standing appropriations of \$3,000,000 have been made annually. The total appropriation made for meat inspection for the fiscal year 1924 was \$3,866,180.

MICROSCOPIC EXAMINATION OF PORK FOR TRICHINÆ

In the fiscal years 1892 to 1906, inclusive, the Bureau maintained a microscopic examination for the detection of trichinæ in pork to be exported to countries requiring such inspection.* The amount so inspected annually was determined by the sales of American pork to such countries. The smallest amount inspected in any one fiscal year was 8,059,758 in 1903, and the largest 120,110,356 in 1898. The average for the fifteen years of such inspection was about 38,400,000 pounds per year. That inspection was discontinued at the termination of the fiscal year 1906.

No evidence has appeared at any time to cast doubt on the wisdom of the Bureau's action in discontinuing the microscopic inspection of pork. Undoubtedly much good has been accomplished through the Bureau's publicity work to educate and warn the public against the danger of eating uncooked pork. However, such warnings have not reached or have not convinced a certain part of our people that the danger is sufficiently real to be feared. Therefore, among such people the habit of eating certain kinds of products containing uncooked pork has persisted. The seriousness of this fact could not be ignored, and affirmative action of some kind regarding it was deemed proper. Accordingly, the Bureau placed in effect a regulation (regulation 18, section 7, paragraph 4, B. A. I. Order 211) which provides that no product containing the muscle tissue of pork and which is of a kind customarily eaten without cooking shall be prepared at an official establishment unless such product, or the pork content thereof, has been subjected to a temperature sufficient to destroy live trichinæ, or unless it be subjected to some other treatment sufficient to destroy them.† Effective curing and temperature formulas have been developed by the Bureau to enable official establishments to conform to this requirement. The regulation has been in effect for about eight years, and so far as is known to the Bureau no case of trichinosis has occurred from eating pork prepared in accordance with the Bureau's formulas.

* See "Pathological Division," page 58.

† See "Zoological Division," page 97.

THE IMPORTED MEAT ACT

The Meat Inspection Act of 1906 contains no provision which makes it applicable to the inspection and control of meats imported from foreign countries. This omission is explained by the circumstance that when the bill was before Congress, that body also had before it the Food and Drugs Bill, which among other things provided for a certain measure of control over all food imported, including meats. At no time has this omission of such control from the meat-inspection law impaired the effectiveness of the latter in the broad field in which it governs. Both bills in their final form were approved June 30, 1906. At that time the control provided in the Food and Drugs Act in respect to imported meats appeared adequate; but when a few years later it became apparent that large instead of very small importations of meats would become common, it also became apparent that the changed conditions could best be met by transfer of the imported meat inspections to the Bureau of Animal Industry and by making the established meat-inspection regulations instead of the Food and Drug regulations directly applicable to imported meats and products. Accordingly when the Tariff Acts of October 3, 1913, and September 21, 1922, provided for the admission duty free of fresh and preserved meats, they also provided for inspection of the same under the direction of the Secretary of Agriculture and in accordance with the provisions of the Meat Inspection Act of June 30, 1906. For convenience this section of the tariff law is designated "The Imported Meat Act." Since the enactment of that law inspection and control of imported meats have devolved on the meat-inspection service of the Bureau of Animal Industry. Under the terms of the law and regulations meats and products which have been inspected, passed and granted admission are deemed and treated as domestic meats.

In anticipation of the Imported Meat Act and of the development of a large trade in the importation of meats from certain countries in South America and from Australia and New Zealand, an investigation of the South American meat inspection and meat industry was made in person, late in the summer of 1913, by Dr. A. D. Melvin, Chief of the Bureau. In his report covering that investigation Dr. Melvin said:

The investigation was undertaken primarily for the purpose of ascertaining at first hand whether the meat inspection was adequate and whether the conditions under which food animals were slaughtered and the meat prepared for export were such as would reasonably insure that the product was sound and healthful, as is required by our laws.

A similar investigation of the meat-inspection service in Australia and New Zealand was made in the latter part of 1913 by Dr. E. C. Joss, Bureau inspector then in charge at Portland, Oreg.

The information collected in the investigations made by Dr. Melvin and Dr. Joss placed the Bureau in position to deal more intelligently and effectively than it could otherwise have done with the work of establishing inspection for imported meats and products. Further, the investigations aided in promoting desirable improvements in the inspection services of foreign countries.

LATER SPECIAL ENACTMENTS

The Act of July 24, 1919, making appropriations for the Department for the fiscal year 1920, contained two provisions particularly affecting meat inspection. One authorized the Secretary to provide inspection for horse meat and meat food products thereof, and for the animals from which they were derived; the other authorized him, at his discretion, to pay employees of the Bureau of Animal Industry employed in establishments subject to the provisions of the Meat Inspection Act for all overtime work performed at such establishments, at such rates as he might determine, and to accept from such establishments reimbursement for any sums paid out by him for such overtime work.

Horse Meat Inspection

The arguments which led up to providing inspection for horse meat were produced chiefly by war-time conditions. During the war-time effort for increased production and conservation of food it was strongly urged in some quarters that the many horses running wild in the great plains of the West and Southwest ought to be slaughtered and the flesh utilized as human food. It was asserted that horses of this kind, aggregating many thousands of animals, were consuming great areas of valuable pasturage, and that through their elimination this pasturage would be made available for the production of beef and mutton. It was argued that a profitable trade in supplying horse meat to several of the countries of continental Europe could be established, also that very probably an important domestic market could be developed in those centers of our country having a considerable foreign population. The sentiment in favor of governmental action to help inaugurate this program did not end with the armistice, but continued for some time after with considerable force.

In response to these appeals and arguments Congress enacted the

law of July 24, 1919, and pursuant to the authority conferred by that law the Bureau prepared and issued, effective August 5, 1919, Amendment 9 to Order 211, defining the conditions under which the inspection and certification were provided for horse meat intended for food and for sale or shipment as articles of interstate or foreign commerce. Soon a number of persons in different parts of the United States signified their intention of entering the business, chiefly for export trade, and several made application for inspection. However, time has failed to fulfill the predictions of those who urged the legislation upon the Department and Congress. Up to this writing inspection has been granted to four horse slaughtering plants, of which two operated only for a short period. The total number of horses slaughtered by these plants in the four fiscal years, 1920 to 1923, inclusive, was but 5,071. A part of the product was exported for use as human food, while a very considerable part was disposed of to zoological gardens for feeding carnivorous animals.

This was not the first time that the Bureau furnished inspection to cover horses and horse meat. The appropriation for meat inspection for the fiscal year 1899 carried a provision that live horses and horse meats were entitled to the same inspection as the other animals and products named in the bill. This provision was continued in the appropriations for the succeeding fiscal years up to and including 1903. In that period one establishment devoted exclusively to the slaughter of horses operated under inspection at Linnton, Oreg. The output of the establishment was not prepared for domestic trade but for export. That plant operated from 1899 to 1903, and slaughtered 12,776 horses.

If horse meat is to become, even in a very small measure, a part of the Nation's food supply, such meat should of course be inspected for the protection of the consumer. Our experiences furnish no ground for assuming that horse meat will become an important part of the diet of the people of this country.

Overtime Pay

The provision relative to overtime pay for inspectors assigned to official establishments was made effective in a memorandum, dated August 4, 1919, by the Secretary. The memorandum provided for pay at the rate of one and one-half the inspector's regular pay for time in excess of eight hours on regular work days, and at the rate of double such pay for all services rendered on a Sunday or a national holiday.

At various times it has been urged in one quarter or another that

the cost of the inspection should be borne, at least in part, by the establishments at which inspection is maintained. Such proposals have been before Congress, but so far the only proposal along this line approved by Congress has been that which imposes upon establishments the overtime provision.

MEAT INSPECTION LABORATORIES

A system of meat inspection to be complete should have facilities for making various chemical and technical examinations of all kinds of meats and animal products and of the numerous materials used in the curing and preparation of meats and their products. To provide such facilities well-equipped laboratories located at convenient points throughout the country were established shortly after the Act of June 30, 1906, became effective. There are seven of these meat inspection laboratories, including a central or chief laboratory in Washington, D. C., and six field laboratories located as follows: New York, N. Y.; Chicago, Ill.; St. Louis, Mo.; Omaha, Nebr.; Kansas City, Kans., and San Francisco, Calif. In the fiscal year 1923 alone these laboratories examined a total of more than 64,000 samples of meats, meat products, water, and of the numerous materials regularly used in official establishments. Research work was conducted in these laboratories in addition to their routine duties, the results of which have been of practical value to the meat industry. In addition to its own laboratories the Meat Inspection Division has available to it, and constantly uses, the services and co-operation of the laboratories of the Pathological, Zoological and Biochemic Divisions of the Bureau.

REGULATIONS

The first meat-inspection regulations, entitled "Regulations for the Inspection of Salt Pork and Bacon for Export," were issued by Secretary J. M. Rusk under date of September 12, 1890. These regulations were superseded on March 25, 1891, by "Regulations for the Inspection of Livestock and Their Products." Supplemental regulations were issued on September 13, 1893, February 14 and June 19, 1894, and on December 21, 1894, an order was issued entitled "Modification of Regulations Relating to Meat Inspection." A compilation of the Bureau's various regulations, including meat-inspection regulations, dated June 14, 1895, was published in Bulletin No. 9, "Rules and Regulations Governing the Operations of the Bureau of Animal Industry." Succeeding meat-inspection regulations appeared as B. A. I. Order 33, issued March 15, 1899, and B. A. I. Order 125, effective June 24, 1904.

The regulations first issued under the authority of the Meat Inspection Act of June 30, 1906, were embodied in B. A. I. Order 137, effective July 25, 1906. While these were comprehensive and complete for their period, the greatly widened scope of the inspection and the great expansion of the service soon called for a revision and amplification of the regulations in order to establish uniformity in the conduct of the work. Accordingly B. A. I. Order 150 was issued, effective April 1, 1908. These regulations embodied new and important rulings evolved from a careful study of questions and conditions growing out of enforcement of the new Meat Inspection Act.

In this connection it is interesting to note that before B. A. I. Order 150 was adopted an important step was taken in regard to the regulations governing the disposal of animals and carcasses affected with diseases and abnormal conditions. These were submitted to a commission of scientists outside of the Department for their criticism and recommendations. That commission was composed of Dr. William H. Welch, Chairman, Professor of Pathology, Johns Hopkins University; Dr. L. Hektoen, Professor of Pathology, University of Chicago; Dr. Joseph Hughes, President of the Chicago Veterinary College; Dr. V. A. Moore, Professor of Comparative Pathology, Cornell University; Dr. Leonard Pearson, Dean of the Veterinary Department, University of Pennsylvania; Dr. M. J. Rosenau, Director of the Hygienic Laboratory, United States Public Health and Marine Hospital Service, and Dr. Ch. Wardell Stiles, Secretary, Chief of the Division of Zoology, Hygienic Laboratory, United States Public Health and Marine Hospital Service. The report of the commission was published in the Twenty-fourth Annual Report of the Bureau (1907). The regulations submitted were substantially approved, and as indicating its judgment that the regulations afforded the consumer ample protection the commission added this comment: "Several sections could be made less stringent without any danger to the health of the consumer."

In 1914 there was issued Bureau of Animal Industry Order 211, "Regulations Governing the Meat Inspection of the United States Department of Agriculture." That order was made effective November 1, 1914, excepting Regulation 27 relating to imported meats, which became effective January 1, 1915. From time to time amendments to the order were issued as changing conditions and the needs of the service required. In 1922 the order was revised by certain but not numerous changes in the text and by the incorporation of the amendments in effect. The order was designated B. A. I. Order 211

(Revised), effective November 1, 1922. It is believed that in its entirety B. A. I. Order 211 embodies the most complete and comprehensive set of meat-inspection regulations ever prepared and published in the English language.

SCIENTISTS APPROVE THE SERVICE

In 1913 the Hon. D. F. Houston, Secretary of Agriculture, requested the scientists and hygienists named below to observe carefully the conduct of Federal meat inspection at a number of designated stations and to report to him their findings and recommendations. The persons selected were: Veranus A. Moore, M. D., V. M. D., Dean of the New York State Veterinary College and Professor of Comparative Pathology and Meat Inspection, Cornell University, Ithaca, N. Y.; Mazyck P. Ravenel, M. D., Professor of Hygiene in the University of Wisconsin and Director of the Wisconsin State Laboratory of Hygiene, Madison, Wis.; William T. Sedgwick, Ph. D., Hon. Sc. D., Professor of Biology and Public Health and Director of the Sanitary Research Laboratory and Sewage Experiment Station of the Massachusetts Institute of Technology, Boston, Mass., also a member of the Advisory Board of the Hygienic Laboratory of the United States Public Health Service; and J. W. Connaway, D. V. S., Professor of Veterinary Science in the College of Agriculture, University of Missouri, Columbia, Mo.

In his letter of appointment for the purpose stated the Secretary said:

With a view to safeguarding public health and maintaining the highest degree of efficiency in the meat-inspection service of this Department, it is my desire that you report directly to me fully and frankly the conditions as you find them at the various packing establishments, together with such recommendations looking to the improvement of the service as in your judgment may seem best.

Personal affairs made it impossible for Dr. Connaway to serve, but the others named investigated the service, as requested by the Secretary, and rendered reports, which were published as Circular 58 of the Office of the Secretary. The reports show that the observations had been carefully made and the findings were favorable to the work and in many respects highly commendatory as regards its efficiency and reliability.

INSPECTIONS FOR THE NAVY

An expert inspection of the foods, especially of the meats and meat food products, purchased by the Navy is of importance. It is essential that definite assurance be had that the supplies for a ship at sea shall

not fail in any respect. Therefore, before deliveries are accepted it is necessary to see that foods are sound and wholesome; that they conform to contract specifications as regards kind, weight and quality, and that they are packed in substantial containers suitable for ship storage. In its endeavor to provide such an inspection the Bureau of Supplies and Accounts of the Navy Department requested of the Bureau of Animal Industry its co-operation and assistance. The first step taken in this direction by the Navy Department was in 1907, when request was made that inspection be furnished for meats delivered to certain ships and stations. The cooperation begun at that time has continued without interruption and has expanded so that all the inspection of meats and meat food products for the Navy is performed by inspectors of the Bureau of Animal Industry. The work of cooperation has included the preparation of numerous standard specifications to which meats must conform as regards kind, grade, quality and manner of packing and marking. The specifications provide in all cases that only meats and products which have been "U. S. inspected and passed" and so marked will be accepted.

At the present time eleven Bureau inspectors are detailed to Navy yards and bases and devote their entire time to Navy inspections. In addition a part of the time of forty other inspectors is devoted to this work. The statistics covering the inspections performed for the Navy are published annually in the reports of the Chief of the Bureau.

INSPECTIONS FOR THE ARMY

When the United States entered the war against Germany the War Department requested the Bureau's cooperation in the inspection of meats for the Army. To this request the Bureau gave immediate and full response. Sixty-four carefully selected Bureau inspectors were detailed to various cantonments, forts, posts, etc., designated by the War Department. Through these inspectors and the cooperation of inspectors in official establishments, a thorough inspection was established. Meats were examined on arrival at the cantonments, forts, posts, etc., to see that they were sound and wholesome and to see that they conformed to contract specifications. If held in storage they were again examined for soundness and fitness when issued for use. This inspection was not only an important sanitary service to the Army, but it protected its expenditures through rejection of deliveries of meats and products which were found to be below the grade or quality named in the purchase specifications. This service was maintained

until the Veterinary Corps of the Army had been properly organized and equipped to take it over. However, at a number of camps, posts, etc., the Bureau inspectors were kept on duty until after the armistice.

The total of meats and meat products inspected for the Army by Bureau inspectors during the war was 376,298,310 pounds. Of this amount 7,761,633 pounds were rejected, failure to conform to contract specifications being the ground on which much the larger part of the rejections were based.

Since August, 1920, the Bureau has been inspecting meats for the Marine Corps.

EXPORT MARKETS.

Early in 1922 there was completed an interchange of correspondence, initiated by the Department of Agriculture, between the United States and British Governments, through which a substantially freer and larger access to British markets for American fresh pork was obtained. The Bureau issued a modified meat-inspection stamp containing the special certification required by the British authorities. Prior to this arrangement the exports of fresh pork to Great Britain were negligible; while, in the first full fiscal year after the agreement had become effective, the modified stamps and certificates issued for the export of fresh pork to Great Britain showed, in round numbers, 20,000,000 pounds. This is practically the equivalent of 100,000 mature hogs.

In September, 1923, and in April, 1924, the Government of the Netherlands and France, respectively, agreed to the admission of American fresh pork subject to compliance with certain specified requirements as to refrigeration, and provided that all such shipments are accompanied by the prescribed meat-inspection export certificate issued by the Department. Sufficient time has not elapsed since the agreements became effective to permit of making an estimate as to the value of these concessions. However, it is believed that time will prove them to be of considerable value to our meat industry.

DESIGNATIONS AND NUMBER OF EMPLOYEES.

In preparing to establish ante-mortem and post-mortem inspection under the Act of March 3, 1891, the Bureau gave full recognition to the importance of the personnel basis of such a service. It was clearly perceived that establishing and conducting the service efficiently would require scientific knowledge, particularly in special and general veterinary pathology; also technical knowledge of a kind which must be acquired through experience, practice and training. Accordingly, the

guiding personnel of the service has always consisted of veterinarians. Only veterinarians who are graduates of accredited veterinary schools and who have passed the U. S. Civil Service examinations for the position of veterinary inspector receive permanent appointment. The personnel also includes laboratory inspectors and an architect and expert in sanitation. The employees in the nonprofessional branch are designated lay inspectors. Although called nonprofessional, the duties of practically all these employees require such measure of knowledge and skill that "technical" is a more accurate classification for them.

From time to time appropriate changes have been made in the titles by which the different groups of employees were designated, more particularly as regards the nonprofessional. Early in the service it was aimed to make the title of a group indicate quite specifically the nature of its duty or work. For instance, the chief duty of the employee called "stock examiner" was to perform or to assist in performing the ante-mortem inspections; the "tagger" was one whose chief work was to mark or to supervise the marking or tagging of animals and carcasses. Since that time the service has become too complex to admit of such distinctions. Therefore, aside from certain necessary exceptions, the designations "veterinary inspector" and "lay inspector" are the only titles used. The exceptions refer to such designations as "inspector in charge," "traveling veterinary inspector," "supervising veterinary inspector" and "supervising lay inspector." During the war the depletion of the forces made necessary, for a temporary period, the employment of women to perform certain lay-inspector duties. These women employees are designated "assistants in meat inspection."

The number of employees regularly assigned to meat inspection necessarily is subject to some fluctuation, chiefly on account of the seasonal variations incident to the packing business. However, the number on the rolls June 30, 1923, may be regarded as the minimum for several years prior to that date. On that date the total was 2,430, divided as follows: Veterinary inspectors, 680; chemists and laboratory inspectors, 26; lay inspectors, 1,600; various, 124.

The names of the chiefs of the Inspection Division who by virtue of that position administered the meat-inspection service are as follows: Mr. Robert S. Forbes, April 1, 1891, to November 30, 1893; Mr. D. G. Hatch, May 1, 1894, to July 31, 1895; Dr. A. D. Melvin, August 1, 1895, to December 31, 1898; Dr. A. M. Farrington, January 1, 1899, to December 31, 1905; Dr. Rice P. Steddom, January 1, 1906, to June

30, 1912; Dr. U. G. Houck, from July 1, 1906, to April 15, 1907, as Associate Chief of the Inspection Division to assist in establishing the greatly enlarged meat-inspection service in accordance with the Meat Inspection Act of June 30, 1906.

Effective July 1, 1912, the Inspection Division of the Bureau was reorganized as two divisions, one of which was named the Meat Inspection Division, which, as the name indicates, is devoted to the administration of the meat-inspection service. Dr. Rice P. Steddom was appointed Chief of this Division.

SCOPE OF THE SERVICE

The Federal meat-inspection service of the United States is the largest and most comprehensive meat-inspection service in the world. In addition to being a National service in hygiene and sanitation it is the medium through which a very important part of our export trade has been secured and preserved. As an indication of its magnitude the figures covering its principal operations for the fiscal year 1923 are cited. In that year inspection was conducted at 867 establishments in 261 cities and towns. The animals inspected were, in round numbers, cattle, 9,029,000; calves, 4,337,000; sheep, 11,400,000; goats, 25,000; swine, 48,600,000, a total of more than 73,400,000 animals. The total condemnations on the post-mortem inspection on account of disease or other condition which rendered the meat unsafe or otherwise unfit for food were 294,851 whole carcasses, and in addition there were condemned many hundred thousand organs or parts of carcasses affected with some disease or condition that made the part or organ unfit for food but without injury to the meat of the carcass. More than forty diseases or conditions are recorded as causes for condemnation. The number of inspections and reinspections of meats and products when measured by pounds reached the aggregate of more than 8,888,000,000. The condemnations made necessary on account of sourness, taint, uncleanness, rancidity or other unwholesome conditions total more than 14,000,000 pounds.

The following tables give statistics of the Federal meat inspection over a period of years:

ANIMALS SLAUGHTERED UNDER FEDERAL MEAT INSPECTION.

Fiscal Year.	Cattle.	Calves.	Sheep.	Goats.	Swine.	Horses.	Total.	Microscopic Examination	
								Carcasses.	Pieces.
1891.....	83,891						83,891		2,216
1892.....	3,167,009	59,089	583,361				3,809,459	1,267,329	
1893.....	3,922,174	92,947	870,512				4,885,633	1,960,069	
1894.....	3,861,594	96,331	1,020,764		7,648,146		12,626,835	1,372,410	
1895.....	3,722,042	116,093	1,428,601		13,616,539		18,883,275	905,050	1,005,365
1896.....	3,995,461	257,836	4,633,342		14,278,219		23,164,858	469,025	510,355
1897.....	4,253,850	273,911	5,213,894		16,839,034		26,580,689	550,291	1,331,018
1898.....	4,433,181	245,155	5,501,657		20,936,840		31,116,833	1,927,838	875,008
1899.....	4,398,746	247,119	5,609,119		23,904,939	3,232	34,168,155	2,227,740	
1900.....	4,861,994	315,969	6,125,095		23,428,996	5,559	34,737,613	999,554	
1901.....	5,244,154	414,580	6,646,561		24,720,482	1,992	37,027,769	733,196	
1902.....	5,589,691	556,551	7,443,953		25,311,781	1,649	38,903,625	681,865	
1903.....	6,165,890	670,173	8,598,175		21,827,047	344	37,261,629	489,667	
1904.....	6,383,080	767,927	8,269,133		24,170,230		39,590,370	315,045	
1905.....	6,134,388	850,227	7,878,973		25,357,425		40,231,013	346,026	
1906.....	6,925,526	1,102,775	8,223,630		26,649,353		42,901,284	536,997	
1907.....	7,621,717	1,763,574	9,681,876	52,149	31,815,900		50,935,216		
1908.....	7,116,275	1,995,487	9,702,545	45,953	35,113,077		53,973,337		
1909.....	7,325,337	2,046,711	10,802,903	69,193	35,427,931		55,672,075		
1910.....	7,962,189	2,295,099	11,149,937	115,811	27,656,021		49,179,057		
1911.....	7,781,030	2,219,908	13,005,502	54,145	29,916,363		52,976,948		
1912.....	7,532,005	2,242,929	14,208,724	63,983	34,966,378		59,014,019		
1913.....	7,155,839	2,098,484	14,724,465	56,556	32,287,538		56,322,882		
1914.....	6,724,117	1,814,904	14,958,834	121,827	33,289,705		56,909,387		
1915.....	6,964,502	1,735,902	12,909,089	165,533	36,247,858		58,022,884		
1916.....	7,404,288	2,048,022	11,985,926	180,356	40,482,799		62,101,391		
1917.....	9,299,489	2,679,745	11,343,418	174,649	40,210,847		63,708,148		
1918.....	10,938,287	3,323,077	8,769,498	149,503	35,449,247		58,629,612		
1919.....	11,241,991	3,674,227	11,268,370	125,660	44,398,339		70,708,637		
1920.....	9,709,819	4,227,558	12,334,820	77,270	38,981,914	1,089	65,332,477		
1921.....	8,179,572	3,896,207	12,452,435	20,027	37,702,866	1,335	62,252,442		
1922.....	7,871,457	3,924,255	11,968,434	13,758	39,416,439	1,898	63,196,241		
1923.....	9,029,536	4,337,780	11,403,703	25,129	48,600,069	1,459	73,397,676		
Totals.....	213,000,121	52,390,552	280,717,256	1,511,502	890,652,372	18,557	1,438,290,360	14,784,318	2,721,746

*
NUMBER OF EXPORT CERTIFICATES ISSUED AND WEIGHT OF PRODUCTS CERTIFIED FOR EXPORT.

Fiscal Year	Certificates Issued	Horse Meat Products		Inedible Products.	
		Weight of Products Pounds	Certificates	Weight Pounds	Certificates	Weight Pounds
1899.....	64,945	748,994,191	14	347,048	
1900.....	55,738	766,679,419	8	188,800	
1901.....	43,186	720,812,363	9	249,900	
1902.....	38,357	640,177,250	11	170,968	
1903.....	33,284	526,880,701	1	28,000	
1904.....	38,727	583,233,831			
1905.....	38,057	531,454,343			
1906.....	45,888	618,920,486			
1907.....	105,101	1,358,492,781			1,661
1908.....	122,295	1,545,761,808			2,626
1909.....	104,232	1,181,809,650			2,066
1910.....	72,032	815,362,150			2,174
1911.....	90,424	975,066,006			2,836
1912.....	103,529	1,114,279,558			2,599
1913.....	90,653	977,182,936			2,049
1914.....	90,197	904,256,881			2,259
1915.....	87,998	1,391,180,516			1,362
1916.....	124,694	1,895,863,936			752
1917.....	114,584	1,953,093,309			430
1918.....	87,218	2,510,446,802			214
1919.....	93,555	3,492,070,795			536
1920.....	97,652	2,086,980,265	21	153,762	996
1921.....	81,440	1,699,721,167	19	263,287	1,359
1922.....	102,160	1,718,083,728	14	335,781	2,487
1923.....	123,863	2,041,103,337	10	183,484	2,672
Total:	2,049,809	32,797,908,209	107	1,921,030	29,078
					349,088,073

INSPECTION OF IMPORTED MEAT AND MEAT FOOD PRODUCTS.

Fiscal year	Inspected and admitted, pounds	Condemned and refused entry, pounds	Total inspections, pounds
1914 (9 months).....	197,389,348	551,859	197,941,207
1915.....	245,023,437	2,090,745	247,114,182
1916.....	110,514,476	412,183	110,926,659
1917.....	29,138,996	396,771	29,535,767
1918.....	59,025,484	1,404,368	60,429,852
1919.....	179,911,142	842,160	180,753,302
1920.....	77,781,329	521,504	78,302,833
1921.....	162,042,627	522,712	162,565,339
1922.....	41,913,496	12,411	41,925,907
1923.....	49,847,714	41,202	49,888,916
Total	1,152,588,049	6,795,915	1,159,383,964

SANITATION.

Sanitation is one of the essential and basic features of the Federal system of inspection. The Meat Inspection Act of 1906 authorizes the Secretary of Agriculture to define the sanitary requirements and to see to their enforcement at the establishments granted inspection.

When the law became effective a survey of the establishments to which it applied showed many plant buildings which were susceptible of being readily maintained in a satisfactory sanitary condition, but it also brought to light some in which it would not be possible to maintain the sanitary standards which must ultimately prevail. In applying the law it was necessary to decide whether inspection should be withheld from all establishments of the latter type, or be granted conditionally and then the attainment of fully satisfactory sanitary conditions sought by a continuous upbuilding or evolutionary process. The latter course was adopted, and although the rate of progress often appeared to be somewhat slow, its movement was on substantial ground and in the right direction. The majority of the packers were in sympathy with the extended inspection under the new law and willingly cooperated with the officials of the Bureau from the beginning in meeting the requirements of the regulations.

Several stages have marked the development of the sanitary standards which now obtain in official establishments. First, from the structural standpoint, was the installing of modern toilet, lavatory and other sanitary facilities and the providing of increased and improved dressing-room accommodations. Following this was the order requiring that the rooms and departments in which edible products are prepared or stored shall be separate from those in which inedible products are stored or handled. In many instances full compliance with the order required extensive structural changes, but at no time was the wisdom of that order successfully questioned, and the sanitary improvement resulting from its adoption has been almost immeasurable.

From the first the requirement upon which special emphasis was placed was for cleanliness in rooms and equipment and cleanliness in the conduct of operations and in the handling of meats and products; in short, cleanliness throughout the establishment. The progress made in the attainment of this part of the program as regards rooms and departments was excellent in those plants of modern and sanitary construction, and as good as could be expected in those which did not possess the advantages of that type of construction.

From the beginning it was apparent that the maintenance of proper sanitary standards was so closely related to good structure as to make the terms practically synonymous. This was true not only in regard to buildings, but of equipment as well; for in comparatively few establishments was the meat-handling equipment of a type and quality that would now be acceptable. It was repeatedly demonstrated

through experience that cleanliness in operation and the handling of products was very largely dependent on the use of equipment which made compliance with the requirements easy and partly or wholly automatic. To design and install such equipment was a slow, experimental and laborious process and was largely accomplished through the example of a number of companies actuated by progressive ideas and through cooperation with those inspectors whose ability and judgment in mechanics proved to be of valuable assistance. That period was marked by some complaints against too frequent requests for changes and improvement in equipment. Nevertheless the progressive establishments and the Bureau had the right goal in view, and the way was opened for others to follow and share in the benefits. The comment that progress was slow and laborious is not to be regarded as a complaint against any official establishment, but is simply to be read as history, and as leading to the declaration that we believe the standard as to cleanliness in the conduct of operations and in the handling of product now obtaining in official establishments generally is not surpassed in the world, and further to express the belief that official establishments generally view their achievement with satisfaction and pride.

SUMMARY OF IMPORTANT EVENTS

*Calendar
Years.*

1879. Great Britain put into effect a restriction that American cattle be slaughtered within 10 days upon the docks where they were landed. Italy and Austria-Hungary prohibited the importation of American pork, alleging the presence of trichinæ.
1880. Spain and Germany prohibited the importation of American pork.
1881. France, Turkey and Rumania prohibited the importation of American pork.
1883. Greece prohibited the importation of American pork.
1888. Denmark prohibited the importation of American pork.
1890. Congress enacted the first meat-inspection legislation (approved August 30) providing for the inspection of salted pork and bacon intended for export and the inspection of export cattle, sheep, swine and other ruminants.
- First meat-inspection regulations issued, entitled "Regulations for the Inspection of Salt Pork and Bacon for Export" (Sept. 12).
1891. Congress enacted legislation (approved March 3) providing for the inspection of live cattle, sheep and swine, also inspection of same at time of slaughter. Terms of the law applicable to animals and carcasses intended for interstate or export commerce. Meat inspection established by the Bureau under the above law.
- "Regulations for the Inspection of Livestock and Their Products" issued March 25.
- Bureau of Animal Industry reorganized by order of Secretary of Agriculture into four divisions, namely, (1) Inspection Division;

(2) Division of Animal Pathology; (3) Division of Field Investigations and Miscellaneous Work, and (4) Division of Quarantine. Inspection Division established April 1.

Microscopic inspection and certification of pork established.

The following European countries modified regulations against American pork so as to admit pork certified by the U. S. Government as microscopically inspected: Germany, Denmark, Italy, France, Austria-Hungary and Spain.

1893. "Supplementary Regulations for the Inspection of Livestock and Their Products," issued September 13.
1894. Denmark, Belgium, France and various States of Germany prohibited importation of cattle from United States, alleging prevalence of Texas fever, pleuropneumonia, etc.
Amendment to the meat-inspection regulations February 14.
Additional meat-inspection regulations, "Condemned Carcasses in Cooling Room with Edible Meats," issued June 19.
"Modification of Regulations Relating to Meat Inspection Service" issued December 21.
1895. Legislation enacted by Congress (approved March 2) strengthening the meat-inspection law of March 3, 1891.
Meat-inspection regulations issued June 14 and published in Bulletin 9, "Rules and Regulations Governing the Operations of the Bureau of Animal Industry."
1899. Meat-inspection regulations published as B. A. I. Order 33, March 15.
1904. Meat-inspection regulations published as B. A. I. Order 125, June 24.
1906. All previous Federal meat-inspection regulations superseded by the Meat Inspection Act (approved June 30).
Microscopic inspection of pork discontinued (effective June 30).
Meat-inspection regulations published as B. A. I. Order 137, June 30.
1908. Meat-inspection regulations published as B. A. I. Order 150, April 1.
1912. Inspection Division reorganized and a new division, the Meat Inspection Division, established (effective July 1, 1912).
1913. By the acts approved October 3, 1913, and September 21, 1922, the provisions of the Meat Inspection Act of June 30, 1906, made applicable to imported meats and meat food products.
1914. B. A. I. Order 211, "Regulations Governing the Meat Inspection of the U. S. Department of Agriculture," issued November 1.
1915. Regulation No. 27, B. A. I. Order 211, relating to imported meats, effective January 1.
1919. Congress enacted legislation (approved July 24) providing inspection for horses and horse meats and products.
Legislation enacted by Congress (approved July 24) providing for payment by official establishments for overtime inspection service.
1922. B. A. I. Order 211 (Revised) issued November 1.

PERSONNEL OF THE MEAT INSPECTION DIVISION

Division Chiefs:

- Mr. ROBERT S. FORBES appointed the first Chief of the Inspection Division, April 1, 1891; served in that capacity to November 30, 1893.
- Mr. D. C. HATCH appointed Chief of the Inspection Division, May 1, 1894; served to July 31, 1895.
- Dr. A. D. MELVIN appointed Chief of the Inspection Division, August 1, 1895; served to December 31, 1898.

- Dr. A. M. FARRINGTON appointed Chief of the Inspection Division, January 1, 1899; served to December 31, 1905.
- Dr. RICE P. STEDDOM appointed Chief of the Inspection Division, January 1, 1906. Had served as Assistant Chief of the Division since August 28, 1905.
- Dr. U. G. HOUCK appointed Associate Chief of the Inspection Division, July 1, 1906, with special consideration to meat-inspection organization; served to April 15, 1907.
- Dr. RICE P. STEDDOM appointed Chief of the Meat Inspection Division, which was established as a result of the reorganization of the Inspection Division, effective July 1, 1912. Dr. Steddom is the present Chief of the Division.

Field Inspection Division

Although the efforts of the Bureau of Animal Industry were devoted largely to the eradication of contagious pleuropneumonia and the study of Texas fever and hog cholera for several years after its establishment on May 29, 1884, it did give attention also to the study of such diseases as sheep scab, dourine, anthrax, glanders and other diseases, but it did not take up regulatory activities in connection with these diseases until later.

Dr. D. E. Salmon, who was Chief of the Bureau from its beginning until November 1, 1905, personally supervised and directed all of the animal disease work of the Bureau until 1891. On April 1, 1891, the Bureau was organized into four divisions, one of which was the Inspection Division.* To this Division was assigned all field work of an executive nature, including the field investigation of contagious diseases and the regulation of the movement of southern cattle. On September 1, 1912, the Inspection Division was divided into the Meat Inspection Division and the Field Inspection Division. All of the work that the Inspection Division had been carrying on, other than meat inspection, was placed in charge of the Field Inspection Division.

During its existence as such, the Inspection Division was headed as follows:

MR. ROBERT S. FORBES, from April 1, 1891, to December 30, 1893.

VACANT, from December 31, 1893, to April 30, 1894.

MR. DANIEL G. HATCH, from May 1, 1894, to July 31, 1895.

DR. A. D. MELVIN, from August 1, 1895, to December 31, 1898.

DR. A. M. FARRINGTON, from January 1, 1899, to December 31, 1905.

DR. R. P. STEDDOM, from January 1, 1906, to August 31, 1912.

Dr. R. A. Ramsay was the first Chief of the present Field Inspection Division. He held that position from September 1, 1912, to April 30, 1917, when he was placed in charge of the Tick Eradication Division. Dr. A. W. Miller, the present Chief of the Field Inspection Division, succeeded Dr. Ramsay on May 1, 1917.

Following the retirement on March 31, 1922, of Dr. R. W. Hickman, Chief of the Quarantine Division, after thirty-four years of service, all the activities of that Division were taken over on May 1, 1922, by the Field Inspection Division.

At the present time the personnel of the Field Inspection Division comprises 305 employees, including 149 veterinary inspectors, 103 lay inspectors, 22 clerks, and 53 otherwise designated. The present scope

* See "Organization of the Bureau of Animal Industry," page XI.

of the field activities of this Division includes the administration of the regulations governing the importation and exportation of live-stock, the joint regulations of the Treasury Department and the Department of Agriculture for the sanitary handling and control of hides, skins, wool, other animal by-products, hay, straw, etc., offered for entry into the United States, the eradication of outbreaks of foot-and-mouth disease when they occur, and the control or eradication, in co-operation with the States, of such diseases as dourine, sheep and cattle scabies, glanders and anthrax, also conducting inspection at public stockyards for contagious diseases and the enforcement of the twenty-eight-hour law and quarantine regulations.

DOURINE

Dourine, also known as *maladie du coit*, was introduced into this country in horses imported from France in 1884. The disease was first discovered in the vicinity of Bloomington, Ill., in 1885, by Dr. W. L. Williams, who was then a veterinary practitioner in Illinois. Later it was found to have spread through the shipment of a diseased stallion to northwestern Nebraska. The first official report of its existence in the latter vicinity is found in a communication to the Bureau dated June 10, 1892, from Dr. George C. Faville, one of its veterinary inspectors. The infection was confined principally to range horses, and as the complement-fixation test was then unknown, the eradication work for a number of years did not give the results hoped for. All animals in localities in which the disease was known to exist were inspected and those found affected were purchased and slaughtered. From 1892 until 1902 the disease continued to reappear in northwestern Nebraska and South Dakota after it had apparently been stamped out on several different occasions by inspectors of the Bureau.

In 1902 a more vigorous and systematic campaign was inaugurated for the suppression of the disease. On January 20, 1903, the Department issued regulations governing the transportation of horses affected with *maladie du coit*. This order placed under quarantine the counties of Dawes, Box Butte, Sheridan and Cherry in the State of Nebraska, and the counties of Custer and Fall River and the Pine Ridge and Rosebud Indian Reservations in the State of South Dakota. It prohibited the movement of animals from the sections defined until they had been inspected and certified for shipment by an inspector of the Bureau of Animal Industry. A small outbreak of dourine occurred in Iowa in 1904. Gratifying progress was made in stamping out the disease and by 1905 it was practically eradicated from the areas in which the work was being carried on.

Originally the field work for the control and eradication of dourine was handled by the Division of Field Investigation and Miscellaneous Work, and later and until May 1, 1917, by the Quarantine Division, of which Dr. R. W. Hickman was Chief. The work accomplished in combating this disease from June 1, 1911, to April 30, 1917, is outlined in that part of this review which deals with the activities of the Quarantine Division.* On May 1, 1917, dourine eradication work was transferred to the Field Inspection Division.

The progress made in the control and eradication of the 1912 outbreak, the most extensive this country has ever experienced, is indicated in the following table:

	No. of Laboratory Tests	No. of Reactions
1913.....	4,970	634
1914.....	51,293	2,550
1915.....	52,896	1,515
1916.....	45,100	1,400
1917.....	49,585	1,225
1918.....	45,651	1,018
1919.....	46,819	1,143
1920.....	18,468	257
1921.....	22,855	515
1922.....	14,549	243
1923.....	11,530	364

FOOT-AND-MOUTH DISEASE†

Europe has never been entirely free from foot-and-mouth disease since it made its appearance there. In 1886 it became much more widely disseminated in European countries than usual. Although the United States was in great danger from this source, it escaped any serious outbreaks up to 1902. In 1870 the contagion was introduced by way of Canada into the State of New York and spread to New England. The type of the disease at that time appears to have been mild and the conditions were not favorable for the spread of the malady. In 1880 and 1881 two or three lots of affected cattle were brought to the United States, but they were discovered in time to prevent any spread of the contagion.‡ In 1884 there was a small outbreak in the vicinity of the quarantine station at Portland, Maine. Owing to the sparse animal population of the invaded area and the favorable weather conditions during that cold winter, this outbreak was easily suppressed by the ordinary measures of quarantine and disinfection.

* See "Quarantine Division," page 151, and "Pathological Division," page 66.

† See "Export Trade in Cattle and Meats," page 8, and "Pathological Division," page 71.

‡ See "Quarantine Against Foreign Importations of Livestock," page 29.

Early in the spring of 1884 the country was startled by a report of the appearance of a virulent outbreak of foot-and-mouth disease in the West. On March 3, Dr. Wilhite, a local practitioner, visited the farm of Daniel Kieth, Coffey County, Kansas, near Neosho Falls, and diagnosed foot-and-mouth disease among Mr. Keith's cattle. The same day G. W. Glick, Governor of Kansas, telegraphed Hon. George B. Loring, Commissioner of Agriculture, informing him of the outbreak and requesting assistance. Dr. M. R. Trumbower was directed to proceed to Kansas and reached there March 9. In the meantime Dr. A. A. Holcombe, of the Army veterinary service, had been detailed at the request of the Governor of Kansas to make an investigation. Dr. Holcombe arrived at Neosho Falls March 6, and after a hurried examination of the affected herds in that locality confirmed the diagnosis of Dr. Wilhite. When Dr. Trumbower arrived he found the people much excited. Relying rather on the representations of others than on what he was actually able to see, he was led to concur in the opinion of the veterinarians who had been upon the ground for the preceding three or four days. On March 10 Dr. Holcombe made his formal report to the Governor.

The excitement became great and such exaggerated accounts were circulated that a feeling of alarm and insecurity spread rapidly among all engaged in the livestock industry of the West. On March 19, Dr. Salmon, Chief of the Bureau, visited Neosho Falls and after a careful examination telegraphed the Commissioner of Agriculture that the affection was not foot-and-mouth disease but ergotism. While in the West Dr. Salmon visited affected herds in other places and found them to be suffering with the same condition but found no foot-and-mouth disease.

On April 9 information was received that Dr. Duncan McEachran, Principal of the Montreal Veterinary School and livestock inspector for Canada, had visited Neosho Falls and other places and positively asserted that the malady was the real foot-and-mouth disease of Europe. On April 10 the State Agent of the United States Department of Agriculture for Kansas wired that the State Veterinarian reported to the Governor that six healthy animals had contracted the disease from contact with sick animals. A few days later an item appeared in the press, stating that cases of sickness among cattle which had been most carefully examined had turned out to be true foot-and-mouth disease.

It seemed that a repetition of the former excitement and panic

was about to occur, and Dr. Salmon again visited Kansas, reaching Emporia April 20, where he was met by the State Veterinarian and Professor James Law on the morning of April 21. At this conference the State Veterinarian announced that all attempts to convey the disease by inoculation had failed as well as the second attempt to convey the disease by contact, and he was satisfied that the disease was not foot-and-mouth disease. The trouble among the cattle in question was proved to be ergotism.

The Outbreak in 1902

An unexpected outbreak of foot-and-mouth disease was discovered in New England in November, 1902, which was the most extensive that had appeared in the United States up to that time.

The Department of Agriculture first received an intimation of the existence of the disease on November 14, 1902, when a letter was received from Dr. Austin Peters, Chief of the Cattle Bureau of Massachusetts, stating that a disease had been discovered in Rhode Island which resembled foot-and-mouth disease. On November 17 Dr. Peters telegraphed that he believed the malady to be foot-and-mouth disease. Dr. J. R. Mohler, Chief of the Pathological Division of the Bureau, was sent to investigate the nature of the disease. On November 24 he reported that a calf and two sheep which he inoculated contracted the disease within two, four and five days, respectively, confirming the opinion of the State authorities. This opinion was further confirmed in a joint report, November 27, from Dr. Mohler, Dr. Leonard Pearson, Dean of the Veterinary Department of the University of Pennsylvania, and Dr. James Law, Dean of the New York State Veterinary College, who had been sent to New England to confer with Dr. Mohler. Orders were issued by Hon. James Wilson, Secretary of Agriculture, the same day, quarantining the States of Connecticut, Rhode Island, Massachusetts and Vermont and prohibiting the exportation of animals from the port of Boston, Mass. New Hampshire was not placed under quarantine until March 7, 1903. Headquarters was established at Boston and a number of Bureau veterinarians and lay inspectors from various parts of the country were hastily summoned there to assist Dr. S. E. Bennett, who was placed in immediate charge of the forces in Connecticut, Rhode Island and Massachusetts. Dr. F. A. Rich of Burlington, Vt., was especially engaged and put in charge of the work in Vermont. On December 1 Dr. D. E. Salmon, Chief of the Bureau, arrived at Boston personally to supervise and direct the Federal work of eradicating the outbreak.

Investigation revealed that the infection had existed in Massachusetts since some time in August, 1902. By the time the Federal quarantine was established the disease was spreading rapidly. After carefully considering the conditions and the great danger that menaced the livestock industry of the country, and after conference with Dr. Pearson, Dr. Law and other interested authorities, it was decided to resort to the drastic measures of quarantine, slaughter and disinfection which had proved so successful in the United States in eradicating contagious pleuropneumonia. It was agreed that the National Government would pay 70 per cent of the expense of eradication in each infected State, including the appraised value of animals slaughtered, and the State would pay the remaining 30 per cent.

On February 2, 1903, the Act of Congress was approved giving the Secretary of Agriculture greater powers in dealing with contagious diseases of animals, and various orders and regulations were issued from time to time to meet the developments of the situation. Although there was considerable opposition to the heroic measures employed, the work of eradication progressed rapidly and inside of 60 days from the beginning the country was practically free of the plague. Connecticut was released from quarantine December 22, 1902; Rhode Island, May 9, 1903; Vermont, September 11; Massachusetts and New Hampshire, October 14. The outbreak extended to twelve counties in the four last-mentioned States, as follows: Providence County, Rhode Island; Windsor and Windham Counties, Vermont; Middlesex, Worcester, Essex, Norfolk, Plymouth and Bristol Counties, Massachusetts, and Hillsboro, Rockingham and Merrimac Counties, New Hampshire. During the outbreak, 3,637 cattle were destroyed at an average cost of \$34.03 per head, 235 calves at \$7.17 per head, 360 hogs at \$6.85 per head, and 229 sheep and goats at \$4.30 per head, making a total of 4,461 animals slaughtered.

In the beginning this outbreak appeared in a very mild form and was not recognized by the inexperienced cattle owners and veterinary practitioners of Massachusetts for more than four months. It gradually became more virulent, and by the time the disease was diagnosed 39 herds, comprising 940 animals, had apparently recovered. It was decided not to slaughter them, but the premises were cleaned and disinfected to destroy any infection that might remain. Later the owners of a number of the spared herds reported that a large proportion of their cows had failed to return to their normal

milk yield, many had contracted garget or chronic lameness, and some had aborted; generally, the animals were no longer profitable and the owners requested that the entire herds be condemned and slaughtered. At first their request was refused, but on reconsideration all of the cows showing garget or deformed feet were purchased and destroyed for fear these chronic lesions might have retained some of the virus which would cause a recurrence of the disease in these herds or new outbreaks in other localities to which some of the cattle might be removed.

The total cost to the National Government of eradicating this outbreak was about \$300,000. The source of the infection remained a mystery, but information obtained in connection with the source of the next outbreak seemed to indicate that contaminated smallpox virus imported into this country was the source of the 1902 outbreak.

The Outbreak in 1908

The outbreak in 1908 came as unexpectedly as did the preceding one. There was no history of infected animals having arrived at the quarantine stations. The disease was first observed early in November on the farm of Jacob M. Shultz, near Danville, Pa. Both the owner of the cattle and Dr. J. O. Reed, a local practitioner, regarded the affection as suspicious and reported the cases to Dr. Leonard Pearson, State Veterinarian of Pennsylvania, on November 7, who after a personal investigation notified Dr. A. D. Melvin, Chief of the Bureau, on November 10, of the existence of foot-and-mouth disease in this country. Dr. Melvin, Dr. J. R. Mohler, Chief of the Pathological Division, and Dr. R. P. Steddom, Chief of the Inspection Division of the Bureau, proceeded immediately to the infected herds, and after a careful examination they concurred in the diagnosis.

Columbia, Montour and Northumberland Counties, Pennsylvania, were quarantined on November 13, 1908. A few days later some cases were found in the vicinity of Akron, N. Y., and on November 19 the quarantine was extended to include the entire territory of Pennsylvania and New York.

In tracing the origin of the disease it was found that it was carried into Pennsylvania by two lots of cattle which came through the public stockyards at Buffalo, N. Y. About the same time word was received that the disease had been found in several herds near Detroit, Mich. Hon. James Wilson, Secretary of Agriculture, and Dr. Melvin proceeded immediately to Buffalo and Detroit to give

personal attention to organizing the eradication work and making arrangements with the State authorities in regard to sharing the expenses and cooperating in other ways. On November 25 the State of Michigan was quarantined. At about the same time infection was found in Maryland and that State was quarantined on November 27.

The plan adopted for eradicating the disease was practically the same as that which had proved so successful in combating the outbreak of 1902, except that it was agreed that the National Government would pay two-thirds of the expense of eradication and the States would pay one-third. Dr. S. E. Bennett was placed in charge of the Bureau forces in Pennsylvania and Maryland, Dr. U. G. Houck was put in charge in New York, and Dr. P. H. Mallowney in Michigan. The State cooperation in Pennsylvania was carried on under the direction of Dr. Leonard Pearson, State Veterinarian; in New York under the direction of Commissioner of Agriculture R. A. Pearson, brother of Dr. Leonard Pearson; in Michigan under the direction of Mr. H. H. Hinds, Chairman of the State Live Stock Sanitary Board, and in Maryland under the direction of Dr. F. H. Mackie, State Veterinarian. The affected States were all provided with livestock sanitary officials, and quite a number of the veterinarians in the Bureau had had experience in the New England outbreak of 1902, so there was no delay in beginning operations. The Bureau force at one time numbered 572 employees, of whom 159 were veterinarians. In Pennsylvania the Bureau inspectors made 69,836 farm visits and revisits, in New York 24,748, in Michigan 8,393, and in Maryland 4,884. In addition, 822 farm visits were made to other States in tracing shipments from the Buffalo stockyards, making a total of 108,683 such visits, comprising the inspection and reinspection of 1,565,699 animals. So rapidly was the work of eradication carried on that by December 19, or within six weeks from the beginning, all diseased and exposed animals so far as known at that time had been destroyed, and only a few additional infected herds were found later. The outbreak was practically eradicated within six weeks.

In this outbreak the disease appeared on 101 premises in 15 counties of Pennsylvania; on 45 premises in 5 counties of New York; on 9 premises in 2 counties of Michigan, and on 2 premises in 1 county of Maryland. During the outbreak 2,025 cattle, 1,329 hogs, 275 sheep and 7 goats were destroyed, at an appraised value of \$90,033.18. The total cost to the National Government of eradicating this outbreak was a little less than \$300,000.

The quarantine regulations were modified from time to time to meet the conditions, and all restrictions were removed from Maryland and Michigan March 15, New York March 26 and Pennsylvania April 24, 1909.

In tracing the origin of the infection in the outbreak of 1908 it was learned that some calves that had been furnished by Shaw Brothers to a biological laboratory in Detroit, Mich., for propagating smallpox vaccine were the first to develop the disease. This aroused a suspicion that the vaccine which was used on the calves September 23 and October 26 might have been contaminated with the virus of foot-and-mouth disease. As the U. S. Public Health and Marine-Hospital Service at that time had the supervision of biological products used in human medicine, that Service was requested to join the Bureau of Animal Industry in making an investigation. Dr. J. R. Mohler, representing the Bureau, and Dr. Milton J. Rosenau, Director of the Hygienic Laboratory of the Public Health Service, undertook the investigation, which revealed that undoubtedly the smallpox vaccine in question was the cause of the outbreak. The Detroit firm had obtained this particular strain of vaccine from a Philadelphia firm in May, 1908, and tests of the vaccine of the latter company showed that it likewise was contaminated. The Philadelphia firm had imported the vaccine from Japan in 1902. While it is not known positively how long the infection existed in the Philadelphia establishment, the fact that the outbreak in Massachusetts appeared first in the vicinity of a biological establishment located in Chelsea, Mass., where the first cases appeared in 1902, suggests that in all probability that outbreak originated from the same source. The importing licenses of both the Detroit and Philadelphia firms were at once suspended, all of the contaminated and suspected vaccine and virus on hand at these establishments was destroyed, and all products on the market that were probably contaminated were recalled and destroyed in order to prevent further trouble.

The Outbreak of 1914-15

The whole country was astonished on October 15, 1914, to learn that the livestock industry again was threatened by an outbreak of foot-and-mouth disease. This outbreak made its first appearance on August 2 among hogs on the farm of W. E. Hoadly, situated near Niles, Berrien County, Mich., a place remote from any seaport. Local practitioners as well as the State livestock sanitary authorities and a Bureau veterinarian of Dr. E. P. Schaffter's meat inspection force at

Detroit, who was called in consultation on September 3, failed at that time to recognize the true character of the malady. This was due to the mild type of the disease, its disinclination to spread rapidly in the beginning, the presence of mixed infection and the absence of the characteristic vesicles in the advanced stage of the disease when the affected animals were examined. On October 10 a letter was received from Dr. E. P. Schaffter stating that on October 5 he, in company with the State Veterinarian and the President of the Live Stock Sanitary Commission of Michigan, had returned to Niles for the purpose of examining some of the affected animals. While he did not make a positive diagnosis, the symptoms described pointed to the possibility of foot-and-mouth disease. Dr. Adolph Eichhorn, Chief of the Pathological Division, was sent to Niles on the first train after the letter was received, and calves were inoculated at the Washington Experiment Station with material sent from Michigan by Dr. Schaffter. A positive diagnosis of foot-and-mouth disease was made on October 15. The Secretary of Agriculture quarantined Berrien and Cass Counties, Michigan, and St. Joseph and Laporte Counties, Indiana, on October 19. By the time the quarantine order was issued 39 infected herds had been found in Michigan and 7 in Indiana.

The Union Stock Yards at Chicago became infected and were placed in quarantine October 31, 1914. By the end of November, or within 30 days after the outbreak was discovered, the infection had been spread to 20 States and the District of Columbia.

As soon as the disease was positively diagnosed a corps of experienced veterinarians and lay inspectors were assembled and the work of eradication was begun along the lines pursued in previous outbreaks. Arrangements were made whereby the National and State Governments shared equally the expenses for the purchase, slaughter and burial of affected and exposed animals and for the disinfection of infected premises. Animals were appraised at their actual meat or dairy value by representatives of the State and National Governments in the presence of the owner or his representative. Very great care was taken to avoid the possibility of the infection being carried from affected to well animals by persons who were obliged to visit or care for affected animals. The inspectors and others whose duties brought them in contact with susceptible animals were, as in the outbreaks of 1902 and 1908, required to wear rubber boots, gloves, coat and hat when on duty, and all of the rubber outer clothing was

thoroughly washed with a disinfectant immediately before the inspectors left premises where any susceptible animals were kept, irrespective of whether or not any infection was found. In addition, a suitable rubber cape was supplied to each inspector and he was required to fumigate his clothing with gas generated by mixing formaldehyde and permanganate of potassium even after the liquid disinfectant had been applied freely to the rubber outer garments with a sponge.

The National Dairy Show was held October 22 to 31, 1914, in buildings situated just outside of the Union Stock Yards, Chicago, although the officials in charge of the show were warned of the danger previous to the opening. Dr. Melvin, Chief of the Bureau, requested that the animals in the show be held for a few days after the close of the show so that it might be ascertained if any infection had been carried to them. Dr. O. E. Dyson, State Veterinarian of Illinois, quarantined the herd. On November 1 one of the cows developed lesions of foot-and-mouth disease. Immediately the herd, consisting of over 700 of the choicest breeding animals in the country, was placed under a more rigid quarantine. On account of the breeding value of these animals and the fact that they were confined to brick buildings where it was possible to maintain a stricter quarantine than could be maintained on farms, it was decided to try to save them. Dr. W. E. Cotton of the Bureau Experiment Station at Washington was detailed to Chicago to observe the progress of the disease and to represent the Bureau in carrying out the prescribed quarantine and to conduct certain tests before the herd was released. After apparently complete recovery of the animals that remained of the original herd it was released from quarantine May 31, 1915.

The herd received the most skillful surgical and medical attention that could be obtained. During the time it was in quarantine most of the very young calves died as a result of the disease and its complications. Several animals developed metritis and a few others were found to be affected with tuberculosis. The expense connected with the care and maintaining the quarantine of this herd under the most favorable conditions was so great that it exceeded several times the average value of farm cattle and showed conclusively that it would not pay to attempt to save farm animals under ordinary farm conditions.

By June 18, 1915, it appeared that the outbreak of 1914 had been

completely eradicated, but on July 28 infection was found among some herds in a small valley in Steuben County, New York. Doubtless the infection had been smouldering in this valley for several months. Seven herds were slaughtered in Steuben County and it seemed again that the country was free of the disease.

On August 8, 1915, however, the disease reappeared in Illinois among herds of hogs, and about the same time a diseased herd of hogs was found in Indiana and another in Minnesota. The infection spread from swine to other susceptible animals, and vigorous measures were necessary to stop the progress of this new outbreak. On investigation it was ascertained that this second outbreak in Illinois, Indiana and Minnesota was due to infected hog-cholera serum produced at a Chicago establishment where foot-and-mouth disease had not appeared and where these products were tested carefully for foot-and-mouth disease infection before they were marketed. After repeated tests involving 62 animals, one of the last series developed the disease, demonstrating that the serum was the source of infection.

The last animals to become infected through the natural spread of the disease in this outbreak were slaughtered on the premises of James Norris, Christian County, Illinois, on February 21, 1916. On May 2, 1916, reinfection appeared on the previously infected farm of A. J. Houk, near Taylorville, Christian County, Illinois, among some animals that had been placed there to test the premises before the owner was allowed to restock fully. The slaughter of these animals on May 3 and the recleaning and disinfection of the premises concluded the complete eradication of the outbreak of 1914-15, which extended to 22 States and the District of Columbia. The quarantines were modified from time to time and the last restrictions were removed June 5, 1916.

About 450 veterinary inspectors of the Bureau and nearly as many State employees and private practitioners participated in the eradication work.

The extent of the outbreak and the number of animals slaughtered are shown in the following table:

Statistics of Foot-and-Mouth Disease Outbreak of 1914-1916.

State.	Counties		Animals slaughtered.							Total	Appraised value of animals.	Duration of outbreak.
	Total	Infected	Herds.	Cattle.	Swine.	Sheep.	Goats.	Total.				
Connecticut	8	3	35	701	175	.....	.....	.....	876	\$48,366	Nov., 1914, to April, 1915.
Delaware	3	1	12	152	49	22	.....	.....	223	8,068	Nov., 1914, to Dec., 1914.
District of Columbia	.....	.....	4	48	39	.....	.....	.....	87	7,139	Nov., 1914, to Mar., 1915.
Illinois	102	54	1,226	31,074	45,560	1,866	'66	78,566	7,050	2,569,102	Nov., 1914, to May, 1916.	
Indiana	92	20	118	2,437	3,973	640	.....	.....	3,914	179,731	Oct., 1914, to Aug., 1915.
Iowa	99	9	49	1,547	2,335	32	.....	.....	1,531	125,297	Nov., 1914, to Mar., 1915.
Kansas	105	4	12	1,218	313	.....	.....	.....	4,025	76,097	Feb., 1915, to May, 1915.
Kentucky	119	11	82	2,942	866	216	1	3,105	69,038	135,000	Nov., 1914, to June, 1915.	
Maryland	24	10	70	1,008	1,784	313	.....	.....	8,238	217,848	Nov., 1914, to May, 1915.
Massachusetts	14	9	103	2,066	6,088	78	6	7,877	212,334	212,334	Oct., 1914, to Oct., 1915.	
Michigan	83	16	272	2,951	4,108	818	.....	.....	60	2,384	Aug., 1915.
Minnesota	86	1	1	25	35	.....	.....	.....	1,667	67,603	Nov., 1914, to Jan., 1915.
Montana	31	3	42	1,416	11	240	.....	.....	104	4,960	Nov., 1914, to Jan., 1915.
New Hampshire	10	1	3	78	26	.....	.....	.....	2,145	123,387	Nov., 1914, to June, 1915.
New Jersey	21	8	52	1,315	815	9	6	6,545	476,578	359,971	Nov., 1914, to Aug., 1915.	
New York	62	21	219	5,737	625	150	33	12,142	26,306	947,958	Nov., 1914, to Apr., 1915.	
Ohio	88	39	228	4,069	5,003	3,070	.....	.....	1,397	71,096	Nov., 1914, to Mar., 1915.
Pennsylvania	67	34	892	15,294	10,684	368	33	1,028	4,050	27,744	Nov., 1914, to Mar., 1915.	
Rhode Island	5	3	59	985	379	33	.....	.....	102	12,814	Feb., 1915, to Apr., 1915.
Virginia	100	3	9	378	650	.....	.....	.....	531	119,155	Nov., 1914, to May, 1916.
Washington	39	1	1	102	.....	.....	.....	.....	123	172,222	Oct., 1914 to May, 1916.
West Virginia	55	3	27	194	189	149	.....	.....	4,703	.....	.....
Wisconsin	71	12	40	1,503	1,435	1,764	1	.....	.....	.....	.....
Total	1,284	266	3,556	77,240	85,092	9,767	123	172,222	\$5,865,720	.....	.....

¹Including 9 deer.

The cost to the National Government and the States of eradicating this, the most extensive outbreak that has appeared in this country, was approximately \$9,000,000, which is a small sum compared with the damage that would have resulted if the disease had been allowed to spread and become permanently implanted in this country.

Preparation for Future Outbreaks

Following the outbreak of 1914 the Department began immediately to make preparations for future outbreaks. Experienced men were listed and leaders in the various lines of foot-and-mouth disease activities were selected to insure promptness in organization and action in event of another outbreak. In addition 2,000 copies of a booklet were printed giving information and instructions regarding methods to be followed in the eradication of future outbreaks of foot-and-mouth disease for the guidance of those that may be called upon for such work. A small number was distributed to our various stations and cooperating agencies, but the remainder was held for distribution in case of emergency.

On May 22, 1917, the following letter was sent to the livestock authorities in every State in the Union:

In a letter dated January 16, 1917, you were informed that the Department is desirous of formulating some definite plan of action to be followed in cooperation with the various States in the event that the country should be visited by another outbreak of foot-and-mouth disease. All authorities in charge of livestock sanitary affairs at this time no doubt appreciate the importance of making preparations for combating future outbreaks. It is deemed important that there be an understanding between the Department and your State in regard to cooperation and a plan of action. In case of a future outbreak, it is proposed to follow in general the plan that proved successful in eradicating the outbreaks in this country in 1902, 1908 and 1914. The main features of this plan are application of quarantine, slaughter of affected herds, subsequent cleaning and disinfection of infected premises and sharing of expenses between the State and Federal Government. The Department has been making preparations so as to be ready to respond promptly to any State's request for assistance. It has outlined its proposed plan of action and this plan is submitted herewith for your consideration and approval. In order effectively to carry out the plan for eradicating foot-and-mouth disease, the State laws should provide for:

1. A livestock sanitary board or other executive head with a wide range of power to promulgate regulations without delay to meet conditions as they arise and act independently on matters of detail. The regulations should be in conformity with Federal regulations.

2. An adequate emergency fund immediately available or authorizing the Governor to issue interest-bearing certificates of indebtedness for meeting promptly all expenses incurred in connection with eradication work, including the payment for animals and other property destroyed.

3. Cooperation with the United States Department of Agriculture

in controlling and eradicating contagious diseases of animals, especially foot-and-mouth disease.

4. A State veterinary organization with representatives located in the important livestock districts.

5. Veterinary practitioners to report immediately to the proper authorities all cases of foot-and-mouth disease that come to their attention.

6. The sterilization of public creamery by-products before they are returned to the farm.

7. Authority lodged with the livestock sanitary board or other executive head to establish quarantines of infected herds, exposed herds and as much territory within the State as is deemed advisable.

8. Authority for entering premises and compelling the destruction of animals and property.

9. The appointment of an appraiser or appraisers.

10. The fixing of a just maximum valuation for grade and pure-bred registered animals of affected herds.

11. Penalties for violations of the law and regulations.

If you have not now all the facilities for carrying out this plan, what prospect have you of securing them and how soon do you think your State legislature could provide them?

Following is the plan of procedure which was approved by the authorities of every State:

1. Request the State authorities immediately to quarantine any animals or herds as soon as they are suspected of being affected with foot-and-mouth disease, and to hold these animals and premises under quarantine until a definite diagnosis has been made.

2. Request the State immediately to place guards on the premises when suspicious animals are found and quarantined. A guard will be maintained continuously on all infected premises from the time the disease is discovered until the diagnosis has been proved incorrect or if proved correct, until the premises have been cleaned and disinfected.

3. Confirm the diagnosis. Since infectious vesicular stomatitis has made its appearance in this country it will require an expert to differentiate by inoculation tests this disease from foot-and-mouth disease. If the disease proves to be foot-and-mouth disease the plan of procedure would be as follows:

4. Quarantine a sufficient area to include all probable foci of infection. As the foci of infection have been located and the spread of infection brought under control, reduce the areas quarantined. The circular zone quarantine will be applied where it is considered practicable to do so and territory will be released as rapidly as conditions warrant it.

5. Request the State authorities immediately to quarantine all infected premises and also a sufficient area surrounding the infected herds. When centers of infection are located, urge the State authorities to draw their regulations to correspond with the Federal regulations in regard to extent of territory to be quarantined and the duration of the quarantine.

6. Dispatch representatives of the Department immediately to make arrangements with the State authorities in regard to the details of Federal and State cooperation.

7. Notify by wire the livestock sanitary authorities of all other States and request them to use all their facilities to detect the first appearance of the disease in their respective States.

8. Notify by wire the officials of all railroads tributary to the infected areas and request them to call in for cleaning and disinfection before they are again used all cars that had carried livestock

into or out of the infected territory within a definite period preceding the outbreak.

9. Use telegraph in assembling a sufficient number of veterinarians, lay inspectors and other employees of the Department to participate in the different lines of eradication work.

10. Order by wire equipment sent from the places where it is now stored to the area or areas of operation.

11. Order by wire or telephone disinfectants and any new equipment necessary.

12. Immediately start tracing infected cars.

13. Immediately start tracing probable infected shipments of live-stock and ask the States to do likewise.

14. Immediately quarantine all stockyards where the indications are that infection has reached them.

15. Immediately station men at car-cleaning stations, at railroad points on the borders of the infected areas, and increase the inspection force in public stockyards.

16. Immediately establish headquarters in the area of operations and others as new areas of infection are discovered.

17. Immediately start tracing the origin of the outbreak.

18. Immediately commence educational work, including meetings, distribution of literature, press articles, etc.

19. Urge owners of infected herds to slaughter under the supervision of inspectors all the healthy exposed animals that they will need for their own use and thus conserve all the meat possible.

20. Immediately slaughter all herds found to be affected with the disease. Much has been said about saving purebred herds on farms. Such a policy is considered dangerous.

21. The "Instruction for Employees Engaged in Eradicating Foot-and-Mouth Disease" give further information in regard to the details of our plan of action for field operations.

22. The expenses shall be shared equally between the Department and the State for:

(a) Animals destroyed.

(b) Burial of affected herds.

(c) Property destroyed in connection with the cleaning and disinfection of infected premises.

(d) Cleaning and disinfecting infected premises, including labor, disinfectant, teaming, pumps and their equipment, and the implements used in cleaning.

(e) Hiring of guards.

(f) Office rents.

(g) Guns and ammunition.

23. The U. S. Department of Agriculture shall jointly direct the work of eradication in cooperation with the State Live Stock Sanitary authorities.

24. Appraisals of affected and exposed animals shall be made by an appraisal board consisting of a representative of the Department, a representative of the State and the owner or his representative.

25. Federal and State officials cooperating in an infected district will carry on their work from the same headquarters in order that they may confer when necessary on matters relating to the work.

Outbreak of 1924

This country was entirely free from foot-and-mouth disease from the termination of the 1914 outbreak until February, 1924, when the malady suddenly appeared in the vicinity of Oakland, California.

Within an hour after the telegram was received on February 23 an-

nouncing a positive diagnosis the Secretary of Agriculture issued a quarantine order and the Bureau office force was busily engaged in preparing telegrams ordering picked, experienced men to proceed to California to reinforce the Bureau and State forces in that State, notifying railroads and stockyard companies, preparing press notices, dating and sending out circular letters and other literature which had been prepared for such an emergency, and forwarding office supplies, including forms for reporting the field work. Livestock sanitary officials and Government inspectors throughout the country, especially west of the Mississippi, were promptly advised regarding the appearance of the disease in California. In addition, radio stations cooperated with the Department in broadcasting warnings and advising livestock owners to watch for symptoms of the disease and to report promptly any suspicious cases to either the State or Federal officials.

Headquarters were established at Oakland and Dr. Rudolph Snyder, inspector in charge of the field forces regularly assigned to California and who had previous experience in foot-and-mouth disease eradication work, was placed in charge of the Bureau field force. At the request of the Bureau, Dr. S. E. Bennett, who had directed Bureau forces in the outbreaks of 1902, 1908, and 1914, and who happened to be in California at the time of the outbreak, was released by the Union Stockyards Company to serve in an advisory capacity to Dr. Snyder and the State officials. The State cooperative activities were headed by Mr. G. H. Hecke, Director of Agriculture, and Dr. J. P. Iverson, Chief of the State Division of Animal Industry. County and municipal officials, peace officers and public-spirited stockmen, also the representatives of numerous organizations, extended their support and assistance to the Federal and State officials in a united effort to eradicate the disease. Later, at the request of Governor Friend W. Richardson of California, the Federal and State forces were combined under the leadership of Dr. U. G. Houck, effective April 24, 1924.

The source of this outbreak is unknown at present, but it is believed that the infection was carried to California from the Orient. The disease first appeared in hogs that were being fed on garbage obtained from ships which docked at the Mare Island Navy Yard in San Francisco harbor.

As in previous outbreaks, the policy of promptly slaughtering infected herds, the cleaning and disinfecting of infected premises, and the remuneration of owners was adopted immediately, as this procedure had proved effectual in previous outbreaks and seems to be the

only certain way of protecting as far as possible the nation's eight-billion-dollar livestock industry against this disease.

Rapid progress was made in stamping out the disease in the three counties, Alameda, Contra Costa and Solano, in which it first appeared and to which it was confined until March 22. On that date infection was discovered in a large herd of range cattle in Merced county. Shipments leaving that county for slaughter before the disease was discovered there, carried infection to stock yards in Los Angeles, Stockton and San Francisco. From Merced the infection was also spread to Madera county. The outbreaks in Merced, Madera and Los Angeles counties were extensive and serious and control was not established until early in May. Other counties in which outbreaks have occurred are Kern, Stanislaus, San Bernardino, Orange, Tulare, Tuolumne and Fresno. In this group outbreaks have been limited and have been eradicated or appear to be under satisfactory control, except in Tuolumne county, where the disease was found in range herds. Additional time must elapse before the seriousness of the outbreak in that county can be determined. The extent of the disease up to May 19 when this chapter went to press is shown by the following figures: Total infected herds 379, involving 41,753 cattle, 20,158 hogs, 22,462 sheep, and 538 goats.

SCABIES IN SHEEP*

In reviewing the early reports of the Bureau it is found that sheep scab caused heavy losses. In a communication in 1890, covering conditions in New Mexico, the following statement on this subject is noted:

One of the greatest difficulties that has beset flockmasters of New Mexico has been the careless, indifferent management regarding scab. Those flockmasters that use the proper precautions were found handicapped by the slipshod sheep owner so that it became necessary to move them by legislative enactment.

The Chief of the Bureau in his report for the fiscal year 1895 recommended that regulations under the Acts of May 29, 1884, and March 2, 1895, be issued to prohibit the shipment from one State into another of any animal affected with sheep scab or certain other contagious, infectious or communicable diseases. He stated that such diseases were disseminated and were to a large extent due to contagion carried through channels of interstate commerce, and that they could never be controlled or their ravages greatly diminished until these interstate channels of commerce were thoroughly supervised and purified, and that this purification must include all these

* See "Zoological Division," page 113.

channels, the stockyards in which the animals are unloaded, watered and fed, as well as the railroad cars and boats which transport them.

In the same report, the fact was mentioned that a large export trade in live sheep which had recently been established was menaced by the discovery of scab in many lots when they were landed in foreign countries. Great Britain in 1896 prohibited the importation of live sheep from this country on account of the large number of scabby sheep sent abroad by our exporters. This action impelled the Federal Government to take steps to bring the disease under control. At first employees were stationed at public stockyards to inspect animals offered for export. It was found that the disease continued to appear during the voyage after all affected lots had been rejected.

June 18, 1897, the Department issued an order governing the transportation of sheep affected with scabies. This order, the first that had been issued pertaining to this disease, notified managers and agents of railroads and transportation companies, stockmen and others that the contagious disease known as sheep scab, or scabies of sheep, existed among sheep in the United States, and that it was a violation of the law to receive for transportation or to transport from one State to another stock affected with this disease. This order also required the cleaning and disinfection of railroad cars, boats or other vehicles which had been used in the transportation of scabby sheep. Federal inspectors were then placed at the principal feeding points of all the railroads leading to market centers to inspect and supervise the shipping of sheep.

July 20, 1899, an order was issued requiring that all sheep shipped from stockyards to other States for feeding purposes be dipped in some preparation that would kill the parasites. About 770,000 animals were so treated during that year, and the statement was made that the indications were it would soon be possible to make the stockyards and cars and other channels of interstate commerce safe and free from infection. The question of dips was receiving consideration, as some of those on the market were unsatisfactory in that they did not kill the mite. In July of this year an order was issued that from and after August 10, 1899, no sheep affected with scabies and no sheep which had been in contact with others so affected should be allowed shipment interstate unless said sheep shall first have been dipped in a mixture approved by the Department. The approved dips were tobacco and sulphur and lime and sulphur.

The following year special sheep inspectors were stationed at a number of points in the western range States, and various livestock sanitary officials issued dipping orders. In 1903, 8,306,000 sheep were dipped. As the work progressed, it was found that inspection at public stockyards and at the principal feeding points was not sufficient to eradicate the disease. Inspection was gradually extended to the points at which the sheep originated and were accepted for interstate shipment.

While this plan got nearer to the trouble and was more satisfactory to the sheep growers and transportation companies, it still did not accomplish the desired results. Accordingly June 1, 1905, Federal quarantine was placed on all the territory west of the eastern border of North Dakota, South Dakota, Kansas, Oklahoma and Texas, which included an area of more than 1,700,000 square miles. A plan of co-operation which provided for the inspection of all sheep and the proper treatment of all flocks found to be affected with or exposed to the disease was arranged by the Department with the sheep sanitary commissions of the several States. This plan, which included a range inspection of all sheep in the quarantined area, was found to be very effectual, and from 1905 on continued progress was made toward the eradication of the disease until the beginning of the World War, when the work was somewhat disorganized by the demands for war service. As a result of this disorganization, there was a considerable spread of the disease. Since the war the work has been vigorously conducted and most of the ground lost has been regained.

On July 1, 1923, all of the area originally quarantined for sheep scabies, which comprised 1,785,345 square miles, had been released except 33,415 square miles. The latter area consisted of ten counties and one island in the State of California and three parishes in the State of Louisiana.

Lime-sulphur and nicotin were the dips principally used. In 1907, however, as a result of laboratory experiments and field tests, permission was given, pending further investigation, for the use of creosote dips in the official dipping of sheep for scabies. After experimenting a number of years with the last two mentioned products, it was found that they did not give the results that had been hoped for, and on August 18, 1913, an order was issued which provided that no dip other than lime-sulphur or nicotin would thereafter be given Department permission for use in official dipping of

sheep for scabies, unless it was shown to the satisfaction of the Bureau that the strength of the bath prepared therefrom might be satisfactorily determined in the field by a practicable portable testing outfit. Since that year all official dipping has been accomplished in either lime-sulphur or nicotin solution.

The magnitude of the work involved in the eradication of sheep scabies is shown in the following table:

Inspections and Dippings of Sheep for Scabies.

Fiscal year.	Inspections.	Dippings.
1900.....	1,801,392	626,838
1901.....	7,912,724	1,034,368
1902.....	11,186,661	1,017,162
1903.....	16,444,370	2,167,002
1904.....	40,967,961	9,578,476
1905.....	53,680,786	16,873,659
1906.....	59,246,288	12,396,976
1907.....	62,625,831	12,133,466
1908.....	59,471,141	17,589,578
1909.....	59,762,512	15,597,823
1910.....	52,749,920	12,153,356
1911.....	56,584,129	12,715,631
1912.....	62,261,020	13,891,648
1913.....	59,370,477	12,557,457
1914.....	20,639,428	7,517,578
1915.....	15,659,624	3,790,967
1916.....	19,555,969	6,473,419
1917.....	18,645,071	5,539,919
1918.....	19,630,126	5,585,543
1919.....	22,394,561	10,518,196
1920.....	20,371,965	9,515,720
1921.....	22,114,154	8,273,450
1922.....	24,190,956	8,869,386
1923.....	22,796,623	6,714,961

SCABIES IN CATTLE

The first reference to scabies in cattle is found in the report of the Chief of the Bureau for 1902. At that time numerous inquiries were being received with regard to this disease, which was commonly known as Texas itch. Preliminary inspections and dippings were accomplished during 1903, and on March 18, 1904, regulations were issued to prevent the spread of scabies (mange) in cattle. This order placed in quarantine that part of the United States lying west of the Mississippi River and the eastern boundary of Minnesota and outlined the manner in which animals originating in that section might be moved interstate therefrom. It provided for the dipping of diseased and exposed animals and the cleaning and disinfection of infected premises.

June 1, 1905, a Federal quarantine embracing 1,269,844 square

miles was placed on those States and parts thereof in which the disease was quite prevalent. In the same year a large force of inspectors was detailed to take up the work of inspecting and dipping. As the work progressed the area under quarantine was gradually released. At the present time, while cattle scab prevails to some extent in several of the western range States, no territory is under Federal quarantine.

The scope of these activities during the period from 1904 to 1923 is shown in the figures given below:

Inspections and Dippings of Cattle for Scabies.

Fiscal year.	Inspections.	Dippings.
1904.....	1,124,321	162,554
1905.....	14,085,267	563,394
1906.....	14,983,260	243,826
1907.....	15,243,323	466,623
1908.....	16,920,100	1,527,280
1909.....	17,656,934	1,559,477
1910.....	18,190,456	1,336,829
1911.....	18,593,251	1,234,123
1912.....	17,920,364	1,180,296
1913.....	17,462,824	1,134,476
1914.....	2,812,632	1,807,950
1915.....	1,264,009	588,228
1916.....	2,934,098	691,715
1917.....	1,924,970	343,517
1918.....	1,829,532	642,831
1919.....	1,707,917	935,539
1920.....	2,925,712	1,657,418
1921.....	2,797,001	1,073,696
1922.....	1,508,924	453,708
1923.....	2,398,646	952,857

GLANDERS

Glanders is mentioned in the earliest reports of the Bureau as causing considerable losses in horses.* In 1890 unsuccessful experiments were being conducted for the purpose of ascertaining if animals could be rendered immune from the disease by treatment similar to that adopted for hog cholera. The preparation and free distribution of mallein was commenced in 1893.

In 1899 the use of mallein as a diagnostic agent for glanders was becoming quite general. The Bureau from that year until the present time has carried on investigational work in determining the reliability of mallein as a diagnostic agent, and upon request of State authorities, transportation companies and others, has detailed its

* See "Pathological Division," page 60.

employees to assist in carrying out measures for the control and eradication of glanders. So successful has been the co-operative work between the Bureau and the livestock sanitary officials of the various States that the disease has been nearly suppressed.

PUBLIC STOCKYARDS INSPECTION

An order issued October 20, 1890, requiring inspection at public stockyards of cattle for export, was the beginning of the present system of public stockyards inspection. The scope of this work was gradually enlarged. For several years Texas fever was the only disease that was controlled by this inspection. Later, about 1898, the inspection of sheep for scabies and swine for hog cholera was inaugurated, and the service from that time on was gradually extended until in 1905 the inspection for contagious, infectious and communicable diseases of all livestock received at public stockyards was required. With the perfection of the anti-hog-cholera serum-and-virus treatment, the immunization of swine as a regular activity at public stockyards was taken up under B. A. I. Order 210, effective July 1, 1914.

The inspections and dippings of cattle and sheep and the immunization of swine against hog cholera at public stockyards from 1915 to 1923, inclusive, are indicated by the following figures:

Inspections and Dippings of Cattle.

Fiscal year.	Inspections.	Dippings.
1915.....	12,634,444	18,332
1916.....	14,451,291	7,942
1917.....	18,069,218	20,963
1918.....	20,987,998	52,092
1919.....	22,594,329	10,897
1920.....	20,063,290	24,628
1921.....	18,625,203	30,293
1922.....	18,475,991	11,611
1923.....	20,904,267	12,775

Inspections and Dippings of Sheep.

1915.....	21,397,574	784,849
1916.....	20,538,977	868,689
1917.....	19,368,277	973,272
1918.....	17,019,386	651,339
1919.....	20,597,232	884,294
1920.....	23,472,528	2,744,481
1921.....	22,658,919	1,825,729
1922.....	20,462,270	1,059,801
1923.....	19,516,344	1,004,480

Immunization of Swine.

1915.....	20,759
1916.....	56,494
1917.....	94,720
1918.....	254,731
1919.....	614,673
1920.....	574,558
1921.....	386,130
1922.....	383,295
1923.....	458,097

ENFORCEMENT OF THE TWENTY-EIGHT-HOUR LAW

The original act known as the Twenty-eight Hour Law was passed March 3, 1873. To comply with the act, transportation companies provided feeding, watering and resting facilities at convenient places on their lines. The conditions under which livestock were handled in transit were improved slightly under this law.* Very little consideration was given to the habits of the different classes of animals. The facilities at many of the feeding stations were inadequate. Fences of sufficient strength were not provided at some yards; at others watering troughs were lacking. Dissatisfaction which arose among the shippers on account of these features and the frequent unloading of the animals finally led to the repeal of this act and the enactment of the present law of June 29, 1906.

The enforcement of the latter law has resulted in better facilities being provided for feeding, watering and handling livestock in transit and also has been a means of compelling the railroads to expedite the movement of livestock while in transit. The present law has reduced considerably the shrinkage in transit by causing the animals to be fed at regular intervals and by quickening their journey to market. The Act of 1906 does not authorize measures to prevent overcrowding, the loading of swine or calves under cattle, or the use of long-spiked prod poles. Much has been accomplished through cooperation on the part of the Bureau, transportation companies, shippers, commission men and other interested agencies in controlling abuses of this nature. At the present time animals are arriving at market centers in a great deal better physical condition than formerly, and every possible effort is being exerted to reduce the number of animals that die or suffer injuries in transit which render them worthless or of little value upon arrival at destination. A very marked reduction has been noted in the last two or three years in the number of hogs dying in transit from suffocation as a result of heat and overloading.

* See "Animal Transportation," page 23.

SUMMARY OF IMPORTANT EVENTS

1870. First outbreak of foot-and-mouth disease in the United States.
- March 3, 1873. Original Twenty-eight Hour Law enacted.
1880. Another small outbreak of foot-and-mouth disease in the United States.
- May 29, 1884. The Bureau of Animal Industry established. First few years devoted largely to eradication of contagious pleuropneumonia.
1884. Foot-and-mouth disease again occurred in the United States.
- Oct. 20, 1890. Present system of public stockyards inspection had its beginning in order issued requiring inspection of cattle at public stockyards for export.
- April 1, 1891. Bureau of Animal Industry organized into four divisions, one of which, the Inspection Division, handled all work of an executive nature relating to contagious diseases.
- Sept. 26, 1892. Proclamation issued giving notice that the United States was free from contagious pleuropneumonia.
1896. Great Britain prohibited importation of live sheep from the United States on account of large number of scabby sheep sent abroad by exporters. This caused the Federal Government to take steps to bring the disease under control.
- June 18, 1897. First order issued governing transportation of sheep affected with scabies.
- July 20, 1899. Dipping required of all sheep shipped interstate from public stockyards for feeding purposes. About 770,000 so treated.
- April 1, 1902. A vigorous and systematic campaign was inaugurated for the suppression of dourine.
- Nov. 14, 1902. First extensive outbreak of foot-and-mouth disease. It extended to twelve counties in the States of Massachusetts, New Hampshire, Vermont and Rhode Island. Cost to Federal Government about \$300,000.
- Jan. 20, 1903. Regulations issued governing transportation of horses affected with dourine. Order quarantined portions of Nebraska and South Dakota.
- March 18, 1904. Regulations issued to prevent spread of scabies in cattle.
- June 1, 1905. Sheep scabies quarantine placed on all territory west of the eastern boundary of North Dakota, South Dakota, Kansas, Oklahoma and Texas, comprising area more than 1,700,000 square miles.
- June 1, 1905. Cattle scabies quarantine placed on area comprising 1,269,844 square miles.
1905. Public stockyards service gradually extended until inspection for contagious, infectious and communicable diseases of all livestock received now required.
- June 29, 1906. Present Twenty-eight Hour Law enacted.
- Nov. 7, 1908. A serious outbreak of foot-and-mouth disease occurred. It appeared in fifteen counties in Pennsylvania, New York, Michigan and Maryland. Cost of eradication to Federal Government about \$300,000.

- July 30, 1912. Dourine discovered in Montana. Investigation showed it also prevailed in North Dakota, South Dakota, Arizona, New Mexico, Wyoming and Nebraska.
- Sept. 1, 1912. Inspection Division divided into Meat Inspection Division and Field Inspection Division.
- July 1, 1914. First regulation governing immunization of swine at public stockyards.
- Oct. 15, 1914. The most serious outbreak of foot-and-mouth disease. It spread to twenty-two States and the District of Columbia. 172,222 animals were slaughtered. Cost of eradication to Federal Government about \$4,600,000.
- May 3, 1916. Last animals affected with foot-and-mouth disease slaughtered.
- June 5, 1916. Foot-and-mouth disease quarantine restrictions entirely removed.
- April 15, 1918. Last cattle scabies quarantine released.
- July 1, 1921. 34,415 square miles remained in quarantine for sheep scabies.
- May 1, 1922. All activities of the Quarantine Division transferred to Field Inspection Division.

PERSONNEL OF THE FIELD INSPECTION DIVISION

Chiefs of Division:

DR. R. A. RAMSAY, September 1, 1912, to April 30, 1917.

DR. A. W. MILLER, May 1, 1917, to date.

Assistant Chiefs of Division:

DR. W. P. ELLENBERGER, September 1, 1912, to April 30, 1917.

DR. S. O. FLADNESS, July 1, 1917, to September 19, 1920.

DR. W. P. ELLENBERGER, September 20, 1920, to date.

DR. GEORGE W. POPE, May 1, 1922, to date.

Division of Hog-Cholera Control*

We have no record of the presence of hog cholera in the United States prior to the outbreak in Ohio in the year 1833. Apparently this was the first appearance of the disease in this country. It spread from Ohio and eventually reached every State in the Union. While hog cholera has been a constant menace to the hog-raising industry for over 90 years, it has been exceptionally prevalent at certain periods. During these periods nearly all the swine in some communities were destroyed.

No medicinal or prophylactic treatment which proved effectual in coping with this highly contagious plague had been discovered before the development of the present immunization treatment.

Extensive demonstrations were undertaken in a number of counties located in some of the States of the Middle West in 1913 to show the feasibility of reducing losses from hog cholera through the use of anti-hog-cholera serum as an immunizing agent and the improvement of sanitation in raising hogs. In conducting these demonstrations serum, virus and the services of trained veterinarians were furnished to swine growers by the Bureau free of charge.

The field work was conducted under the supervision of the Biochemic Division of the Bureau until the end of the calendar year 1915. On January 1, 1916, owing to the large volume of work of the Biochemic Division, and in accordance with the policy adopted at that time of segregating research and regulatory activities, the hog cholera field work was made a separate function of the Bureau and placed in the newly created Office of Hog Cholera Control under the supervision of Dr. O. B. Hess, who had been brought to Washington on April 2, 1914, to assist the Chief of the Biochemic Division in the administration of cholera control activities. At that time hog cholera field work was being carried on in 16 counties in 13 States, as follows: Decatur County, Georgia; Montgomery and Hendricks Counties, Indiana; Dallas and Clay Counties, Iowa; Davison County, South Dakota; Gage and Johnson Counties, Nebraska; Maury County, Tennessee; Henderson County, Kentucky; Marshall County, Kansas; Rentville County, Minnesota; Branch County, Michigan; Pettis County, Missouri; Twin Falls County, Idaho, and Muskogee County, Oklahoma. In addition to these county projects, statewide educational work was being conducted in nine States: Alabama, Arkansas, California, Florida, Virginia, Oklahoma, Tennessee, Texas and North Carolina.

* See "Hog Cholera," page 21, and "Biochemic Division," page 158.

ACTIVITIES IN 1916

Texas.—On August 16, 1916, the project, which had been entirely educational, was modified to include regulatory work, and the headquarters of the inspector in charge were moved from Bryan to Fort Worth.

Iowa.—The work was extended from county projects to intensive activities in larger areas, and the headquarters were changed from Adel in Dallas County and Spencer in Clay County to Des Moines on July 1, 1916.

Georgia.—On July 1, 1916, the county project and the educational work were discontinued and regulatory activities were extended to the principal hog-raising districts in cooperation with the regulatory officials of the State. The headquarters were located at Atlanta.

Indiana.—The work, which had been confined to two counties, was changed to intensive efforts in a larger territory. The official station was located at Indianapolis, July 1, 1916.

Michigan.—On July 1, 1916, the work was extended from one county to include several counties and the headquarters were moved from Coldwater to Lansing.

North Carolina.—Regulatory work was taken up September 1, 1916, a joint project agreement having been entered into with the State regulatory authorities and the officials of the State Agricultural College. Elizabeth City was selected as the official station.

Kansas.—Headquarters were changed from Marysville to Topeka on October 20, 1916, and several counties were added to the territory.

Tennessee.—The county project was discontinued on September 18, 1916, and was replaced by statewide educational work in November of the same year.

Ohio.—Intensive work comprising four counties was taken up on August 16, 1916, headquarters being located at Columbus.

Oklahoma.—The county project was discontinued June 19, 1916, also the educational work in the following month.

Missouri.—The territory was extended from one county to 11 counties, the headquarters remaining at Sedalia.

Idaho.—In June, 1916, the work was extended from one county to intensive regulatory activities in four counties comprising the principal hog-raising sections of the State. The headquarters remained at Twin Falls.

Kentucky.—The county project was moved from Henderson County to Bourbon County on June 17, 1916. At a meeting of the Kentucky

Live Stock Sanitary Board, August 8, 1916, Jefferson, Bullitt, Hardin and Nelson Counties were selected as the territory for intensive hog-cholera work. The headquarters remained at Frankfort.

Minnesota.—The county project was discontinued in October, 1916.

On October 9, 1916, Dr. T. P. White was brought to Washington from a field assignment in South Dakota to assist in the administration of hog-cholera control work. During the year the activities were extended to 127 counties. On account of the rapid growth of the work and the limited appropriation, the Bureau found it necessary, effective January 1, 1916, to discontinue supplying serum and virus for the immunization of swine herds. In the counties in which control work had been carried on there was an increase in the number of hogs raised from 859,910 in 1912 to 1,334,644 in 1915. At the same time there was a decrease in the number of hogs killed by cholera from 132,296 in 1912 to 30,668 in 1915, which meant an increase of 474,734 and a saving of 121,628 animals. It was estimated that cholera killed 59.6 hogs per 1,000 throughout the country.

ACTIVITIES IN 1917

During the fiscal year 1916-17 intensive regulatory activities were extended to 295 counties in the following States: Georgia, Iowa, Indiana, South Dakota, Nebraska, Tennessee, Kentucky, Kansas, Missouri, Idaho, Michigan, Oklahoma and Texas. The project in Ohio, directed by the Extension Division of the Agricultural College, included the same class of activities as were being performed in other States in cooperation with the regulatory authorities. General extension of the work made a change of headquarters necessary in many of the States where projects were already established, as well as locating new stations in States to which activities were being extended at this time.

With the increase in territory covered it was found necessary to adopt new plans and policies. It was recognized that less personal service could be rendered than had been done when working in small territories such as the county units; therefore it was thought of more advantage to all concerned to carry on the work along the following lines: On receipt of a report of an outbreak, the inspector proceeded to the infected locality. If cholera was found the Bureau veterinarian investigated the outbreak to find the source of infection and the extent to which it had spread in the community. He conferred with farmers and local veterinary practitioners on methods to control the disease and prevent losses. The owners of infected and exposed herds

were advised as to treatment and sanitary measures to be applied. Where practicable either warning cards were posted at the entrance to the infected premises or quarantine was imposed. Neighboring hog owners were informed of the existence and location of outbreaks in order that they might guard their herds against exposure. Assistance was offered to local practicing veterinarians, especially those whose experience in the use of serum and virus was limited.

In States where laws were adequate and enforced, infected farms were placed under quarantine until such time as the herds had recovered, the dead animals had been properly burned or buried, and the premises had been thoroughly cleaned and disinfected. In sections of the Southern States where the services of veterinarians were not available it was found necessary for Bureau inspectors to treat as many hogs as possible for the farmers until other satisfactory arrangements could be made. In some communities, provided the State laws permitted, laymen were trained to administer the treatment so that protection might be available in case of serious outbreaks. While the Bureau generally does not encourage the use of such dangerous agents as hog-cholera virus by laymen, the plan is still adhered to in those localities in order to promote the swine industry while awaiting the time when veterinarians may be available.

During the year 1917 regulatory work was established in a number of additional States. These projects were placed as follows:

Tennessee, January 1, 1917	Wisconsin, November 19, 1917
Arkansas, March 1, 1917	Delaware, December 3, 1917
Maryland, March 5, 1917	Utah, December 16, 1917
Illinois, May 11, 1917	Montana, December 17, 1917
Oklahoma, September 5, 1917	Colorado, December 16, 1917
South Carolina, November 19, 1917	

In Maryland and South Carolina the educational and regulatory work were combined.

The headquarters were located as follows:

Tennessee	Nashville
Arkansas	Little Rock
Maryland	College Park
Illinois	Springfield
Oklahoma	Oklahoma
Wisconsin	Madison
Delaware	Newark
Utah	Salt Lake City
Montana	Helena
Colorado	Denver
South Carolina	Clemson College

South Dakota.—The work, which had been confined to one county, was changed and extended to statewide educational efforts and the

headquarters were moved from Mitchell to the Office of Extension of the A. & M. College at Brookings, July 1, 1917.

Nebraska.—The work, which had been confined to two counties, was extended to larger areas and the headquarters were changed from Beatrice to the University Farm, State Agricultural College, Lincoln, July 27, 1917.

North Carolina.—On November 1, 1917, the headquarters were moved from Elizabeth City to Raleigh and regulatory efforts were extended to larger districts in the State.

Kentucky.—The official station was moved from Frankfort to Louisville, January 22, 1917.

Educational work was established during the year (1917) in the following States on the dates stated:

Louisiana, November 15; headquarters, Baton Rouge.

Illinois, November 19; headquarters, Urbana.

Utah, December 3; headquarters, Logan.

Colorado, December 24; headquarters, Fort Collins.

West Virginia, December 24; headquarters, Morgantown.

During the year 343,822 hogs were given the preventive serum treatment by Bureau inspectors in the course of demonstrational work. Farm visits were made to the number of 15,560, and 2,056 meetings were held, with an attendance of 100,190 persons interested in the suppression of hog cholera. Successful efforts were made in bringing about better cooperation on the part of practicing veterinarians, resulting in more uniform and better methods of treatment and more equitable charges. According to the best information available, the number of hogs decreased 313,000 during the year and the loss from cholera was reduced to 43.7 per 1,000 hogs, a decrease of approximately 30 per cent from the death rate of the preceding year.

ACTIVITIES IN 1918

An increased appropriation for the fiscal year 1917-18 made it possible to place in the field an average force of 175 veterinarians, and to extend regulatory work from a limited number of counties in 21 States to statewide activities in 31 States, namely: Alabama, Arizona, Arkansas, California, Colorado, Delaware, Florida, Georgia, Idaho, Indiana, Illinois, Iowa, Kansas, Kentucky, Louisiana, Michigan, Mississippi, Montana, Missouri, Maryland, Nebraska, North Carolina, North Dakota, Ohio, Oklahoma, South Carolina, Tennessee, Texas, Utah, Virginia and Wisconsin. The work in West Virginia and New Mexico remained wholly educational in character.

Illinois.—Educational work was discontinued on March 9, 1918, a regulatory project being established in the State in cooperation with the office of the State Veterinarian at Springfield.

Delaware.—Headquarters were moved from Newark to Dover January 1, 1918.

California.—Regulatory work was inaugurated on April 25, 1918, headquarters being located at Sacramento.

Missouri.—The official station was changed from Sedalia to Jefferson City on March 26, 1918.

Ohio.—The regulatory phase of hog cholera work, which had been administered from the Office of Extension, Ohio State University, Columbus, in connection with the educational features, was transferred to the regulatory officials of the State and headquarters established with the State Veterinarian in the Annex State House, Columbus, April 8, 1918. The educational project continued in force in cooperation with the University.

Kentucky.—On April 4, 1918, in order to bring about a closer contact in the administration of cooperative regulatory work, the headquarters were moved from Louisville to Frankfort, an office being established with the State Veterinarian in the State Capitol.

Alabama.—The official station was moved from Auburn to Montgomery January 1, 1918, and from there to Troy the following September.

Louisiana.—On August 15, 1918, the educational project in Louisiana was combined with regulatory work, headquarters remaining at Baton Rouge.

South Carolina.—The official station was moved from Clemson College to Columbia September 9, 1918.

Mississippi.—A project agreement was entered into with both the regulatory and educational forces and work established March 25, 1918. Headquarters were located at Jackson.

Kansas.—An educational project was placed with the State College of Agriculture on August 1, 1918, headquarters being located at Manhattan.

Georgia.—An educational project was reestablished March 1, 1918, with headquarters at Athens.

Oklahoma.—Educational work was reinaugurated in September, 1918, with headquarters at Stillwater.

The St. Louis Conference

Early in 1918 the Secretary of Agriculture (Hon. D. F. Houston) called a meeting at St. Louis, Mo., to discuss policies involved in con-

ducting hog cholera work. The meeting was held on January 12, 1918, and was attended by representatives of the Bureau, officials of State agricultural colleges of principal hog raising States, and also by State regulatory authorities. Discussion and exchange of views on the various phases of the work brought about an understanding which proved beneficial to all concerned in the hog cholera activities. The following tentative outline defining regulatory and educational activities in cooperative hog cholera work was adopted:

Educational (Extension)

General instruction on hog cholera in conformity with Bureau publications and policies.

Lectures and demonstrations in the use of serum.

Lectures and demonstrations in the use of virus, when authorized by proper State authorities.

Giving information regarding rules and regulations of livestock board.

Organization of farmers for educational purposes on hog cholera.

Control (Regulatory)

Diagnosis of disease.

Post-mortem demonstration.

Establish quarantine on definite areas.

Enforcement of rules and regulations of livestock sanitary board regarding quarantine, disinfection, etc.

Kind of serum and virus permitted.

Establishing serum depots or perfecting plans for supply and distribution, regulating veterinary fees, etc.

Appointing deputies, either veterinarians or laymen, and instructing them in regard to their duties.

Organization of quarantined farmers where adequate organizations do not exist.

Specific instructions on reasons for quarantine.

Specific instructions on methods to be adopted to have quarantine removed.

Finally, the removal of quarantine.

Cooperative Work

Educational agents should cooperate with regulatory authorities in educational work on hog cholera in quarantined districts.

Regulatory authorities should be advised of hog cholera condition by educational agents outside quarantined areas.

In these areas outside of quarantine, general educational work on hog cholera should be done by the educational agency, but when these areas are placed under quarantine, then regulatory authorities shall request the assistance of educational agents as above mentioned.

Extension divisions should solicit cooperation with the regulatory forces of the State in drawing up plans for statewide educational hog cholera work and provide in these plans for the assistance of the State regulatory forces in all educational work such as farmers' meetings, extension schools, etc.

Following the adoption of this division of work, it was moved and carried that this conference recommend to the United States Secretary of Agriculture that the Bureau of Animal Industry be authorized to enter into agreements with the State regulatory authorities to furnish Bureau of Animal Industry inspectors to assist in regulatory work, according to the definition adopted by this conference; also that Bureau of Animal Industry inspectors be assigned to the State agricultural colleges to assist in educational work, as per definition of this conference, according to the needs and desires of the respective officials.

During the fiscal year efforts were concentrated on stimulating production and conservation of swine as a war measure. As a part of the activities of Bureau inspectors, 38,046 calls for assistance were answered, 371,792 farmers were interviewed and advised, and about 5,000,000 hogs were treated by cooperating veterinarians. There was an increase of 3,921,000 in the number of hogs according to the published estimates, and the losses from hog cholera were reduced to 37.9 per 1,000, the lowest death rate in swine since the inauguration of hog cholera work.

An important part of the work was the attention given to hogs brought to farms from public stockyards for feeding purposes. This phase of the swine industry had grown to a large extent since 1914, in which year the Bureau took charge of the immunization and disinfection of such hogs at the stockyards. These shipments had increased from 20,759 hogs in 1915 to 254,731 in 1918. The field men on hog cholera work kept in touch so far as possible with these shipments after they reached destination. These precautions were taken in order to give further encouragement to these shipments and to protect the feeders from losses while finishing these animals for market.

ACTIVITIES IN 1919

Statewide activities were continued in 34 States during the year 1919 and practically the same number of veterinarians were kept in the field as in the preceding year, though it became necessary to reduce the force toward the close of the year in order to keep expenditures within the limits of the appropriation.

On April 15, 1919, Dr. O. B. Hess resigned as inspector in charge of the Office of Hog Cholera Control. The following day Dr. U. G. Houck was placed in charge of the work. The designation of this branch of the Bureau was changed from Office of Hog Cholera Control to Division of Hog Cholera Control, April 16, 1919.

West Virginia.—Following the resignation of the inspector in charge of the educational project, July 15, 1919, no one was assigned to fill the vacancy.

Kansas.—On December 31, 1919, the educational project, which had been administered in cooperation with the Extension Division of the Agricultural College at Manhattan, was discontinued.

Colorado.—The educational project was discontinued January 1, 1919.

Missouri.—At the request of the Director of Extension of the Missouri State College of Agriculture, an educational project was placed

in that State December 23, 1918. The project was withdrawn on October 10 of the following year.

During the fiscal year 51,022 calls for assistance were answered, 53,586 post-mortem examinations were made to diagnose swine diseases, 93,512 farms were visited, 2,743 meetings were held with an attendance of 78,584 persons, and 315,357 farmers and others interested in the swine industry were interviewed and advised. The records show that 238,987 hogs were immunized by Bureau veterinarians, while in addition it is estimated that more than 12,000,000 hogs were given the treatment by cooperating veterinarians. There were investigated 12,336 outbreaks of hog cholera, and in cooperation with State officials 9,564 farms on which hog cholera existed were quarantined. Of the farms quarantined 4,382 were cleaned and disinfected under supervision.

The number of hogs in the United States increased from 71,374,000 on January 1, 1918, to 75,587,000 on January 1, 1919, an increase of 4,315,000 hogs. This increase was largely due to the advance in price as a result of the war and because of the protection afforded swine growers through the cooperation of the Bureau with the various State agencies to reduce losses from hog cholera.

According to official estimates the losses from hog cholera during the year were reduced to 37 per 1,000. The shipment of stocker and feeder hogs from public stockyards to farming communities continued to increase, the number returned to farms to be finished for marketing reaching 614,673. The field inspectors kept these shipments under supervision, and gave considerable attention to hogs fed at garbage-feeding establishments.

ACTIVITIES IN 1920

During the greater part of the fiscal year 1920 there were maintained in the field approximately 140 veterinarians. This number was gradually reduced in the last quarter owing to a reduction of the appropriation and consequent curtailment of activities in the next fiscal year. While the Bureau had discontinued treating hogs in communities where the services of veterinary practitioners were available, it was found necessary to render a certain amount of personal service in suppressing outbreaks in sections of the South where veterinary service was not available, and Bureau inspectors continued to train laymen to administer serum and virus in localities where it was deemed advisable and where State laws permitted such practice.

In the principal hog-raising States supplied with veterinary practitioners the work was of an advisory and supervisory nature. Out-

breaks of hog cholera reported by county agents, veterinarians, farmers and others who cooperated were investigated so far as the number of field inspectors would permit, and diagnoses were made and proper advice was given to swine owners as to methods of treatment, cleaning and disinfecting. As much time as possible was spent with local practitioners, discussing problems of cholera control.

New York.—An educational project was placed in New York, in cooperation with the Extension Division of the Agricultural College at Ithaca, effective January 1, 1920.

Arizona.—The inspector in charge of regulatory work resigned on April 15, 1920, and in view of the limited production of swine in that State the vacancy remained unfilled.

California.—The inspector in charge of educational work resigned on April 5, 1920. The vacancy remained unfilled.

Oklahoma.—The inspector in charge of educational work resigned on May 31, 1920. The vacancy was not filled.

Idaho.—The headquarters were moved from Twin Falls to Boise in September, 1920.

The activities for the year are summed up as follows: Number of meetings, 1,005; attendance at these meetings, 62,144; number of hogs treated for demonstration, 347,702; attendance at demonstrations, 8,725; number of farms visited, 46,125; number of farms quarantined, 6,129; premises cleaned and disinfected, 2,099; interviews on hog cholera prevention, 200,034; number of laymen trained to administer the treatment against hog cholera, 472. There were reported to the inspectors in the field through various sources 9,788 outbreaks of hog cholera. The mortality rate was estimated that year to be 46.3 per 1,000 hogs.

ACTIVITIES IN 1921

A greatly reduced appropriation for the year 1921 compelled the reduction of the field force on hog cholera work from 140 veterinarians to 54. Efforts during the year were directed especially to preventing the spread of infection from primary outbreaks with a view to saving as many hogs as possible. In view of the reduction of funds and the attitude of Congress toward duplication of work by the Bureau and the extension service of the agricultural colleges, all projects which were purely educational in character were withdrawn at the beginning of the fiscal year. Such projects were in effect at that time in Florida, Georgia, New Mexico, New York, South Dakota and Ohio. In Georgia and New Mexico the colleges assumed the payment of the salaries and the traveling expenses of the Bureau inspectors and the work was continued under the direction of the extension officials.

Even with the greatly reduced force, a great amount of good resulted from the work in the field. During the year 1,202 meetings were held with an attendance of 50,928. Demonstrations in the use of serum and virus were given to the number of 3,420, in which 67,295 hogs were treated. These demonstrations were witnessed by 8,140 persons. Investigations were made on 29,423 farms; 3,888 autopsies were held; 2,268 infected premises were quarantined; 656 such places were cleaned and disinfected; 96,115 farmers and others interested in the control of hog cholera were interviewed and advised, and 432 laymen were trained to administer the serum treatment. The mortality rate in swine from hog cholera during the year was estimated to be 39.3 per 1,000.

ACTIVITIES IN 1922

The work in 1922 was administered and conducted along similar lines as in 1921. There was an increase in the amount of funds provided which made it possible to maintain approximately 80 veterinarians in the field during the year. Activities were continued in the following States:

Alabama	Illinois	Mississippi	South Carolina
Arkansas	Indiana	Missouri	South Dakota
California	Iowa	Montana	Tennessee
Colorado	Kansas	Nebraska	Texas
Delaware	Kentucky	North Carolina	Utah
Florida	Louisiana	North Dakota	Virginia
Georgia	Maryland	Ohio	Wisconsin
Idaho	Michigan	Oklahoma	

California.—A new project agreement was signed with the State officials embodying both regulatory and educational features. Sacramento was made the headquarters under the new agreement, which was made effective July 1, 1921.

West Virginia.—Regulatory work in cooperation with the State authorities was begun on June 19, 1922, with headquarters at Charleston. The work was placed under the supervision of the inspector in charge of tuberculosis eradication, adding another State to the number in which the projects are combined.

During the fiscal year 1922 a total of 1,074 meetings were held, at which 67,408 persons interested in hog cholera work were present. In connection with these activities 171,325 farmers and others were interviewed, and 47,137 farms were visited for investigation, in the course of which 5,390 autopsies were held to diagnose swine diseases. Out of 7,920 outbreaks of swine diseases reported Bureau inspectors were able to investigate 6,333 cases, and diagnoses were made as fol-

lows: Cholera, 3,887; hemorrhagic septicemia (swine plague), 55; necrobacillosis, 368; pneumonia, 499; tuberculosis, 88; other conditions, 1,436. A total of 1,401 farms were quarantined and 439 premises were cleaned and disinfected. Demonstrations in the use of serum and virus were given in 4,343 herds before a total attendance of 26,428 persons, 86,846 hogs being treated in these demonstrations. During the year 246 laymen were trained to administer the serum treatment.

It was estimated that during the year 48.7 hogs per 1,000 died of cholera as compared with 39.3 in 1921. The increased loss was the result of extensive outbreaks in various sections of the country early in the year. Many farmers in those localities were financially unable to purchase serum for immunization, and before the outbreaks could be checked considerable losses had been sustained.

ACTIVITIES IN 1923

During the year ending June 30, 1923, approximately 80 veterinarians were maintained in the field doing work on similar lines as in the preceding year. Again the appropriation for the ensuing year (1924) was reduced, which compelled a reduction of the field force to about 47 veterinarians during the latter part of the year. Many of the excess men who were to be transferred on July 1 were placed in other lines of work on March 1 and at later dates as opportunities were presented.

Florida.—The hog cholera work was combined with tuberculosis eradication work on April 9, 1923, and the two projects placed under the direction and supervision of one inspector in charge.

New Mexico.—An educational project was placed in New Mexico on October 1, 1922, but owing to the reduction of funds for 1924 the work was discontinued on June 1, 1923.

West Virginia.—The regulatory project was withdrawn on June 19, 1923.

During the fiscal year 1,418 meetings were held at which 84,896 persons were in attendance. In the course of the year 51,306 visits were made to farms to investigate conditions and 183,545 interviews were held with farmers and others for the purpose of advising them in the control of hog cholera. There were reported from all sources 7,074 cases of hog cholera, 5,182 autopsies were made through which hog cholera was diagnosed in 4,081 cases and other diseases in 1,101 cases. In addition to the diagnoses through autopsies, diseases of swine other than cholera were diagnosed in 1,411 cases without mak-

ing autopsies. There were 1,632 premises quarantined and 896 were cleaned and disinfected. A total of 4,855 demonstrations in the use of serum and virus were given, during which 108,472 hogs received the treatment and 21,547 persons were present. There were 320 laymen trained in the use of the simultaneous treatment in sections where no veterinary services were available. The mortality rate for the year was placed at 40.4 per 1,000, estimating that 80 per cent of losses from all causes was due to cholera.

CONSOLIDATION OF ANIMAL DISEASE ACTIVITIES

From time to time, in accordance with the Bureau's policy of combining its several disease-control activities in a State under one inspector in charge, the hog cholera work was consolidated with other projects in the field. So far, the work has been combined in the following States on the dates mentioned:

Missouri, December, 1918	Texas, July, 1920
California, December, 1918	Indiana, April, 1920
South Dakota, December, 1918.	Nebraska, April, 1920
Kansas, February, 1919	Iowa, May, 1920
Ohio, May, 1919	Utah, July, 1920
Tennessee, June, 1919	Idaho, September, 1920
Colorado, July, 1919	Oklahoma, November, 1920
Kentucky, August, 1919	Georgia, March, 1921
Louisiana, October, 1919	Mississippi, November, 1921
South Carolina, October, 1919	West Virginia, June, 1922
Montana, December, 1919	Florida, April, 1923
Arkansas, January, 1920	North Carolina, December 26, 1923

Tick eradication has been kept under separate supervision except in South Carolina, Louisiana, Texas and Oklahoma.

The appropriations have not been sufficient to undertake systematically the eradication of hog cholera, but through field work during the past 11 years our knowledge concerning this dreaded malady has been materially increased and many times the cost of the field work has been saved to the swine industry. There seems to be no doubt that when public sentiment becomes more favorable and sufficient funds are provided, hog cholera can be eradicated as successfully as we have eradicated contagious pleuropneumonia, foot-and-mouth disease, dourine, and sheep and cattle scabies, and as successfully as we are now eradicating bovine tuberculosis and the southern cattle tick.

APPROPRIATIONS

No special appropriation was made for hog cholera field work prior to the fiscal year ending June 30, 1914. The money spent for such work before that date was allotted by the Bureau from available funds. The appropriations for field work were as follows:

1914. Regular appropriation	\$ 75,000
1915. Special appropriation	450,000
(Available February 23, 1914, and until exhausted)	
1916. Regular appropriation	110,000
Out of special funds	136,000
Total	\$246,000
1917. Regular appropriation	150,000
Out of special funds	48,710
Total	\$198,710
1918. Regular appropriation	208,800
War emergency funds	138,065
Total	\$346,865
1919. Regular appropriation	247,600
War emergency funds	202,965
Total	\$450,565
1920. Regular appropriation	446,865
1921. Regular appropriation	192,200
1922. Regular appropriation	285,480
1923. Regular appropriation	285,080
1924. Regular appropriation	181,500

SUMMARY OF IMPORTANT EVENTS

- Jan. 1, 1916. Office of Hog Cholera Control created.
- Jan. 1, 1916. The supplying of free serum discontinued.
- July 1, 1917. Work made statewide instead of limited to counties.
- Jan. 12, 1918. St. Louis Conference.
- Dec. 1918. Policy of combining hog-cholera activities with other animal-disease control projects under one inspector in charge inaugurated.
- Apr. 16, 1919. Office of Hog Cholera Control changed to Division of Hog Cholera Control.

PERSONNEL OF THE DIVISION OF HOG-CHOLERA CONTROL

In charge:

- Dr. M. DORSET, Chief of the Biochemic Division, in charge of hog-cholera work to January 1, 1916.
- Dr. O. B. HESS, in charge of Office of Hog Cholera Control, January 1, 1916, to April 15, 1919.

Chief of Division:

- Dr. U. G. HOUCK, April 16, 1919, to date.

Assistants:

- Dr. U. G. HOUCK, July 16, 1913, to April 1, 1914.
- Dr. O. B. HESS, April 2, 1914, to January 1, 1916.
- Dr. T. P. WHITE, October 9, 1916, to date.

Tick Eradication Division

The field studies of Dr. D. E. Salmon, Chief of the new Bureau, convinced him that the losses which occurred so regularly every summer from Texas fever were largely the result of ignorance of the districts from which it was dangerous to bring cattle in summer and to which adult cattle could not be taken with safety at any season of the year unless for immediate slaughter.* State laws and regulations had failed to accomplish their purpose, as outbreaks had occurred in New York, New Jersey, Pennsylvania, Maryland, Virginia, West Virginia, Ohio, Illinois, Missouri, Kansas and Dakota, and in most of these States the disease had appeared repeatedly. Therefore it seemed that an approximately correct determination of the northern boundary of the permanently infected area was a matter of supreme importance at that time. In 1883 the northern boundary line of this area had been determined for 200 miles west from the Atlantic Ocean through Virginia. During the year 1884 it was extended to the Mississippi River, in 1885 to the Rio Grande River, and in 1895 it was extended from the Rio Grande to the Pacific Coast. This line has been modified from time to time to correspond with the progress made in eradicating the tick. Little work was done on Texas fever between 1884 and 1888 besides determining the northern boundary of the infected area and collecting data on the disease, as the efforts of the Bureau were concentrated on the eradication of contagious pleuropneumonia and on hog-cholera investigations.

On July 3, 1889, the first Texas fever quarantine order was issued by the Bureau. This order required that cattle from the quarantined area en route to northern markets be yarded away from native cattle in separate pens, and that the cars in which they were transported be cleaned and disinfected before they were again used. The order remained in effect until November 1 of that year, and similar orders have been issued every year since that time.

DISCOVERING THE CAUSE OF TEXAS FEVER

The Bureau was fortunate in obtaining the services of Dr. Theobald Smith* on July 1, 1884, to take charge of the investigations of infectious animal diseases under the supervision of the Chief of the Bureau. It was during the summer of 1888 that Dr. Smith first noticed the destruction of the corpuscles in the blood of cattle sick with Texas fever, and he began to formulate theories as to how it came about. His observations in 1888 led to systematic experiments, beginning June 27,

* See "Texas Fever," page 15, and "Pathological Division," page 55.

1889, which were at once fruitful in confirming a previous discovery made in 1886, of a peculiar microorganism in the red blood corpuscles, a protozoon which later studies proved to be the true cause of the disease. Dr. R. C. Stiles was the earliest and the only observer hitherto who had laid any stress upon the changed condition of the blood corpuscles in this disease. His description would lead one to believe that he saw the microorganism of Texas fever in the red corpuscles of the blood of infected cattle in 1868, but he did not prove its relation to the disease. And Babes had diagnosed these organisms as bacteria (*hæmatococcus*) for Starcovici, who found them in the blood of Rumanian cattle in 1888.

At the same time that Smith discovered this organism in the blood corpuscles, other experiments indicated that the cattle tick was somehow necessary to the transmission of the disease, and finally Texas fever was caused experimentally by putting recently hatched ticks on susceptible cattle protected from any other possible source of infection.

Dr. Cooper Curtice, a member of the Bureau force, began the study of the life history of the tick in the fall of 1889, and on December 16 his first experiment was completed. It was discovered quite accidentally that adult females kept confined in bottles or other receptacles always lay their eggs. Such a stock of eggs furnished the starting point for Dr. Curtice's investigations. Some of these young ticks were placed on a calf in an artificially heated stable November 15, 1889, for the purpose of studying the life history of the parasite. The calf became sick but the cause of the sickness was not determined. In all probability if a count had been made of the blood corpuscles of this calf the relation of the tick to Texas fever might have been discovered at that time. Dr. Curtice succeeded in working out the life history of the Texas fever tick. He placed the parasite in a new genus, *Boophilus*, calling it *Boophilus bovis*, which name later became *Boophilus annulatus*, after it was recognized that the tick described by Riley in 1869 as *Ixodes bovis* was the same as that described from deer in Florida in 1821 by Say. More recently the scientific name *Margaropus annulatus* has been commonly used.

In referring to his studies of this parasite Dr. Curtice stated, in a paper which he read on February 3, 1890, before the Washington Biological Society: "Having learned to breed the ticks in quantity, I conceived the experiments of taking northern calves and placing young ticks upon them to determine the extent and kind of injury that the ticks should cause their hosts."

Dr. Smith says in his report on the early investigations:

During the summer of 1889, Dr. F. L. Kilborne, in arranging the various inclosures at the experiment station for the exposure of native cattle to the infection of Texas fever, conceived the happy idea of testing this popular theory of the relation of ticks to the disease.

The first test was made during the summer months, and others followed in September, all of which pointed directly to ticks as being in some way the carriers of Texas fever. The tentative conclusions reached from the work of 1888 and 1889 were that:

Texas fever is a disease not produced by bacteria.

Texas fever is probably caused by a protozoon living for a time within the red corpuscles of the blood of infected animals.

Southern cattle without ticks can not infect pastures.

Ticks alone scattered on a pasture will produce the disease in susceptible cattle.

Investigations were planned for 1890 to confirm or refute the preliminary conclusions already reached, but the field experiments were interrupted by a heavy rain which washed ticks or eggs from one field containing ticky southern cattle to other fields where experiments were under way. However, in the investigations in which ticks were hatched artificially and placed on cattle, Texas fever resulted in every case, and a clear proof of the transmission of the disease by ticks was secured.

During the year 1891 the disease was transmitted from sick to well animals by blood inoculations, and the tentative conclusion that the tick is the intermediate host of the protozoon which destroys the blood corpuscles in the course of the disease was further substantiated by the experiments conducted.

The final experiments conducted in 1892 confirmed those of 1888, 1889, 1890, and 1891, and on February 6, 1893, B. A. I. Bulletin No. 1 was issued, giving a review of the investigations and the conclusions reached as to the nature of the disease, its cause and the manner in which it is transmitted from infected to susceptible animals.

Dr. Theobald Smith entered the service of the Bureau July 1, 1884; Dr. F. L. Kilborne, July 29, 1885; Dr. Cooper Curtice, August 1, 1886; Dr. V. A. Moore, December 22, 1886; Dr. E. C. Schroeder, August 15, 1887; Dr. Emile A. de Schweinitz, January 1, 1890. We cannot conceive that it would have been possible at that time to select a group of men better fitted for their respective duties in the new Bureau, and it was inevitable that such a staff of scientists, organized and working harmoniously under the direction of their able chief, Dr.

Salmon, would accomplish much in the fertile fields of investigation and research that lay before them. Naturally they discussed among themselves new features in connection with their investigations and conferred with one another on perplexities as they arose. There seems to be no doubt that Texas fever was the most engrossing subject of thought and activity at the Experiment Station from 1888 to 1892. Each member of the staff performed his duties well and to each belongs his share of the glory for what he contributed toward the discovery of the cause of Texas fever.

It was definitely proved that the tick is instrumental in carrying the infection from one animal to another, but up to this time the infective agent had not been observed in the body of the tick. In 1906 Koch reported the discovery of certain bodies in engorged female ticks of the African variety of our Texas fever tick and also in their eggs, which bodies he identified as developmental stages of the microorganism. In 1907 Christophers recorded similar results in connection with his study of the dog tick which transmits canine piroplasmosis, and in 1916 Crawley of the Zoological Division of the Bureau found in Texas fever ticks and their eggs bodies evidently corresponding to the forms described by Koch and Christophers.

Texas fever has the distinction of being the first disease caused by a microorganism proved to attack its victim exclusively through the agency of an intermediate host or carrier of its causative germ or microparasite, and the Bureau of Animal Industry has the distinction of being the first institution to discover that a disease can be transmitted in this manner. This is regarded as one of the greatest and most beneficent achievements in medical research, as it led to the discovery that other dreaded diseases, including yellow fever, malaria, typhus fever, African sleeping sickness, Rocky Mountain spotted fever, nagana and others, are carried through an intermediate host. In referring to this achievement, Dr. Mohler in his address as President of the American Veterinary Medical Association on September 1, 1913, in New York City, said: "It has made possible such triumphs of sanitary science as have been accomplished on the Isthmus of Panama and without which the great canal could not have been constructed so expeditiously and with so little loss of human life."

Dr. E. C. Schroeder, who participated in conducting some of the original investigations and is now Superintendent of the Bureau Experiment Station, stated in a lecture on "The Economic Advantages Derived from Animal Experimentation," delivered at Georgetown University May 16, 1920, that "the Panama Canal would not

have been built if animal experimentation had not revealed the etiology of yellow fever. The French failed to build it not because they lacked intelligence, courage, or perseverance, but because they did not know how to control yellow fever."

Dr. Simon Flexner, of the Rockefeller Institute of Medical Research, in a lecture at Georgetown University on March 28, 1920, expressed the opinion that "our knowledge of yellow fever would in all likelihood have been delayed if the work of the Bureau of Animal Industry of the U. S. Department of Agriculture on Texas fever had not been done."

EARLY QUARANTINED AREAS

The Secretary of Agriculture, the Department having been raised to the status of a cabinet department in 1889, issued an order on February 26, 1892, putting the following States and the Indian Territory within the permanently infected area: South Carolina, Georgia, Florida, Alabama, Mississippi, Arkansas and Louisiana. The southern portions of the following States crossed by the quarantine line were also included in the order: Virginia, North Carolina, Tennessee, Oklahoma and Texas. In 1894 outbreaks of Texas fever in Nevada, Kansas and Missouri, were reported as apparently caused by cattle originating in California, and Mr. W. E. Hill, an inspector of the Bureau of Animal Industry, was sent to California to investigate, with the result that it was found that a large part of this State was permanently infested with the Texas fever tick. Accordingly in 1895 California was included in the infested or quarantined area. The determining of the northern boundary line of the permanently infected area was a contribution to the investigations of Texas fever that figured next in economic importance to the discovery of the cause of the disease and the manner of its transmission.

The enforcement of regulations controlling the movement of cattle from the quarantined area resulted in largely preventing the heavy losses that had occurred previously each year, and the Bureau has continued to supervise the movement of southern cattle ever since the first order was issued.

EXPERIMENTS IN IMMUNIZATION

After the cause of Texas fever had been determined definitely, investigations were directed by the Bureau and various State agencies to discover some chemical agent or combination which might be applied to cattle by dipping or otherwise to free them from ticks, also to work out a method of inoculation or vaccination by which northern

cattle might be immunized against the disease before they were shipped south for breeding or other purposes, and also to ascertain whether it was feasible to eradicate the ticks in large infested districts and by what means. The investigations were continued along these three lines from 1892 to 1906, when systematic tick eradication was taken up by the Department of Agriculture in cooperation with the States.

It was suggested by the experiments of the Bureau in 1892 and 1893 that through the production of a mild, nonfatal attack of Texas fever in northern cattle a very considerable amount of protection would be produced against the disease when these cattle were subsequently exposed to the infection on tick-infested pastures. The methods proposed for procuring such a mild, nonfatal attack were (1) the artificial inoculation either into a vein or under the skin of susceptible animals, during the fall or winter, of defibrinated blood from an immune bovine; or (2) the less certain way consisting of the exposure of the nonimmune animals to ticks by confining the animals to an inclosed pasture after scattering ripe, egg-laying ticks over the grass. Up to 1897 most of the investigations along this line were directed toward the preparation of an effectual serum which could be administered with safety. Artificial serum, spleen pulp, sterilized blood serum and other preparations were used, but the results were not generally satisfactory. The simple hypodermic injection of fresh blood taken from immune southern cattle displaced all other methods of immunization and seemed quite promising.

In October, 1895, Moore and Schroeder, of the Bureau Experiment Station at Washington, D. C., inoculated 11 head of susceptible cattle with fresh blood from immune cattle. Five of the 11 showed no sign of the disease after the treatment, while the remainder had mild attacks, but soon recovered. Four out of five checks that were not inoculated developed the disease and died, while the fifth suffered severely but recovered.

Dr. M. Francis, of the Texas Experiment Station, and Dr. J. W. Connaway, of the Missouri Experiment Station, were the first investigators to use the fresh-blood method on a sufficiently large scale to test its merits in actual practice. Dr. J. C. Robert, of the Mississippi Experiment Station, and Dr. W. H. Dalrymple, of the Louisiana Experiment Station, began serum inoculation with fresh blood early in 1897. Pond and Hunt planned a similar line of investigation and began to carry it out in Australia in 1897. Various veterinarians were working independently to perfect immunization against Texas fever, but the methods and results of immunization by blood injections

were not well understood until 1898. The results of the work of some of those early engaged in immunization experiments were published in 1904, as follows:

C. A. Cary, Alabama.....	45 immunized,	8.9	per cent loss
Charles F. Dawson, Florida.....	26 immunized,	11.5	per cent loss
W. H. Dalrymple, Louisiana.....	200 immunized,	3.5	per cent loss
J. C. Robert, Mississippi.....	200 immunized,	6.0	per cent loss
J. W. Connaway, Missouri.....	1,800 immunized,	8.0	per cent loss
Tait Butler, North Carolina.....	63 immunized,	1.6	per cent loss
G. E. Nesom, South Carolina.....	388 immunized,	0.77	per cent loss
M. Francis, Texas.....	2,028 immunized,	9.2	per cent loss
Average loss, 7.6 per cent.			

Young animals were used largely in these experiments, as the mortality in calves following immunization was much lower than in adult animals. These results were considered rather successful at the time from a scientific point of view, but this method of combating the disease did not prove entirely satisfactory in practice and gave way to other methods that were more certain.

EXPERIMENTS IN DIPPING CATTLE TO DESTROY TICKS

Various substances and combinations suggested for spraying, dipping and smearing cattle to kill the ticks were tested between 1892 and 1906, with the hope of finding one that would accomplish the desired object, but none was found that proved entirely satisfactory, as they either did not kill the ticks or affected the cattle too severely to be of practical value.

Under the quarantine regulations cattle from below the quarantine line could be shipped to market for purposes other than slaughter only between November 15 and February 15. The restrictions placed upon the transportation and marketing of southern cattle had such a depressing effect upon the cattle industry south of the quarantine line that the discovery of some method of destroying the ticks upon all cattle, or even upon those intended for marketing, was regarded as second in importance only to the discovery of the cause of Texas fever. Therefore the Bureau directed its efforts toward finding a suitable dip.

Dr. Victor A. Nørgaard, who later was appointed Chief of the Pathological Division of the Bureau, was detailed to conduct dipping experiments in Texas. R. J. Kleberg, manager of the Santa Gertrudes ranch in Nueces County, Texas, designed and built the first vat used by the Bureau in its dip investigations. This vat was placed at the disposal of the Bureau early in 1895, together with the ticky cattle on the ranch. During the following five years 25,000

cattle were passed through this vat in testing the tick-destroying properties of various disinfecting preparations.

The best results were obtained during the first year from the use of Chloronaphtholeum and the Lone Star cattle and sheep wash, two coal-tar preparations. In August, 1897, the Fort Worth Stock Yards Company built a large cattle-dipping plant and placed it at the disposal of the Bureau, and the experiments were transferred from the Santa Gertrudes ranch to the Fort Worth Stock Yards.

The so-called paraffin lubricating oils were tested at Fort Worth. The results obtained at first with these oils were so satisfactory that in September, 1897, a meeting was called at Fort Worth to demonstrate dipping with this substance. The meeting was attended by delegates from Illinois, Missouri, Nebraska, Kansas, Colorado, Oklahoma, Texas and the Indian Territory. The results of this demonstration did not prove entirely satisfactory, but it was decided to continue the experiments.

On April 1, 1898, the experiments with paraffin oil were resumed at the Santa Gertrudes ranch, where it was less difficult to obtain ticky cattle. The results on the ranch were not uniformly satisfactory, and paraffin oil was discarded. Next, two oils with sulphur added were tried, but they, too, failed to give the results desired, and the experiments were again discontinued at the ranch.

In June, 1898, the experiments were resumed at Fort Worth. "Extra dynamo oil" was used, and after a few trials, sulphur was added to this oil. The results obtained from dipping in this oil seemed so pleasing that it was decided to test it on quite a large number of cattle and ship them north immediately after dipping. Accordingly, 311 cattle were dipped on July 22 and shipped to Rockford, Illinois, the following day. The weather was rather hot and the cattle suffered severely in transit. The oil killed the ticks, but eight cattle died en route and eight "downers" were left behind at unloading stations. The greatest barrier to success in dipping cattle was that the ticks were better able to resist the effects of dips than were the cattle.

Dips containing as the main ingredients carbolic acid, tobacco extract, sodium sulphate, glycerin, lime and sulphur and numerous other substances either singly or in combination were tried and found to be unsatisfactory. Dr. M. Francis, of the Texas Agricultural Experiment Station, was the first to suggest the use of oil as a dip. Cottonseed oil was tried first at his suggestion, and after it was found that this oil did not prove satisfactory he suggested crude mineral oil. In

1903 attention was given to testing the value of crude mineral oil. Beaumont crude petroleum (from the vicinity of Beaumont, Texas) gave better results generally than any other crude oil or any other dip that had been tried, and it was used almost exclusively from 1903 to 1911 as a spray, a smear and a dip in freeing cattle of ticks.

THE BEGINNINGS OF TICK ERADICATION

While efforts were being made to develop a safe, effectual system of immunization and various dips were being investigated, experiments were conducted in ridding pastures of ticks. From Dr. Curtice's study of the life history of the tick it was learned that it can mature and reproduce its kind only by passing a portion of its existence upon an animal, preferably bovines, and that the whole progeny will die out within a few months if they can not reach such animals. It was demonstrated conclusively that by excluding animals from infested premises for a few months the ticks in the pasture would perish for want of a host, as they can not mature without the nourishment that they normally get from the blood of an animal. And if at the expiration of the required time after removal from an infested pasture the cattle were cleaned of ticks by hand picking, spraying or dipping and placed in a clean pasture, they remained free from them. Freeing cattle of ticks thus in connection with the rotation of pastures was the plan first used for exterminating the pest on an extensive scale. Experience showed that ticks could be exterminated quickly by this method in communities where farms and fields were fenced, but it was appreciated that it would be very difficult if not impossible to carry out the plan on the ranges and in territory where there was no fence law.

In a paper read June 24, 1896, before the Virginia State Veterinary Medical Association, Dr. Cooper Curtice said: "It is the relationship between the tick and the disease and the means of eradicating them from Virginia and the United States to which I invite your attention." This paper of Dr. Curtice's probably contained the first published statement of the possibility of tick eradication. In introducing Dr. Curtice in a lecture tour in Alabama, Representative Richmond P. Hobson referred to Dr. Curtice as "the father of tick eradication."

By 1906 the following methods of eradicating ticks had been developed and tried in different sections of the South:

1. Picking and brushing ticks off of cattle.
2. Smearing or spraying cattle with a disinfecting solution.
3. Dipping in a vat containing a substance that would destroy the ticks without undue injury to the cattle.

4. The "soiling" method.
5. Freeing pastures of ticks:
 - a. By excluding cattle from the pasture to be freed of ticks for a definite period (the "starvation method").
 - b. By cultivation of the pasture.
 - c. By burning the grass off of the pasture.
6. Freeing cattle and pasture of ticks at the same time:
 - a. By the "feed-lot" method, as recommended by Morgan of Louisiana.
 - b. By pasture rotation, which combined the suggestions of Curtice, Butler and Morgan.

Long before it was known that ticks were the carriers of the infection, cattlemen had learned through unfortunate experiences that for unknown reasons at uncertain times some ranges were dangerous for cattle. In many instances, after losing nonimmune cattle that had been grazed on an infested range, these pastures were avoided for a season or longer; thus the starvation method of freeing pastures of ticks was unconsciously applied. Also some ranchmen had been in the habit, for many years before tick eradication work was begun, of removing ticks from cattle by the use of a curry comb, or by the application of some kind of medicine or dip. Usually only the most heavily infested animals were thus treated. In some instances the cattle were crowded into a chute and sprayed through the cracks of the chute. In other instances on the Pacific Coast ranchmen drove their cattle into the ocean surf from time to time, which resulted in some good, as the largest ticks were dislodged by the force of the surf. Some good was accomplished, but of course none of these palliative measures resulted in permanent relief, as the work was only partially done.

The national interest and activity in the work of tick eradication was stimulated by the successful pioneer work done in North Carolina by Dr. Tait Butler, State Veterinarian, from 1902 to 1906. The method he used was the application of Beaumont crude petroleum, and the removal of cattle from pastures from September 1 to May 1, or the rotation of pastures. In 1902 only sixteen of the northwestern counties of the State were free from the Federal quarantine. At the end of 1906 twenty counties had been freed of ticks in North Carolina.

South Carolina also was active in tick-eradication work. Dr. Louis A. Klein was appointed State Veterinarian to succeed Dr. G. E. Nesom October 1, 1904. During the remainder of that year he finished the immunizing experiments begun by Dr. Nesom. Dr. J. R.

Mohler, Chief of the Pathological Division of the Bureau, who had conducted successful tick-eradication work on some farms in Virginia during 1904, went to South Carolina in the fall of 1905 to enlist the services of Dr. Klein in conducting some cooperative tick eradication experiments in Oconee County of that State. These experiments were conducted to determine the practicability of attempts to get rid of ticks by applying crude petroleum to the cattle while they continued to use tick-infested lots, barns and pastures in the usual manner, and to determine the best time to begin the applications and how often and at what intervals it would be necessary to reapply the oil in order to free the cattle and premises from ticks. The most satisfactory results were obtained in South Carolina from a plan arranged by Dr. Mohler. With this plan a part of the pasture was not used for five months at a time in order to starve the ticks. The cattle were freed from ticks by being kept for three successive periods of twenty days each in three separate lots or fields. Up to this time some States had centered their activities on immunization experiments. The results of Dr. Mohler's studies of tick eradication and his observations in the field inspired him with confidence that the complete eradication of ticks from the South was a feasible undertaking, a feeling that was not shared confidently by all of his superiors at that time.

There are others who deserve recognition in connection with the pioneer tick-eradication work. Dinwiddie, of the Arkansas Experiment Station, was an early investigator. Morgan, of the Louisiana Agricultural Experiment Station, reported investigations conducted in Louisiana having to do with the various stages of the tick, especially with regard to the influence of heat, cold and light and the effects of water upon the tick and its eggs. Later, Morgan discussed and emphasized the practicability of freeing cattle and pastures of ticks by following pasture-rotation methods based upon known facts in the life history. Newell and Dougherty, of the State Crop Pest Commission of Louisiana, made a comprehensive study of the ticks, and they, too, formulated a pasture rotation method of ridding cattle and farms of ticks, adapted to conditions prevailing in Louisiana. Cotton, of the Tennessee Experiment Station, published life-history notes on ticks and suggested a number of rotation methods for tick eradication. Also the Bureau of Entomology of the Department of Agriculture issued a bulletin by Hunter and Hooker which incorporated the results of comprehensive investigations conducted by these authors at Dallas, Texas, and Graybill and Sewallen of the

Bureau of Animal Industry made further important contributions to the knowledge of the life history from work done at Auburn, Ala.

The seventh annual convention of the Southern States Association of Commissioners of Agriculture was held at Richmond, Va., November 22, 23 and 24, 1905. Addresses relating to different phases of tick eradication were delivered by Dr. Tait Butler, Veterinarian of the North Carolina Department of Agriculture; Dr. C. A. Cary, of the Alabama Experiment Station, and Dr. J. R. Mohler, Chief of the Pathological Division of the U. S. Bureau of Animal Industry. There were some at this meeting who doubted the possibility of eradicating ticks in large areas, and in replying to them Dr. Butler said: "But it is being done; it has been done."

Hon. James Wilson, Secretary of Agriculture, attended the convention, and was so impressed with the addresses and the sentiment expressed in favor of tick eradication, the possibility of exterminating the pest, and the need of the States for assistance from the National Government, that after conferring with Dr. Mohler he telegraphed to Dr. A. D. Melvin, then Acting Chief of the Bureau, Dr. D. E. Salmon having resigned October 5, to come to Richmond immediately for a conference. After his conference with Dr. Melvin and Dr. Mohler, the Secretary, in addressing the convention, announced his decision to lay the matter before Congress and ask for an appropriation to enable the Bureau to cooperate with the States more actively in the eradication of the cattle tick. On the way back from Richmond the Secretary informed Dr. Melvin that he would be appointed Chief of the Bureau of Animal Industry, and expressed the belief that tick eradication would be the paramount activity of the Bureau for several years to come. On the recommendation of the Secretary and the representations of prominent State livestock authorities and cattlemen who had satisfied themselves that tick eradication was both possible and practicable in the South, Congress appropriated the sum of \$82,500, available July 1, 1906, to begin the work of freeing the South of cattle ticks.

Anticipating the favorable action of Congress, inspections were continued along the quarantine line to locate tick infestation, and an investigation was commenced soon after the meeting in Richmond in November, to ascertain if the States had laws under which the National Government could cooperate effectually in the work of tick eradication. It was learned that while some State laws afforded ample provisions, other States either had no laws bearing on the subject or the statutes were inadequate. At that time only seven States,

Virginia, North Carolina, Georgia, Kentucky, Tennessee, Oklahoma, and California, had laws which would enable the Bureau to cooperate with them.

SYSTEMATIC TICK ERADICATION UNDERTAKEN

Tick eradication was commenced in earnest in July, 1906, under the direction of the Inspection Division of the Bureau. Dr. Rice P. Steddom, Chief of that Division, was relieved from all other duties from July 1 to the latter part of the following January in order that he might devote all his time and efforts to organizing and pressing forward this new project.

The infested territory was divided into five districts as follows:

1. California.—Headquarters at Los Angeles. Dr. W. M. MacKellar in charge.
2. Texas, Oklahoma, Missouri, Arkansas and Louisiana.—Headquarters at Kansas City, Mo. Col. Albert A. Dean in charge.
3. Kentucky, Tennessee, Alabama and Mississippi.—Headquarters at Nashville, Tenn. Dr. W. P. Ellenberger in charge.
4. Georgia and South Carolina.—Headquarters at Atlanta, Ga. Dr. A. J. Payne in charge.
5. Virginia and North Carolina.—Headquarters at Lynchburg, Va. Dr. Cooper Curtice in charge.

The Bureau veterinarians in charge of these districts were instructed to direct their efforts from the quarantine line south.

Considerable trouble was experienced in procuring a sufficient number of competent veterinarians for the tick work, as the meat-inspection law of 1906, which required a large increase of the meat inspection force, became effective at about the same time that the tick eradication work was begun. However, by the end of the year 97 Bureau veterinarians were at work in the field.

Although the field operations were not commenced until late in July, by November 1, 1907, 29,315 herds, numbering 548,844 cattle, located in 82 counties, had been inspected. Of this number 328,064 were found infested and 220,780 were found free of ticks. On November 1, 1907, 37 counties and 19 portions of counties in Virginia, North Carolina, South Carolina, Georgia, Alabama, Tennessee, Kentucky, Arkansas, Texas, Missouri, California, Louisiana and the Territory of Oklahoma, comprising a cleaned area of 40,970 square miles, were released from quarantine. This was considered a very creditable accomplishment the first year, in view of the fact that considerable time was spent at first in doing advance educational and demonstra-

tional work before placing quarantine restrictions on individual premises and otherwise applying intensive methods.

At the close of the year 1907 the Bureau tick-eradication force numbered 220 men. Most of the work was done contiguous to the quarantine line, but encouragement was given to local work in any part of the quarantined area by assuring those who contemplated local activities that when any considerable area, such as a county, was rendered free of ticks it would be released from quarantine. Two parishes in Louisiana, Lincoln and Claiborne, were the first local areas situated away from the quarantine line to receive the benefits of this provision. They were given provisional quarantine November 1, 1907.

Although the more intelligent cattle owners manifested much enthusiasm in tick eradication, it was found impossible to guard against infractions of the regulations in maintaining the quarantine line. Local butchers persisted in violating the regulations in driving butcher stock; ox teams carried ticks into territory that had been released from quarantine; stray cattle were allowed to roam at will over unfenced pasture land; and the man who owned livestock and did not believe in tick eradication was a constant menace. Inspectors were derided and ridiculed and looked upon with great suspicion by many people who still had in mind the "carpetbagger" of reconstruction days. To many persons cattle-tick eradication seemed an impossible proceeding because they could not be induced to recognize that any difference existed between ticks found on the various small wild animals and the cattle ticks with which their cattle, horses and mules were infested.

The most discouraging conditions with which the inspectors had to contend were the need of adequate State laws, the disinclination of State authorities to enforce existing law, the lack of State and county funds to carry on the work, and the prevailing ignorance and prejudice encountered everywhere. A troublesome factor, and one which added to the prejudice against the work, was the fact that in the quarantined area immediately below the original quarantine line, notably in northern Arkansas, and in Tennessee and Kentucky, some cattle were oftentimes found as grossly infested as elsewhere and no losses were sustained from Texas fever. Inspectors assigned to the work were frequently embarrassed when urging the importance of tick eradication in these areas by the insistence of cattle owners and State officials that cattle-tick infestation was not a serious menace. It was later found that the ticks in these particular sections had been brought in by horses, mules and colts which had been removed from

pastures in Texas where no cattle had been kept, and that these ticks were not engorged with the blood of Texas fever hosts and therefore could not transmit the disease to other cattle.

During the first year of the work many articles were prepared for the press, also two bulletins were written by Dr. Mohler pertaining to the life history of the cattle tick, the points of differentiation between different species of ticks found in the South, the methods of eradication that had proved most successful in different sections of the infested area, the damages to the cattle industry from ticks, and the benefit that would be derived in the South from the eradication of this pest. These bulletins were distributed widely, meetings were held at which tick eradication was discussed, and other means, including the press, were employed to enlighten cattle owners and interest them in the great work that had been undertaken in their behalf.

A uniform method of procedure could not be outlined, as the conditions differed in different sections. It was essential that the inspectors assigned to duty on the plains of the Southwest be proficient in the use of the lariat in securing animals for inspection, and in the open range country the dipping vat was found the most practicable means of applying an insecticide. In the Southeast, where the herds were small, hand dressing and the rotation of pastures could be used to advantage. In all of this work the representatives of the Bureau, State or county found it necessary to apply the insecticide, or at least assist, or often it would not be done.

As might be expected where so many State and Bureau men were assigned to a new work under unfavorable conditions, some through ignorance and others in their enthusiasm did not at first display as much tact and judgment as the circumstances required. A conference of Federal and State representatives was called to meet at Nashville, Tenn., December 5 and 6, 1906, for the purpose of discussing plans for tick eradication and methods of procedure. At this conference it was decided to hold a series of meetings for instructing State and Federal representatives who were to engage in tick eradication in farm management, the rotation of crops and such other subjects as would better fit them to deal with the question in the different localities where the work was to be done. Accordingly two meetings were held, one at Chattanooga, Tenn., the latter part of April, and the other at Richmond, Va., early in May, 1907. These meetings or schools were addressed by persons selected by the State authorities.

The Bureau worked only in States and counties or parishes where State and local authorities were prepared to assist and where public

sentiment was favorable. The work continued to spread and by 1909 some of the benefits were being realized in territory freed of ticks. An investigation was made that year which revealed through letters received from livestock men that—

More cattle were being raised in areas freed of ticks than before the ticks were eradicated.

Cattle put on flesh more rapidly during the grazing season, and in the fall were in better condition for wintering.

Cattle could be marketed without quarantine restrictions, which resulted in an increase in price of from \$3 to \$15 a head above cattle of the same grade from tick-infested territory.

Dairy cows gave a larger yield of milk and higher prices were being obtained.

Calves grew faster and were worth twice as much as in ticky territory.

Values in farm lands were increasing with the development of the cattle and dairy industries.

By 1910 the efforts of the Bureau to eradicate cattle ticks had attracted the attention of the officials of the various railroads in the Southern States and also the management of some industrial concerns, as well as most banking institutions interested in the development of the South. Great impetus was given to the work by some of these organizations through the publication and wide distribution of literature stressing tick eradication as an economic measure of national importance affecting not only the cattle owners of the South but the merchants, bankers and all other business proportionately. Tick eradication began to assume the proportions of a great business enterprise, and skepticism regarding its practicability rapidly disappeared. The duties of the Federal inspectors, which up to that time had been in the nature of personal service, for the first time became really supervisory in character.

DEVELOPMENT OF THE ARSENICAL DIP

At the Nashville meeting in 1906, Dr. Joseph W. Parker reported that since July of that year he had been working under instructions from the Chief of the Bureau in cooperation with the Live Stock Sanitary Commission of Texas in experimenting with an arsenical dip based on an Australian formula which had been used with promising results by Dr. N. S. Mayo, Chief Veterinarian of Cuba. Dr. Parker's report indicated that this dip was worthy of further trial. Following the experimental work of 1906, the Zoological Division, in co-

operation with the Biochemic Division, undertook an extensive study of this dip. In California in 1907, following unsatisfactory experience with oils and other disinfectants, the arsenical dip, with the addition of soap, was used extensively, with such good results that this dip was given official approval by State authorities and was generally used from that time until the work in that State was finished. The arsenic-soda-pine-tar preparation, which later became known as "boiled dip," came into favor rapidly, and, effective November 1, 1911, an order was promulgated permitting the use of arsenical solution as an official dip for the interstate movement of cattle originating in the quarantined area.

The development of the arsenical dip proved a boon to tick eradication, for the activities in the field were beginning to lag by 1911, owing to the fact that none of the methods used in the eradication work up to this time had proved entirely satisfactory. The oil dips proved irritating to the skin of cattle in too many instances, especially where the animals were exposed to the rays of the sun or were exercised severely after dipping. Hand dressing had proved too slow and expensive. Spraying was often done carelessly, with disappointing results. Pasture rotation methods were effective where applicable, but many farmers did not have the facilities to carry these methods into effect and some were lacking in inclination. Funds were lacking to make rapid progress with these methods. The development and official approval of the arsenical dip in 1911 gave an impetus to tick eradication that has continued to the present. Also by this time the people of the South had come to realize that on account of the ravages and rapid spread of the boll weevil in the cotton districts, they must give more attention to diversified farming and stock raising. While much had been accomplished in improving the hog and poultry industries, it was pretty generally realized that their cattle raising and dairy industries could never be developed to a high degree of success under the handicap imposed by Texas fever ticks. Thus the value of the work being done at that time in exterminating ticks became more apparent.

But the arsenical dip did not always prove effective. Even in the experimental period of arsenical baths in 1910 it became evident that something was happening to the arsenic which lowered the efficiency of the solution. In 1911 A. V. Fuller, of the Biochemic Division, discovered the phenomenon of oxidation of the arsenic by the growth of microorganisms in the bath, and it was found by investigations in the Zoological Division that oxidized arsenic is less efficacious in destroying ticks than the unoxidized arsenic in the freshly made dip.

The variation noted from time to time in the effect of the dip was perplexing and annoying to the field inspectors. Dr. C. J. Becker in a letter in August, 1911, suggested that hydrometers be supplied so that inspectors "could at any time test the strength of the solution in the vat, and have a definite way to add enough of the concentrated arsenical solution to bring it up to the required standard." Though a hydrometer test was not practicable; the suggestion of Dr. Becker gave a clue, and a practicable field test was devised by R. M. Chapin of the Biochemic Division in 1911.

The safe disposal of the poisonous contents of the vats next received attention. The matter of detoxication was first brought to the attention of the Bureau in a letter of June 15, 1911, by Dr. W. H. Dalrymple, of the Louisiana Experiment Station, who suggested the use of ferrous sulphate to precipitate the arsenic and thus render the supernatant liquid safe for disposal. On investigation the Bureau found that lime would accomplish the purpose.

PROGRESS FROM 1906 TO 1911

Although the eradication of ticks did not progress as rapidly from the first as was expected, the results obtained from July 1, 1906, to April 1, 1911, were very encouraging.

In Virginia there still remained infected 6 counties and parts of 2 counties, while 24 had been freed of ticks.

In North Carolina the ticks had been eliminated from 30 counties out of 72 infected in 1906.

In South Carolina 4 counties out of 42 infected in 1906 had been released and 8 others were nearly clean.

In Georgia, 3 out of 144 counties infected in 1906 had been released.

The work in Kentucky had been finished.

In Tennessee 26 counties and parts of 8 counties out of 42 had been released.

In Mississippi 3 counties and nearly all of 2 other counties out of 78 had been released.

In Arkansas 10 out of 75 counties had been released.

In Oklahoma 7 counties out of 59 had been released.

In Texas 7 counties and parts of 5 counties out of 190 had been released.

In California $11\frac{1}{2}$ of the 15 originally infected counties had been released.

In Missouri the work was finished in all but 4 counties.

In all, 127 counties and parts of 20 counties, comprising an area of

approximately 139,821 square miles, out of 927 counties, comprising an area of 741,515 square miles, originally infested, had been released from quarantine in five years, and the work was partially finished in many other counties.

LATER PROGRESS

With the perfection of a practicable, economical, speedy and effectual means for the disinfection of cattle for ticks by dipping, an all-important step was taken in furthering and popularizing the work. Compared with the grease rag or spray pump which had been used in the application of disinfecting material, the dipping vat was a device approaching in importance the cotton gin as compared with the hand method formerly used in handling cotton.

The next great task in tick eradication was to effect the systematic dipping of all cattle and exposed horses and mules at regular intervals in order to accomplish the eradication of the tick in a given area in one summer. This was apparently necessary because of the established custom in the Southern States of allowing cattle to run at large during the winter months, even in areas where stock laws were on the statute books. Accordingly county officials of areas desiring to engage in the work were induced to provide material to build a sufficient number of dipping vats so that vats would be conveniently located and the cattle owners usually would not be required to drive stock more than two miles for dipping. The dipping vats were constructed and maintained by community labor. The systematic dipping of the cattle was accomplished by designating a specific date for each vat in an area and posting notices to that effect, and assigning a county-paid inspector to be present on such dates to supervise the dipping and keep a record of the animals dipped, the condition of the cattle, etc. In some sections there was some opposition to the regular gathering and dipping of cattle as required by the laws and regulations, and some vats were destroyed by dynamite. In such instances the dynamiting was usually done by someone who owned only one or two cattle or sometimes by irresponsible persons who owned no cattle or other property.

On July 1, 1912, the Field Inspection Division was established in dividing the work of the Inspection Division, and Dr. R. A. Ramsay, who had held the position of Associate Chief of the Inspection Division, was designated as Chief of the Field Inspection Division. The work of the Field Inspection Division included tick eradication, the eradication of scabies of cattle and sheep, and supervision of the inter-

state transportation of livestock. This organization continued until May 1, 1917, when, on account of the rapid growth of the field inspection work, the further provision made by Congress for additional disease eradication projects, and the further fact that the appropriation for tick eradication was greatly augmented, the Tick Eradication Division was organized. Dr. Ramsay was placed in charge and has continued up to the present time as Chief of that Division.

Although tick eradication progressed quite steadily from the beginning, the most rapid strides were made after the arsenical dip was officially recognized and a method for testing the dip in the vats was developed. This is shown by the territory released from Federal quarantine each year, as follows:

TERRITORY RELEASED FROM QUARANTINE

Year	Square Miles	Year	Square Miles
1906.....	4,445	1915.....	37,255
1907.....	12,549	1916.....	31,358
1908.....	40,798	1917.....	40,111
1909.....	13,544	1918.....	67,308
1910.....	57,518	1919.....	79,217
1911.....	10,965	1920.....	50,555
1912.....	22,827	1921.....	32,171
1913.....	24,556	1922.....	4,347
1914.....	28,704	1923.....	6,362

The cost of tick eradication may be briefly stated as follows:

The Department expenditures for the fiscal years 1907 to 1923, inclusive, amounted to approximately.....	\$ 7,129,598
The State expenditures for the years 1907 to 1923, inclusive, amounted to approximately.....	2,995,111
The county expenditures for the years 1907 to 1923, inclusive, amounted to approximately.....	13,318,123

PROGRESS OF TICK ERADICATION, JULY 1, 1906, to DEC. 31, 1923

States	Counties quarantined		Counties released to	Released counties
	July 1, 1906	Dec. 31, 1923	Dec. 31, 1923	tick-free Nov. 1, 1923
Alabama	67	7	60	26
Arkansas	75	39	36	21
California	15	.....	15	15
Florida	58	54	4	3
Georgia	157	4	153	119
Kentucky	2	.....	2	2
Louisiana	65	33	32	3
Mississippi	81	21	60	47
Missouri	4	.....	4	4
North Carolina.....	75	14	61	46
Oklahoma	61	6	55	47
South Carolina.....	44	.....	44	35
Tennessee	42	.....	42	41
Texas	199	98	101	49
Virginia	30	4	26	.....
Total.....	975	280	695	458

BENEFITS OF TICK ERADICATION

An experiment conducted by the Dairy Division, in cooperation with the Zoological Division, showed that dairy cows when lightly infested with ticks produced 18.6 per cent less milk than when tick-free, and that when heavily infested some produced as low as 42.4 per cent below their production when free of ticks. The census for the year 1920 shows that the average milk production of dairy cows in the tick-free counties of eight Southern States was 47 per cent more than in the tick-infested counties of the same States.

Following the elimination of ticks from a territory the farmers have increased the size of their herds and improved them by the addition of purebred and good grade stock; more people have gone into the dairy business; new dairy barns, silos and milk houses have been built, and silage and leguminous crops are being raised for roughage.

There are now 11 cow-testing associations, 60 bull associations, 172 creameries and 40 cheese factories in territory of Southern States formerly infested with ticks.

As a result of tick eradication there has been a large increase in the number of animals in the South. The increase in cattle is especially noticeable in those States that have done most in tick-eradication work, as is shown in the following table:

INCREASE IN CATTLE SOUTH OF THE QUARANTINE LINE

State	Number in 1906	Number in 1921
Virginia	145,752	864,000
North Carolina.....	486,848	639,000
South Carolina.....	342,898	425,000
Georgia	887,991	1,195,000
Florida	751,261	869,000
Alabama	799,734	1,021,000
Mississippi	873,356	1,218,000
Tennessee	247,000	1,092,000
Arkansas	894,535	1,065,000
Indian Territory.....	1,499,364	1,981,000
Oklahoma	743,360	
Louisiana	670,295	811,000
Texas	6,654,764	6,436,000
California	579,867	2,012,000
Total.....	15,577,025	19,650,000

The development of the cattle industry in the South is also apparent from the number of beef cattle from territory south of the original quarantine line that have won prizes at the International and the American Royal cattle shows, and dairy cattle that have won first prize at the National Dairy Show. A partial compilation shows about 50 southern prize-winners at these exhibitions from 1913 to 1922, including several grand champions.

If it had not been for the tick eradication the South could not boast of its prize-winning herds, its cow-testing associations, its creameries and cheese factories, and its development in diversified agriculture. Tick eradication has proved to be one of the greatest and most beneficial undertakings in which the Bureau of Animal Industry has engaged.

In commenting on the tick-eradication work the editor of the Chicago *Daily Drivers' Journal* said, in the issue of March 30, 1922:

Since 1906, when the tick-eradication work began, the Government officials have succeeded in freeing from quarantine 523,837 square miles of territory that was once the domain of the tick, and within a short time, unless plans go wrong, the entire country will be free. A recent statement of the Department of Agriculture says: "There seems to be little question that the time is approaching when there will be no more of the insects in the country."

The work of quarantining, inspecting and dipping has not been without its difficulties, and even tragedies. Just recently, for instance, a cattle tick inspector in Arkansas was shot from ambush and killed and other inspectors in the same territory intimidated.

Tick eradication work has already been worth untold millions of dollars to the Southern States, by making possible the development of beef and dairy cattle industries—a development that, by the way, is just getting well started. The work has cost nearly \$23,000,000, over two-thirds of which has come from the States and counties where the work has been done. Looking at it from either a national or a sectional viewpoint, it is probably one of the best investments the people of this country ever made.

But what impresses us most about the tick-eradication work is the faith of the men who undertook it, and of their successors who have carried it on. At the outset it was a tremendous undertaking. The educational program necessary to the success of the enterprise was alone a task of vast proportions. And while the work is not yet completed, the end is approaching.

The veterinary profession of this country is to be credited with many notable achievements, among which the eradication of ticks will take its proper place. Our livestock industry has had good service at the hands of our veterinary friends.

During February, 1923, Max Lockridge, a Bureau agent in tick eradication, was shot and killed, and Roy S. Ritchie, another Bureau employee, was seriously wounded, by a leader of a lawless element opposed to tick eradication in Echols County, Georgia.

SUMMARY OF IMPORTANT EVENTS

1795. North Carolina State Legislature passed a law relative to moving cattle from lowlands to highlands within the State between April 1 and November 1.
1814. The State of Virginia refused to allow passage through that State of cattle from certain sections of South Carolina.
1814. Nov. 3. Dr. James Mease, in a lecture before the Philadelphia Society for the Promotion of Agriculture, gave an account of Texas fever. This was probably the first published account of the disease.
1836. Law passed by the State Legislature of North Carolina to prevent the driving of cattle into the State from either South Carolina or Georgia from April 1 to November 1.

1861. Missouri enacted laws to regulate movement of cattle from the South into or through Missouri.
1867. Cairo, Ill., was the chief point of transshipment of cattle from steamboat to railroads. In the spring of that year about 30,000 southern cattle landed at Cairo.
1868. July 29. Dr. John Gamgee commenced an investigation of Texas fever.
1869. Mr. J. R. Dodge, Statistician of the Department of Agriculture, in his report, referred to the belief of many that the ticks which infested cattle were in some way responsible for Texas fever.
1879. In the fall of 1879 Dr. D. E. Salmon was appointed by Commissioner of Agriculture Le Duc to investigate animal diseases in the Southern States with particular reference to Texas fever.
1883. Work commenced on Atlantic Coast to establish the northern line of infestation, which later became the quarantine line.
1884. May 29. Bureau of Animal Industry established.
1884. July 1. Dr. Theobald Smith entered the Bureau service and was given charge of the investigation of infectious diseases of animals.
1888. During the summer Dr. Smith first noticed the destruction of blood corpuscles in the blood of cattle sick with Texas fever.
1889. July 3. First Texas fever quarantine order issued.
1889. Dr. Cooper Curtice began the study of the life history of the cattle tick in the fall and finished December 16.
1889. Dr. F. L. Kilborne began to test the theory advanced by some that ticks were in some way related to Texas fever.
1892. Feb. 26. Order issued placing South Carolina, Georgia, Florida, Alabama, Mississippi, Arkansas and Louisiana in quarantine, also parts of Virginia, North Carolina, Tennessee, Oklahoma and Texas.
1892. Beginning of experiments on immunization against Texas fever; also on dips and methods of eradicating ticks from infested areas.
1893. Feb. 6. B. A. I. Bulletin No. 1 issued, announcing the discovery that the tick was the carrier of Texas fever.
1895. Dr. Victor A. Nørgaard detailed by the Bureau early in the spring to conduct field tests of dips for destroying ticks on cattle. Investigations commenced on Santa Gertrudes Ranch, Neuces County, Texas.
1895. Southern quarantine line extended to Pacific Coast.
1897. August. Fort Worth Stock Yards Company built a dipping station at the Fort Worth Stock Yards for the use of the Bureau in conducting experiments with dips.
1905. Nov. 22, 23, and 24. Meeting of the Southern States Association of Commissioners of Agriculture at Richmond, Va., at which Secretary of Agriculture James Wilson announced his decision to take up tick work in cooperation with the States.
1906. July 1. First appropriation (\$82,500) for tick eradication became available and work commenced in cooperation with the States.
1906. Dec. 5 and 6. Conference of Federal and State officials held at Nashville, Tenn.
1911. Field test for arsenical dip developed by Chapin, of the Biochemic Division, put into use in testing the dip in vats.

1911. Nov. 1. Arsenical dip recognized officially on the basis of experiments and investigations by the Zoological Division, begun in 1907, that determined the effective strength and the conditions of use of arsenical solutions for the destruction of ticks.
1911. System developed by Chapin, of Biochemic Division, for detoxicating arsenical contents of dipping vats.
1917. May 1. Tick Eradication Division established and Dr. R. A. Ramsay made Chief.

PERSONNEL OF THE TICK ERADICATION DIVISION

Chief of Division:

Dr. R. A. RAMSAY, May 1, 1917, to date.

Assistant Chiefs of Division:

Dr. W. P. ELLENBERGER, May 1, 1917, to Sept. 16, 1920.

Dr. ROY E. JACKSON, Sept. 16, 1920, to June 26, 1922.

Dr. W. M. MACKELLAR, Nov. 16, 1922, to date.

Division of Virus-Serum Control*

The existence of hog cholera was first recognized in the United States in 1833. By 1884, the year the Bureau of Animal Industry was established, it had become one of our most prevalent and destructive diseases of swine. Soon after the Bureau was organized it began a study of hog cholera with the view of discovering the cause of the disease and devising some form of treatment to prevent the increasingly heavy losses that were reported from different sections of the country.

The investigations resulted in the discovery that the true cause of hog cholera is a filterable virus; this fact was announced to the public in Bureau Circular 41, dated September 28, 1903. During the period from 1903 to 1906 a serum was developed by Dr. M. Dorset, assisted by Drs. W. B. Niles and C. N. McBryde, all of the Bureau of Animal Industry, which proved effectual as an immunizing agent against the disease.†

Following the publication by the Bureau of the method of preparing and using anti-hog-cholera serum, commercial concerns undertook its production in sufficient quantities to meet the demand. Owing to a lack of knowledge of the importance of sanitation and care in the preparation of such biological products on the part of some serum producers, and the lack of honesty on the part of others, impotent and contaminated serum and virus were marketed. In some instances considerable damage was caused in the herds treated, and by 1912 hog growers in certain sections of the country were losing faith in the treatment that was so earnestly recommended by the Bureau.

Anti-hog-cholera serum was only one of many biological products that were being produced by 1912 for use in treating animals. As State supervision of commercial laboratories was inadequate, the situation was one that demanded the attention of the National Government in the interests of the livestock industry.

THE VIRUS-SERUM-TOXIN LAW

On March 4, 1913, Congress passed the Virus-Serum-Toxin Act, which makes it unlawful for any person, firm or corporation to prepare, sell, barter, exchange, or to ship or deliver for shipment in interstate commerce, any worthless, contaminated, dangerous or harmful biological product intended for use in the treatment of domestic animals. The act also makes it unlawful for any person, firm

* See "Pathological Division," page 73.

† See "Biochemic Division," page 161.

or corporation to prepare, sell, barter, exchange, or ship outside of the State where prepared, any virus, serum, toxin or analogous product unless it is prepared in an establishment holding an unsuspended and unrevoked license issued by the Secretary of Agriculture. The importation of biological products for use in the treatment of domestic animals is prohibited by the act except under a permit from the Secretary of Agriculture. The Department of Agriculture is authorized by the act to examine and inspect all biological products intended for use in the treatment of domestic animals which are offered for importation. Any products which are found to be worthless, contaminated, dangerous or harmful are denied entry and are to be destroyed or returned to the point of origin. The Secretary of Agriculture is also authorized to make and promulgate from time to time such rules and regulations as may be found necessary to enforce the act, and also to issue permits and licenses. The act also provides that these licenses or permits may be revoked, after an opportunity for hearing has been accorded the holders, if it is found they are used to facilitate or effect the preparation, sale, barter, exchange or shipment of worthless, contaminated, dangerous or harmful products. Authorized inspectors or agents of the Department of Agriculture are permitted by the law to enter and inspect from time to time any establishment that has been licensed under the act. The law also provides that any person violating its provisions shall, upon conviction, be punished by a fine or imprisonment, or both.

ADMINISTRATION OF THE LAW*

The Department of Agriculture was charged with the administration of the Virus-Serum-Toxin Law. Dr. M. Dorset, Chief of the Biochemic Division of the Bureau, was placed in charge of the administration of the law when it went into effect. A part of this work was conducted in cooperation with the Pathological Division. Dr. Dorset remained in charge until February 17, 1917, when, in accordance with the policy adopted at that time of separating the research and investigational work from the regulatory work, the Office of Virus-Serum Control was created as a separate section of the Bureau to carry out the provisions of this law. Dr. H. J. Shore, who had been assisting Dr. Dorset, was placed in charge of this new office, and Dr. D. I. Skidmore was called to Washington from the field to assist him. On April 15, 1919, Dr. Shore resigned and Dr. Skidmore became acting head of the office until July 1, 1920, when the designation of the office was

* See "Biochemic Division," page 165.

changed to Division of Virus-Serum Control. Dr. Skidmore was appointed Chief of the Division and Dr. R. E. Holm was selected as Assistant Chief.

One of the first tasks after the Act of March 4, 1913, became effective on July 1, 1913, was to supervise the remodeling of plants and equipment which did not meet the requirements. Another important matter was to systematize the methods of production and operation in plants placed under Federal supervision. In order to accomplish the purpose effectively, regulations were issued to guide serum producers and employees of the Bureau. Following this preliminary work, approved methods of producing serum were adopted and have become well established. Now, before a license is issued to a new establishment, plans and specifications of the plant must be submitted to the Bureau for examination and approval.

REGULATIONS

To date the following general regulations governing the preparation, sale, barter, exchange, shipment and importation of viruses, serums, toxins and analogous products intended for use in the treatment of domestic animals have been issued:

B. A. I. Order 196, dated May 31, 1913, effective July 1, 1913.

B. A. I. Order 265, dated Aug. 1, 1919, effective Sept. 1, 1919.

B. A. I. Order 276, dated Aug. 18, 1922, effective Nov. 1, 1922.

ESTABLISHMENTS, STATIONS AND EMPLOYEES

During the first six months of the operation of the law, or up to January 1, 1914, twelve licenses were issued for establishments producing anti-hog-cholera serum and virus, and 12 for establishments producing other products, making in all 24 establishments. At the time the Office of Virus-Serum Control was changed to a division, July 1, 1920, there were operating under Federal license 84 establishments situated in 56 cities in 18 States. On July 1, 1923, there were 95 such establishments in 58 cities in 22 States.

In order to supervise the operation of licensed establishments throughout the country, it became necessary to establish stations with trained Bureau veterinarians in charge and a sufficient number of qualified veterinarians and lay inspectors to assist them. On January 1, 1924, there were 18 Virus-Serum-Control stations with 43 substations in the United States outside of Washington. The force of the Division on that date consisted of 62 veterinarians, 30 lay inspectors and 9 clerks or stenographers.

APPROPRIATIONS FOR ADMINISTRATION OF THE LAW

The following table shows the yearly appropriations that have been made by Congress for supervising the operations of licensed establishments:

Fiscal year ending June 30—	Appropriation	Fiscal year ending June 30—	Appropriation
1914.....	\$ 25,000	1920.....	\$163,560
1915.....	50,000	1921.....	188,280
1916.....	50,000	1922.....	195,000
1917.....	175,000	1923.....	195,000
1918.....	172,240	1924.....	195,000
1919.....	167,240	1925.....	195,000

CLASSES OF PRODUCTS PRODUCED IN LICENSED ESTABLISHMENTS

A large variety of biological products are produced in licensed establishments. The following classification covers the products that are now produced:

Aggressins.—Blackleg aggressin and blackleg filtrate.

Antiserums.—Anti-abortion serum; anti-anthrax serum; anti-blackleg serum; anti-botulinus serum; anti-distemper serum, canine and equine; anti-hemorrhagic septicemia serum, bovine, equine, lepine, ovine and porcine; anti-hog-cholera serum; anti-influenza serum, equine; anti-mixed-infection serum, porcine; anti-navel-ill serum, equine; anti-pyogenes bacillus serum, equine; and anti-tetanic serum.

Serums.—Normal serum is produced by a few establishments.

Bacterins.—Abortion bacterin, bovine, equine and porcine; colon bacterin, bovine and equine; distemper bacterin, canine and equine; hemorrhagic septicemia bacterin, avian, bovine, equine, lepine, ovine and porcine; influenza bacterin, equine; keratitis bacterin, bovine; mastitis bacterin, bovine; mixed-infection bacterin, avian, bovine, canine, equine, lepine, ovine and porcine; navel infection bacterin, equine; pneumonia bacterin, equine; rhinitis mixed bacterin, porcine; scours bacterin, bovine; staphylococcic bacterin, canine and equine; streptococcic bacterin, equine; and suipestifer bacterin.

Diagnostic agents.—Mallein and tuberculin. Tuberculin from the avian type of *Mycobacterium tuberculosis* is also produced.

Serobacterins and serovaccines.—Abortion serobacterin and serovaccine, bovine and equine; distemper serobacterin and serovaccine, canine; hemorrhagic septicemia serobacterin and serovaccine, bovine; influenza serobacterin and serovaccine, equine; pyogenes bacillus serobacterin and serovaccine, bovine; and scours serobacterin and serovaccine, bovine.

Vaccines, viruses and toxins.—Abortion vaccine, bovine; anthrax

vaccine; blackleg vaccine; chicken-pox vaccine; chicken-pox virus; hemorrhagic septicemia vaccine, bovine, ovine and porcine; hog-cholera virus; rabies vaccine; and tetanus toxin.

TRAINING OF INSPECTORS

In carrying on the work of the Division it has been found necessary to train employees especially for the purpose. Since 1914 a large force of veterinarians and laymen has been given special training, and during April and May, 1917, inspectors in charge of the field stations were instructed at the Washington laboratories of the Bureau in the fundamental principles employed in the production of biological products which are produced commercially in the various licensed establishments. These men in turn have trained other Bureau employees and have also been able to render valuable assistance to producers of biological products.

INSPECTION AND CONTROL OF ESTABLISHMENTS

In addition to requiring direct inspection and supervision of all operations in anti-hog-cholera serum plants, certain stipulations are required with respect to the proper labeling of all biological products intended for veterinary use. A more uniform system of terminology has been adopted for these products, so that the name applied indicates either the disease for which a product is intended or the organisms used in its production. The formula used in the production of practically all biological products produced under Federal license now appears on trade labels, also instructions concerning the dosage and proper use of the product.

From time to time inspectors are instructed to collect subcultures of organisms used in the preparation of products produced under license, also samples of the finished products, for laboratory examination and animal tests. These examinations and tests are made by the Bureau under arrangements of the Division of Virus-Serum Control with the Pathological Division, the Biochemic Division and the Experiment Station. This procedure has not only resulted in improvement of the quality of the products placed on the market, but has served to stimulate better technique in licensed establishments.

As a result of the cooperative arrangement of the Division of Virus-Serum Control with the Bureau of Chemistry, many so-called "cures" for hog cholera and other swine diseases have been found worthless for the purpose indicated in the advertising literature. In such cases appropriate action was taken to protect the interests of hog growers.

IMPORTED BIOLOGICAL PRODUCTS

The Division examines all applications of persons or firms desiring to import into the United States products intended for veterinary use and handles problems and correspondence concerning the importation of such products. Permits have been denied consistently to persons desiring to import certain products, such as anti-hog-cholera serum, produced in countries in which foot-and-mouth disease exists.

RESULTS OF ADMINISTRATION OF THE LAW

The enforcement of the Virus-Serum-Toxin Law has resulted in the feeling on the part of livestock people that products prepared under license or imported under permit have been properly produced. Reasonable assurance is also felt that the spread of destructive animal plagues will not result from the use of biological products prepared in licensed establishments.

Great improvement has been made in the quality and efficiency of many biological products. Suggestions made by the Bureau have been welcomed by the producers and cooperation has resulted in most cases in the production of more refined, superior and uniformly potent products.

The confidence shown in the use of anti-hog-cholera serum and virus and the growth of the industry, for instance, is evident from the amount of these products that have been produced and marketed in this country, as shown in the following table:

AMOUNTS OF ANTI-HOG-CHOLERA SERUM AND HOG-CHOLERA VIRUS PRODUCED

Calendar year	Anti-hog-cholera serum			Hog-cholera virus c. c.
	Ordinary c. c.	Clear c. c.	Total c. c.	
1915.....	208,571,232	.....	208,571,232	6,560,041
1916.....	220,095,808	.....	220,095,808	7,597,403
1917.....	248,390,184	.....	248,390,184	10,974,607
1918.....	524,316,572	.....	524,316,572	16,171,423
1919.....	622,983,217	.....	622,983,217	20,928,513
1920.....	350,395,925	39,832,984	390,228,909	22,443,378
1921.....	440,158,658	36,797,347	476,956,005	26,252,175
1922.....	733,542,370	110,721,149	844,263,519	36,298,200
1923.....	597,071,453	176,341,460	773,412,913	44,933,499

The value of animals saved from disease and death by the use of modern biologics cannot be accurately estimated, but it is obvious that it amounts to a very large figure. As the tendency of modern medicine is toward prophylaxis, we may expect great developments, not only in the further perfection of the biological products now in use, but in the production of new products.

SUMMARY OF IMPORTANT EVENTS

- June 12, 1906. Process of production of anti-hog-cholera serum patented.
- Mar. 4, 1913. Virus-Serum-Toxin Act of Congress approved.
- May 31, 1913. B. A. I. Order 196 issued; regulations promulgated under authority of the Virus-Serum-Toxin Act.
- July 1, 1913. Virus-Serum-Toxin Act became effective.
- Aug. 5, 1913. First U. S. Veterinary License covering the production of anti-hog-cholera serum issued, No. 18, to Stock Yards Serum Co., Kansas City, Kans.
- Nov. 27, 1913. First field inspector, Dr. F. A. Imler, assigned to Virus-Serum-Control work.
- Feb. 18, 1916. Methods of the H. K. Mulford Co. for production of a product described as refined hog-cholera serum approved.
- June 9, 1916. Production of clear anti-hog-cholera serum using the bean-salt method discovered by Dorset and Henley begun by E. R. Squibb & Sons, License No. 83.
- Feb. 17, 1917. Office of Virus-Serum Control created. Dr. H. J. Shore placed in charge.
- Apr. 15, 1919. Dr. H. J. Shore resigned. Dr. D. I. Skidmore given temporary charge of the Office.
- Sept. 1, 1919. B. A. I. Order 265, superseding B. A. I. Order 196, issued.
- July 1, 1920. Office of Virus-Serum Control made Division of Virus-Serum Control. Dr. D. I. Skidmore designated as Chief and Dr. R. E. Holm Assistant Chief.
- Oct. 10, 1922. B. A. I. Order 276 issued; effective Nov. 1, 1922.

PERSONNEL OF THE DIVISION OF VIRUS-SERUM CONTROL

In Charge:

- Dr. M. DORSET, Chief of Biochemic Division, in charge of administration of Virus-Serum-Toxin Act from July 1, 1913, to Feb. 16, 1917.
- Dr. H. J. SHORE, in charge of Office of Virus-Serum Control, from Feb. 17, 1917, to April 15, 1919.
- Dr. D. I. SKIDMORE, acting in charge of Office of Virus-Serum Control, from April 16, 1919, to June 30, 1920.

Chief of Division of Virus-Serum Control:

- Dr. D. I. SKIDMORE, from July 1, 1920, to date.

Assistants:

- Dr. H. J. SHORE, from July 1, 1913, to Feb. 16, 1917.
- Dr. D. I. SKIDMORE, from Sept., 1915, to April 15, 1919.
- Dr. R. E. HOLM, from Aug. 16, 1919, to date.

Tuberculosis Eradication Division

Although animal tuberculosis is not so prevalent in the United States as in most European countries, it has become a serious menace to our livestock industry. It seems that this disease was introduced into the United States through the importation of cattle, and it gradually spread until it has reached every State in the Union. Many of our breeders have attempted to establish herds of fine cattle only to find later that their foundation stock had been infected.

On March 3, 1892, a herd of Jersey cattle belonging to Dr. J. E. Gillingham, Claremont Farms, Villa Nova, Pa., was tested with tuberculin which Dr. Leonard Pearson, Dean of the Veterinary Department of the University of Pennsylvania, brought from Europe. Tuberculin had recently (1890) been developed by Dr. Robert Koch of Germany, and the Gillingham herd was the first tested with tuberculin in the United States. Of the 79 animals in the herd 30 reacted to the test. The results obtained by Dr. Pearson from the use of tuberculin promptly led others in this country to use it as a diagnostic agent. The reports of the tests made in different States revealed that a surprising number of animals among our breeding herds were tuberculous.

In 1901 Drs. Russell and Hastings of the Wisconsin Agricultural Experiment Station published the following report which attracted much attention from livestock sanitary officials and breeders:

Results of Some Tuberculin Tests of Cattle Made Prior to 1901

(Compiled by Drs. Russell and Hastings)

States	Number tested	Number of reactors	Per cent of reactors
Vermont	60,000	2,390	3.9
Massachusetts	24,685	12,443	50.
Mass. Entire Herds	4,093	1,080	26.4
Connecticut	6,300	895	14.2
New York, 1894	947	66	6.9
New York, 1897-98	1,200	163	18.4
Pennsylvania	34,000	4,800	14.1
New Jersey	2,500	535	21.4
Illinois, 1897-98	929	112	12.
Illinois, 1899	3,655	560	15.3
Michigan .....	.....	.....	13.
Minnesota	3,430	381	11.1
Iowa	873	122	13.8
Wisconsin:			
Experiment Station tests:			
Suspected herds	323	115	35.6
Non-suspected herds	935	84	9.
State Veterinarian's tests:			
Suspected herds	588	191	32.5
Tests of local veterinarians under State Veterinarian on cattle intended for shipment to States requiring tuberculin certificates	3,421	76	2.2

Other Reports

Herds of Various Institutions	Number in herd	Number tuberculous	Per cent tuberculous
Maine State Agricultural College.....	51	51	100.
Soldiers' Home, Washington, D. C.....	63	53	84.1
Government Hospital for Insane, Wash- ington, D. C.	102	79	77.
Massachusetts Agricultural College.....	32	25	78.1
New Jersey Agricultural Experiment Station	42	25	59.5
Kansas Agricultural College.....	56	15	26.8
Wisconsin Agricultural Experiment Sta- tion	30	26	86.6
Connecticut Agricultural College, Storrs Experiment Station	49	19	38.8
Colorado Agricultural College.....	31	10	32.2
Vermont Agricultural Experiment Sta- tion	33	21	63.6
Ohio Agricultural Experiment Station, first test	30	14	46.6
Texas Agricultural Experiment Station...	21	10	47.6
Louisiana Agricultural Experiment Sta- tion	22	7	31.8
New Hampshire College of Agriculture and Mechanic Arts.....	55	10	18.2
New York (Geneva) Agricultural Ex- periment Station	27	15	55.5
Utah Agricultural Experiment Station....	18	13	72.2
New Mexico Agricultural Experiment Station	19	3	15.8
Central Experimental Farm, Ottawa, Canada	38	21	55.3

A report published by Pearson and Ravenel in 1901 showed that of 12 herds containing 599 cattle, 484, or 80.8 per cent, were classed as reactors. Russell, in a Wisconsin Agricultural Experiment Station Bulletin published in June, 1906, gave similar statistics on 70 herds containing 853 cattle, which were tested by the Wisconsin State Live-stock Sanitary Board during the years 1903 and 1904, of which 50 per cent were found to be tuberculous.

The post-mortem reports of the Bureau covering animals slaughtered in establishments operating under the Federal meat-inspection law also were helpful in revealing the extent of tuberculosis in this country. These reports for the year 1907 showed that 1 per cent of the swine slaughtered in that year were found to be affected with tuberculosis. The number of swine found affected increased at the rate of 1 per cent annually from 1907 to 1917. During the year 1917 a total of 9,299,487 cattle were slaughtered in official establishments, of which 218,928 were found to be affected, and of 40,217,847 swine slaughtered, 3,978,168 showed lesions of the disease.

Many spasmodic attempts were made prior to 1917 by the livestock

sanitary officials of various States and the health officers of various municipalities to control tuberculosis. Much good was accomplished, but permanent results were not conspicuous, as these attempts lacked uniformity and force. Sufficient educational work had not been conducted to convince the owners of cattle of the wisdom of attempting to eradicate the disease, and members of the veterinary profession itself had not acquired sufficient knowledge concerning the detection and prevention of tuberculosis to handle the situation properly in their respective localities. It is regrettable that in some instances unscrupulous cattle owners, assisted by dishonest veterinarians, abused the use of tuberculin by the so-called "plugging" of cattle, which aided in disseminating the disease.

The Bureau, through its Pathological Division and Experiment Station, early engaged in experimental work looking to the establishment of herds known to be free from the disease. Beginning in 1906 many herds were tested with tuberculin by the Pathological Division. After the work was well established it was turned over to the Quarantine Division to be continued as a regulatory measure. The herds tested were located principally in the States of Maryland and Virginia and in the District of Columbia. As a result of an order of the Commissioners of the District of Columbia for the suppression and prevention of tuberculosis in cattle within the District of Columbia, an opportunity was offered to the Bureau to obtain much valuable information. The results obtained indicated that tuberculosis could be eradicated from individual herds and from groups of herds. The following table shows the number of cattle tested in the District of Columbia and vicinity since January 1, 1910:

Eradication of Tuberculosis from the District of Columbia, 1910 to 1922, Inclusive

Fiscal year	Cattle tested	Per cent reacted
1910.....	1,701	18.87
1911.....	1,967	3.71
1912.....	1,390	2.30
1913.....	1,534	1.83
1914.....	1,628	2.03
1915.....	1,078	1.75
1916.....	1,184	1.1
1917.....	1,060	.84
1918.....	1,206	.99
1919.....	1,264	.63
1920.....	1,173	.25
1921.....	1,373	.36
1922.....	1,166	.17

When the Tuberculosis Eradication Division took over the work May 1, 1917,* the annual retest in the District of Columbia was being

* See "Quarantine Division," page 146.

conducted. The results of this retest revealed that for the first time since the work was begun less than 1 per cent of tuberculosis in cattle was disclosed. The history of the reactors discovered since 1917 indicates that they were brought into the District from infected herds. The experience obtained in eliminating tuberculosis from the herds in the District of Columbia was helpful and encouraging. Dr. Salmon stated publicly in 1906 that "when public sentiment favors the eradication of tuberculosis in animals, the task will not be found an impossible one."

TUBERCULOSIS ERADICATION IN COOPERATION WITH STATES

Having become convinced of the possibility of inaugurating a successful campaign, the Bureau, through interested livestock owners, obtained an appropriation from Congress, which became available on July 1, 1917. By direction of the Chief of the Bureau, Dr. A. D. Melvin, a division known as the Tuberculosis Eradication Division was organized on May 1 of that year, with Dr. John A. Kiernan as Chief. On December 24, 1917, Dr. Alexander E. Wight was transferred from Little Rock, Ark., and assigned as Assistant Chief of the Division. Field offices were opened on July 1, 1917, at the following points: Indianapolis, Ind.; Portland, Ore.; Richmond, Va.; St. Paul, Minn.; Salt Lake City, Utah; Springfield, Mass.

Since that time additional stations have been established as follows:

Nov. 1, 1917.....	Birmingham, Ala.	Dec. 2, 1918.....	Bismarck, N. Dak.
Nov. 3, 1917.....	Jackson, Miss.	Dec. 2, 1918.....	Helena, Mont.
Nov. 5, 1917.....	Atlanta, Ga.	Dec. 2, 1918.....	Pierre, S. Dak.
Nov. 17, 1917.....	Columbia, S. C.	Dec. 17, 1918.....	Montpelier, Vt.
Dec. 19, 1917.....	Albuquerque, N. M.		(Transferred from St. Albans)
Apr. 1, 1918.....	Chicago, Ill.	Jan. 1, 1919.....	Madison, Wis.
Apr. 1, 1918.....	New Orleans, La.	Feb. 2, 1919.....	Jefferson City, Mo.
May 1, 1918.....	Omaha, Nebr.	Feb. 2, 1919.....	Topeka, Kans.
May 10, 1918.....	Albany, N. Y.	Apr. 1, 1919.....	Lincoln, Nebr.
May 16, 1918.....	St. Albans, Vt.		(Transferred from Omaha)
June 1, 1918.....	Denver, Colo.	May 16, 1919.....	Columbus, Ohio
June 1, 1918.....	Tallahassee, Fla.	May 19, 1919.....	Charleston, W. Va.
June 17, 1918.....	Harrisburg, Pa.	June 2, 1919.....	Baltimore, Md.
July 1, 1918.....	Oklahoma, Okla.	June 2, 1919.....	Nashville, Tenn.
July 1, 1918.....	Trenton, N. J.	Aug. 1, 1919.....	Frankfort, Ky.
July 1, 1918.....	Clarksburg, W. Va.	Jan. 1, 1920.....	Little Rock, Ark.
July 1, 1918.....	Sacramento, Calif.	June 16, 1920.....	Augusta, Me.
Aug. 1, 1918.....	Boston, Mass.	July 1, 1920.....	Hartford, Conn.
	(Transferred from Springfield)	Sep. 1, 1920.....	Boise, Idaho
Aug. 1, 1918.....	Ft. Worth, Texas	Sep. 6, 1920.....	Cheyenne, Wyo.
Sep. 9, 1918.....	Des Moines, Iowa	Sep. 20, 1920.....	Olympia, Wash.
Oct. 1, 1918.....	Lansing, Mich.	Sep. 1, 1921.....	Raleigh, N. C.

These offices are conducted in cooperation with the State livestock sanitary officials in the States in which they are located.

Efforts were made to encourage owners of purebred cattle to place their herds under the joint supervision of the State and the Bureau for the purpose of establishing disease-free herds. Owners who desired to have their herds tested were required to sign an agreement which briefly provided for tuberculin testing their cattle, quarantine or slaughter of the reacting cattle, cleaning and disinfection of the premises and to observe prescribed precautions in making additions to their herds.

In handling herds on this basis the Department prescribed three projects under which the funds appropriated for tuberculosis eradication would be expended, viz:

1. The eradication of tuberculosis from purebred herds of cattle, or the "accredited-herd plan."
2. The eradication of tuberculosis from circumscribed areas.
3. The eradication of tuberculosis from swine.

In addition, arrangements were made for the tuberculin testing of cattle at public stockyards.

On December 4, 1917, steps were taken at the meeting of the United States Live Stock Sanitary Association, held at Chicago, to effect a more perfect organization. At this meeting a committee composed of representatives of all the purebred cattle breeders' associations of the country, members of the United States Live Stock Sanitary Association and the Bureau formulated what is known as the "Uniform Methods and Rules for Tuberculosis-Free Accredited Herds." This plan was approved by the Bureau on December 23, 1917. The rules of procedure as they were amended at the last meeting of the Association on December 7, 1923, are as follows:

1. A tuberculosis-free accredited herd is one in which no animal affected with tuberculosis has been found upon two annual or three semi-annual tuberculin tests, and by physical examination, applied by a regularly employed veterinarian of the United States Bureau of Animal Industry or of the State in which cooperative tuberculosis eradication work is conducted by the United States Department of Agriculture and the State, or one in which no animal affected with tuberculosis has been found upon two annual or three semi-annual tuberculin tests applied by an accredited and a Federal or State veterinarian in a manner provided in Rule 6.

Section (a). The subcutaneous, intradermic and ophthalmic methods of applying the tuberculin test are approved.

Section (b). The initial testing in accredited herd work may be by either the subcutaneous or intradermic method, but the ophthalmic method shall be used only in combination with the subcutaneous or intradermic method.

Section (c). A herd which in any previous test shows evidence of infection before being accredited, the final test shall be by a combination of recognized tuberculin tests applied at the discretion of the Federal and State authorities.

Section (d). A herd which has been removed from the accredited list on account of a reactor shall, when ordered by the proper livestock sanitary

official of the State, be reinstated on tests applied by accredited veterinarians, provided such tests are made in accordance with this plan.

2. The entire herd, or any cattle in the herd, shall be tuberculin tested or retested at such times as is considered necessary by the Federal and State authorities.

3. No cattle shall be presented for the tuberculin test which have been injected with tuberculin within sixty days immediately preceding, or which have at any time reacted to a tuberculin test.

4. An accredited herd in which not more than one reactor is found at a subsequent tuberculin test may be reinstated to the list if the entire herd passes a successful test without reactors; said test to be applied not less than four months from the date when the reactor is removed from the herd and farm, provided the owner has complied with all the requirements with reference to the introduction of additional animals to the herd, and also other requirements of the accredited herd plan.

5. No cattle other than those of an accredited herd shall be added to an accredited herd or to a herd that is in the process of accreditation, until they have passed two tuberculin tests applied at intervals of not less than sixty days or more than ninety days by a regularly employed State or Federal veterinarian or by a veterinarian specially authorized by the State and Bureau to conduct such tests. The cattle may, after passing the first test, be placed on the farm or premises containing an accredited herd or one in the process of accreditation but must not be allowed to associate with said herd until after passing the second test.

6. (a) When a herd has been officially accredited by the United States Department of Agriculture and State, it shall be, when ordered by the livestock sanitary officials of the State, tuberculin tested annually by any veterinarian whose name is upon the accredited list of veterinarians approved by the United States Bureau of Animal Industry, provided that before any veterinarian other than one who devotes his entire time to the work of any State or the Bureau of Animal Industry can be approved for accredited herd work, he shall have passed an examination conducted by the proper livestock sanitary officials of the State in which he resides and the Bureau of Animal Industry. He then shall be eligible to conduct annual tuberculin tests upon herds which have been officially accredited upon dates approved by the proper State livestock sanitary official and the inspector in charge of the Bureau of Animal Industry in the State wherein the herd is located.

(b) No herd tests can be made by such an accredited veterinarian unless he has instructions in writing from the State officials to that effect. The date of the annual tests for each herd shall be recorded in the State office and also in the office of the inspector in charge. On any annual test the State and the Bureau reserve the right to have a regularly employed official present on the farm to supervise the testing done by the accredited veterinarian.

(c) The accredited veterinarian shall conduct each test strictly in accordance with instructions issued by the Bureau of Animal Industry to employees engaged in cooperative tuberculosis eradication work. At the conclusion of each test the accredited veterinarian shall submit to the State Veterinarian and the inspector in charge of the Bureau of Animal Industry a copy of the record of the test.

(d) Any animal of a herd under supervision which may react in any herd tuberculin tested by an accredited veterinarian shall be marked for the purpose of identification in accordance with the regulations of the State in which the animal is located.

(e) Tuberculin tests applied by veterinarians other than those regularly employed by the State and Federal Bureau of Animal Industry shall be paid for by the owner of the herd.

(f) Upon written instructions from the proper State officials, accredited veterinarians may conduct tuberculin tests at the owner's expense on herds in the process of accreditation in States which approve this method of testing, until all animals in the herd have passed one negative test; provided,

however, that in such herds Federal indemnity shall be payable only in accordance with the regulations of the U. S. Department of Agriculture, which further provide that when 15 per cent of the total Federal indemnity allotted to each State is not sufficient to meet the demands in a given State, for cattle which may react to tests conducted under this plan by accredited veterinarians, then an additional amount of the State allotment shall be used, provided sufficient funds remain available.

7. Before a herd can be accredited the stables and premises shall be placed in a sanitary condition. When reactors are disclosed as the result of any test, they must be immediately removed from the farm and the stables thoroughly cleaned and disinfected before the herd shall be identified as in process of accreditation.

8. Prior to each tuberculin test satisfactory evidence of the identity of the registered animals shall be presented to the inspector. Any grade cattle maintained in the herd or associated with the animals of the herd shall be identified by a tag or other marking satisfactory to the State and Federal officials.

9. All removals of cattle from the herd, either by sale, death or slaughter, shall be reported promptly to the said State or Federal officials, giving the identification of the animal and, if sold, the name and address of the person to whom transferred. If the transfer is made from the accredited herd to another accredited herd the shipment shall be made only in properly cleaned and disinfected cars. No cattle shall be allowed to associate with the herd which have not passed a tuberculin test approved by the State and Federal officials.

10. All milk and other dairy products fed to calves shall be those produced by an accredited herd, or if from outside or unknown sources it shall be pasteurized by heating to not less than 150° F. for not less than twenty minutes.

11. All reasonable sanitary measures and other recommendations by the State and Federal authorities for the control of tuberculosis shall be complied with.

12. (a) That the requirements for tuberculosis-free area work be similar to the tuberculosis-free accredited herd work and to be applied to all cattle located in said area.

(b) That before any area shall be recognized as tuberculosis-free, after having complied with paragraph (a) of this section, there must be satisfactory assurance of official livestock sanitary police restrictions to prevent re-infection of said area.

(c) *Modified Accredited Areas.*—Areas may be classed as modified accredited areas, provided the following requirements are complied with:

1. The extent of the proposed modified accredited area shall be determined by the cooperating Federal and State authorities in conjunction with other cooperating agencies within the proposed area.

2. Definite quarantine rules and regulations shall be determined upon and inaugurated within said area, and must be in force from the beginning of the work.

3. The area designated shall be classed as modified accredited area by the cooperating Federal and State departments, if as the result of any one complete test including all cattle in said area the total number of reactors does not exceed one-half of 1 per cent; and it is further provided that individual quarantine shall be established in less than sixty days from date of original test, and all subsequent tests shall be made in accordance with the uniform accredited herd plan.

4. No cattle shall be imported into said area unless from an accredited herd or after having passed a satisfactory tuberculin test applied by an approved veterinarian; an exception to be made, however, in the case of cattle for immediate slaughter and steers for feeding and grazing purposes. The cattle for immediate slaughter must be so disposed of within ten days, and during this interval must be held separate and apart from any other cattle. Steers for feeding and grazing purposes brought into said area without an approved tuberculin test shall be placed in official quarantine and held separate and apart from any other cattle.

5. Upon compliance with the aforesaid provisions this area shall be officially and jointly declared by the cooperating Federal and State authorities as a modified accredited area for a period of three years, provided the degree of infection does not exceed one-half of 1 per cent at any time.

(d) If paragraphs 1 and 2, section (c), are complied with, and as the result of any one complete test including all cattle in said area the total number of reactors equals 1 per cent or more of all cattle in said area, then all cattle in said area shall be retested; however, if the percentage of reactors is between one-half of 1 per cent and 1 per cent of all cattle in said area, subsequent tests shall be applied to all infected herds in said area, and when their percentage of reactors is not over one-half of 1 per cent the area may then be officially classed as a modified accredited area.

13. Cattle from an accredited herd may be shipped interstate, by certificate obtained from the office of the State livestock sanitary officials of the State in which the herd is located, or from the office of the Bureau of Animal Industry, without further tuberculin test, for a period of one year, subject to the rules and regulations of the State of destination.

14. Strict compliance with these methods and rules shall entitle the owner of a free herd to a tuberculosis-free accredited herd certificate to be issued by the Federal and State departments. Said certificate shall be good for one year from date of test unless revoked at an earlier date.

15. A supplementary list shall be made to the accredited herd list to contain the names of the owners of purebred herds that are found free from tuberculosis on two annual tuberculin tests but in which the herd bull reacted. Such herds shall not receive an accredited herd certificate. The reacting bull may be used under the following conditions:

1. He shall have passed a satisfactory physical examination and be kept in isolation and quarantine under State supervision.
2. When it is desired to breed cattle to the reacting bull, such cattle shall be taken to the bull and bred on neutral ground. The bull shall be controlled on a staff or halter.
3. After the bull is no longer used in the herd, that herd may be fully accredited after two successful tuberculin tests applied not less than six months apart.

16. Failure on the part of the owners to comply with the letter or spirit of these methods and rules shall be considered sufficient cause for immediate cancellation of cooperation with them by the State and Federal officials.

Approved, December 17, 1923.

The principal changes made in this plan since its original adoption provide for the participation of practicing veterinarians, for the reinstatement of herds which have been removed from the list by reason of one reactor having been found, for the defining of a tuberculosis-free area, and other minor changes intended to clarify the different paragraphs.

The following table showing the number of field offices maintained and the average number of Bureau and State veterinary inspectors employed for the fiscal years from the organization of the work to June 30, 1923, indicates the rapidity of its growth:

Fiscal year	Field offices, end of year	Average Bureau inspectors	Average State inspectors
1918	17	53	36
1919	32	135	62
1920	35	155	101
1921	40	194	148
1922	43	246	172
1923	43	230	178

APPROPRIATIONS

The first appropriation made by Congress for tuberculosis eradication work was included in the regular fund for inspection and quarantine work for the fiscal year 1918. A specific appropriation of \$500,000 was made for the fiscal year 1919. The act specifically stated:

For investigating the disease of tuberculosis of animals, and for researches concerning the cause of the disease, its mode of spread, methods of treatment and prevention, including demonstrations, the formation of organizations, and such other means as may be necessary either independently or in cooperation with farmers' associations, State, territory or county organizations. * * * *Provided, however,* that in carrying out the purpose of this appropriation, if in the opinion of the Secretary of Agriculture, it shall be necessary to destroy tuberculous animals and to compensate owners for loss thereof, he may in his discretion, expend in the City of Washington or elsewhere out of moneys of this appropriation such sums as he shall determine to be necessary for the reimbursement of owners of animals so destroyed in cooperation with such States, counties or municipalities as shall by law or suitable action in keeping with its authority in the matter and by rules and regulations adopted and enforced in pursuance thereof provide inspection of tuberculous animals and for compensation to owners of animals, but no part of the money hereby appropriated shall be used in compensating owners of such animals except in cooperation with and supplementary to payments to be made by State, county or municipality where destruction of such animals shall take place; nor shall any payment be made hereunder as compensation for or on account of any such animal destroyed if at the time of inspection or test of such animal or at the time of destruction thereof it shall belong to or be upon the premises of any person, firm or corporation to which it has been sold, shipped or delivered for the purpose of being slaughtered: *Provided, further,* that out of the money hereby appropriated no payment as compensation for any tuberculous animal destroyed shall exceed one-third of the difference between the appraised value of such animal and the value of the salvage thereof; that no payment hereunder shall exceed the amount paid or to be paid by the State, county or municipality where the animal shall be destroyed; and that in no case shall any payment hereunder be more than \$25 for any grade animal or more than \$50 for any purebred animal and that no payment shall be made unless the owner has complied with all lawful quarantine regulations.

Appropriations have been made for the investigation and control of tuberculosis, as shown in the following table:

Fiscal year	Amount appropriated by Congress		Estimated State appropriations
	Operating expense	Indemnity	
1918.....	\$ 75,000	.....	.....
1919.....	500,000 ¹	.....	\$2,000,000
1920.....	500,000	\$1,000,000	2,500,000
1921.....	800,000	1,085,440 ²	3,000,000
1922.....	978,800	1,600,000 ²	4,000,000
1923.....	850,000	2,027,600	4,000,000
1924.....	850,000	2,027,600	5,000,000

¹Includes indemnity.

²Includes deficiency appropriation.

Beginning July 1, 1919, Congress deemed it wise to provide specific sums for operating expenses and a separate fund for the payment of indemnities for animals slaughtered on account of being tuberculous. The funds provided annually for operating expenses were sufficient to permit an extension of work, but the indemnity fund for the year ending June 30, 1921, became exhausted on April 1, 1921. To meet this emergency Congress appropriated an additional sum of \$405,000 to indemnify owners of tuberculous animals which were slaughtered prior to June 30, 1921. Again in December, 1921, Congress appropriated \$600,000 additional indemnity funds, available December 16, to carry on the work to the end of the fiscal year 1922. Notwithstanding these increased appropriations it was necessary to make immediately available \$300,000 of the indemnity fund for the fiscal year 1923. This bill was approved May 11, 1922, and the major portion of this allotment was used in paying indemnity for cattle slaughtered prior to June 30, 1922.

The demand for the work continued to increase steadily. The records show that on February 1, 1924, there were on the waiting list 219,702 herds containing approximately 2,255,682 head of cattle. In addition there were many county units and others asking for cooperation and assistance in eradicating the disease.

ACCREDITED HERD WORK

The accredited herd feature of the tuberculosis eradication problem was pushed at the beginning of the cooperative work. It was found that there were a number of herds which had been placed under the supervision of the Bureau in its investigational work or under the supervision of various livestock sanitary officials. The owners of these herds were in a position to take up the work promptly. The first herd accredited under the present "Uniform Methods and Rules" was that owned by the U. S. Soldiers' Home, Washington, D. C., certificate No. 1 being issued in favor of this herd on February 6, 1918, practically 60 days after the plan was adopted.

While the U. S. Soldiers' Home herd was the first to be accredited under the present "Uniform Methods and Rules," it was not really the first herd in the United States to be accredited. As stated in the history of the Quarantine Division, the dairy herd owned by Ford & Graham, Garrett Park, Md., was certified by the Bureau on April 27, 1908, as being free from tuberculosis.

The following table shows the progress of the tuberculin testing of cattle from the beginning in 1917 to February 1, 1924:

Progress of Tuberculin Testing of Cattle

Fiscal year	Cattle tested	Reactors		Total accredited—		Total once-tested free—	
		found	Pct.	Herds	Cattle	Herds	Cattle
1917.....	20,101	645	3.2	.....	.....	.....	.....
1918.....	134,143	6,544	4.9	204	6,945	883	22,212
1919.....	329,878	13,528	4.1	782	19,021	6,535	117,243
1920.....	700,670	28,709	4.1	3,370	82,986	16,599	197,577
1921.....	1,366,358	53,768	3.9	8,201	193,620	49,814	643,233
1922.....	2,384,236	82,569	3.5	16,216	363,902	161,533	1,548,183
1923.....	3,460,849	113,844	3.3	28,526	615,156	312,281	2,724,497
1924 ¹	2,782,036	97,111	3.5	37,389	784,975	438,284	3,812,859
Total.....	11,178,271	396,718	3.5	.....	.....	.....	.....

¹To February 1.

The great success of the accredited herd work in a majority of the States was due to many causes, chief among which were increased knowledge on the part of the livestock owners concerning the tuberculosis eradication movement and the arrangement made by the National Government and States to pay indemnity for diseased cattle. From the beginning it was realized that eventually it would be impossible to take care of the demands for service with the regularly employed veterinary inspectors of the Bureau and States. On December 3, 1919, the "Uniform Methods and Rules" were amended so that practicing veterinarians, subject to a practical examination by Bureau and State officials, might be detailed at the expense of the owners to apply the tuberculin test to herds of cattle which had been on the accredited list for two years. On December 3, 1920, the plan was further amended to permit accredited herds to be turned over immediately to eligible local practitioners. Examinations have been held in all the States, resulting in the establishment of a list of 5,517 "accredited" veterinarians. The plan of 1921 provided that accredited men, under supervision, could make the first test on a herd in process of becoming accredited. With the assistance of these practitioners this phase of the work grew beyond all expectations.

CIRCUMSCRIBED AREA WORK

It was realized from the beginning that tuberculosis could not be entirely eradicated under the "accredited herd" plan, which contemplated only the establishment of single tuberculosis-free herds. The area project was, therefore, included in the plans, the idea of its feasibility being based on the demonstrations made in the District of Columbia. During the fiscal year 1918-19 some preliminary work on a similar basis was done in the States of New York, Mississippi and Wisconsin. However, it was not until 1919 that concerted efforts to test all cattle within a given county were begun.

Clay County, Mississippi, inaugurated the area plan on November 1, 1919, and completed the work on January 31, 1920. During this drive 1,113 herds containing 9,563 cattle were tuberculin tested by five men.

In order to extend area work it was necessary first to establish methods by which cooperation could be extended by county units. In a number of States, among which were included Iowa, Massachusetts, Minnesota and Washington, the laws did not permit of independent appropriations on the part of county officials. Numerous forms of cooperation were established. In States where the laws permitted and where funds were available, appropriations were made by the various county boards of commissioners for the employment of veterinarians to cooperate with the Bureau and State forces. In some States similar assistance was obtained through farm bureaus. In other States the work was performed by State and Federal inspectors, and in still others a Bureau veterinarian was placed in charge of a county, with the understanding that the county authorities or the farm bureau would pay half his salary and traveling expenses. All these forms of cooperation were generally successful, but the Bureau encouraged the employment of official county veterinarians wherever appropriations were available.

By February 1, 1924, 96 counties and the District of Columbia had completed one or more official tests of all the cattle within those areas, and 175 were engaged in an active campaign contemplating the testing of all the cattle within those counties. Arrangements have been made to provide for modified accredited areas in various parts of the United States. These areas are those where all the cattle in a county or district have been tuberculin tested, and where tuberculosis does not exist to more than 0.5 per cent. The first list of counties of this kind was made July 23, 1923, and included 17 counties in the States of Indiana, Michigan, North Carolina and Tennessee. The following table shows the status of the area project on February 1, 1924:

Status of Area Eradication, February 1, 1924

States	Counties having completed one or more tests of all cattle	Counties intensively engaged in testing cattle
Arizona	1	2
California	—	3
District of Columbia	1	—
Idaho	2	5
Illinois	1	26
Indiana	4	7
Iowa	—	25
Kansas	—	1

Kentucky	—	4
Maine	—	10
Maryland	1	2
Michigan	14	4
Minnesota	2	—
Mississippi	3	1
Missouri	12	5
Montana	2	4
Nebraska	4	1
New Mexico	—	1
New York	2	18
North Carolina	16	15
North Dakota	1	—
Ohio	—	12
Oregon	10	3
Pennsylvania	1	2
Tennessee	3	—
Utah	1	3
Virginia	1	1
Washington	3	17
West Virginia	1	—
Wisconsin	12	3
Total	97	175

ERADICATION OF TUBERCULOSIS FROM SWINE

Investigations were conducted to ascertain the extent of tuberculosis in swine. It was found that in the hog-growing sections of the Middle West approximately 96 per cent of the infection in swine was traceable to—

1. Following tuberculous cattle.
2. Feeding skimmed milk on the farm, or by-products from creameries, condensaries, etc.
3. Feeding tuberculous carcasses of various animals, including fowls.

About 65 per cent of the infection was traceable to dairy sources. In no instances where tuberculosis had been traced to a farm through infection reported in the hogs did the inspectors fail to find reactors when the cattle were tested. Agents of livestock commission companies and exchanges in the principal slaughtering centers were interviewed and urged to inform Bureau officials of the origin of shipments received at slaughtering centers which contained tuberculous swine. A system of notifying owners of infected shipments by means of form letters was begun in 1909 by the Quarantine Division. These letters specified the pathological conditions found when the animals were slaughtered and suggested that a tuberculin test be applied to all cattle on the premises.

The practicability of tattooing hogs shipped to establishments oper-

ating under Federal meat inspection, in order that tuberculous animals might be properly traced to their origin, was successfully demonstrated. This work was carried out at Waterloo, Iowa; Sioux Falls, S. Dak., and Reno, Nev., during the year 1920. The following records of the Meat Inspection Division of the Bureau covering the period from July 1, 1920, to March 31, 1921, inclusive, show the importance of active measures to control tuberculosis of swine:

Meat-Inspection Statistics of Tuberculosis in Swine

City	Total swine killed	Total retained for tuberculosis	Per cent	Total condemned for tuberculosis	Per cent
Sioux City, Iowa.....	812,389	121,191	14.91	2,950	0.35
Albert Lea, Minn.....	184,337	51,121	27.7	.....	.16
Chicago, Ill.....	4,725,359	791,417	16.74	12,570	.26
Omaha, Nebr.....	1,355,670	192,962	14.23	3,386	.25
Sioux Falls, S. Dak.....	263,768	69,912	26.5	585	.22
Milwaukee, Wis.....	797,675	210,212	25.35	1,787	.22
Fort Worth, Tex.....	235,635	5,777	2.45	87	.03
Cincinnati, Ohio.....	594,292	39,341	6.62	233	.04
Denver, Colo.....	145,670	6,478	4.44	101	.06
Baltimore, Md.....	582,665	8,572	1.45	457	.07
Indianapolis, Ind.....	882,896	55,379	6.27	624	.07
St. Louis, Mo.....	1,237,909	50,773	4.1	926	.07
Entire country.....	27,807,310	3,290,098	11.83	45,145	.16

The Bureau advocates the proper pasteurization of all creamery by-products when they are returned to farms to be fed to swine. The Wisconsin Legislature appropriated funds in 1921 for carrying out this work.

The eradication of swine tuberculosis includes the tracing of the sources of infected swine, the tuberculin testing of the cattle on those premises, the pasteurization of creamery by-products fed to swine, means of identifying hogs at the time of slaughter, and the application of sanitary precautions.

INTERSTATE REGULATIONS FOR THE CONTROL AND PREVENTION OF
TUBERCULOSIS IN CATTLE

The infection of new herds in territory practically free from tuberculosis invariably pointed to purchases of cattle in other States and their movement interstate on certificates of health required by the State officials of the State of destination. Each State drafted its own regulations regarding the entrance of cattle, and practically all required a tuberculin test record, but there was a lack of uniformity in the requirements.

Prior to July 1, 1919, the Department of Agriculture assumed no

authority governing the interstate movement of cattle in so far as the question of tuberculosis was involved, other than to prohibit, under authority of the Act of Congress of May 29, 1884, the movement of animals known to be diseased. The act of 1884 did not establish a complete and comprehensive system of inspection or the quarantine of cattle in interstate commerce. It specifically invited the participation of the respective States and made such participation an essential part of the national system of livestock inspection.

Further legislation was enacted on February 2, 1903, directing the Secretary of Agriculture to establish rules and regulations concerning the interstate transportation of livestock. It provided further that whenever an inspector of the Bureau of Animal Industry should issue a certificate showing that he had inspected any cattle which were about to be shipped in interstate commerce and had found them free from infectious diseases, such animals so inspected and certified might be transported in interstate commerce without further restriction. This legislation was in support of the act of 1884 and was enforced as an aid to the States in the exercise of the police powers vested in the State livestock sanitary officials.

In 1905 Congress again spoke on this subject, indicating its intention to exercise exclusive control of the inspection and quarantine of livestock in interstate commerce. This act (1905) authorizes and directs the Secretary of Agriculture to quarantine any locality when he shall determine that infectious diseases of the animals exist there. Further, it prohibits the interstate movement of cattle from such quarantined territory except as provided. It also authorizes the Secretary of Agriculture to promulgate rules and regulations with regard to the movement and handling of cattle from quarantined localities. The act made it unlawful to move any cattle from such localities except under conditions prescribed by the Secretary of Agriculture.

This was the situation with reference to legislation in 1918, when the State Veterinarian of Missouri informed the Bureau that because of Federal legislation on the subject the State tuberculosis regulations had been declared by the courts of Missouri to be null and void, and he requested that the Secretary of Agriculture promulgate regulations under the authority granted him in order that the State of Missouri might receive the necessary protection against the transportation of diseased cattle.

Realizing the utter impossibility of controlling the spread of tuberculosis without drastic Federal and State regulations, and knowing that such regulations could not be enforced by the limited number

of regularly employed veterinary inspectors, the Bureau developed a plan of utilizing the services of authorized practicing veterinarians for this work. Regulations were drafted based on the act of February 2, 1903, and became effective July 1, 1919. They were identified as Regulation 7, B. A. I. Order 263. Briefly, these regulations provided that a practitioner to be eligible for this work must be a graduate of a recognized veterinary institution, must be recommended by the proper State sanitary official of the State in which he resides, and be approved by the Chief of the Bureau. A veterinary practitioner having obtained such approval was given a certificate authorizing him to conduct tuberculin tests on cattle intended for interstate movement in accordance with the regulations of the Bureau. The records of the Bureau indicated that on July 1, 1923, there were on the list 8,389 approved practitioners to conduct this class of work. Veterinarians who test animals for interstate movement are required to submit copies of test records through the proper State livestock official to the Bureau. These records are checked and apparent inaccuracies or discrepancies in the test are noted and called to the attention of the practitioner by letter. These men cooperate splendidly and are of material assistance in making Regulation 7 effective.

In addition to the tuberculin testing done by local practitioners, the present regulations provide that cattle transported interstate to public stockyards where the Bureau maintains inspection may be tuberculin tested by veterinary inspectors of the Bureau.

An amendment to the regulation dated July 1, 1921, provides for the shipment of tuberculous purebred cattle interstate if for inclusion in a "Bang herd" at destination.

METHODS OF TUBERCULIN TESTING

The success of any system for the control and eradication of tuberculosis depends primarily on the proper administration of tuberculin and the proper interpretation of the results obtained. Various methods of administering tuberculin have been devised. The principal tests advocated have been the subcutaneous, the intradermic, the intrapalpebral and the ophthalmic. In connection with experimental work the Bureau has used all these methods.

The only method officially sanctioned by the Bureau at the time the Tuberculosis Eradication Division was organized was the subcutaneous method. Experiments with the different tests during a period of two and one-half years demonstrated that the intradermic test was equally as reliable as the subcutaneous test and was more easily and

rapidly applied. This method especially fits into the plans for intensive area work, because many more herds can be tested within a given time than by the subcutaneous method. Accordingly, on March 1, 1920, the intradermic test was recognized by the Bureau for all official work. Much experimental work was also carried on with the ophthalmic test.

It was deemed advisable in badly infected herds to use a combination of two and sometimes three methods of applying tuberculin. These combination tests aid materially in overcoming the possible failures of tuberculin administered by one method alone. Tuberculin itself was never believed to be an infallible agent; however, as a result of such combination tests many reactors have been detected which would react to one test and fail to react to another. In working out these combination tests it was shown that the most satisfactory combinations are either the intradermic and ophthalmic or the subcutaneous and ophthalmic. The value of these combinations was recognized and at the meeting of the United States Live Stock Sanitary Association held in Chicago on December 3, 1920, an amendment was made to the "Uniform Methods and Rules" whereby a herd to become fully accredited must at its final test for accreditation satisfactorily pass a combination of at least two tests.

Since the intradermic test has been in use alone or in combination with other tests many calves under six months of age have been found to be reactors. The following table contains data collected from January 1, 1921, to January 1, 1924, which show the results obtained from testing calves with tuberculin:

Results of Tuberculin Testing of Calves, 1921 to 1923, Inclusive

	Number tested	Number reactors	Per cent reactors
Calves under 6 months.....	56,806	1,704	3.0
Calves 6 months to 1 year.....	83,691	4,057	4.8
Total	140,497	5,762	4.1

The following table gives data gathered in the field from October 1, 1920, to January 1, 1924, which show results obtained from the use of the different methods of applying tuberculin.

Method of test	Lots	Cattle	Reacted
Subcutaneous	27,703	548,876	27,440
Intradermic	647,659	6,939,668	202,401
Ophthalmic	794	8,098	251
Combination	78,766	1,644,947	93,174

It is a matter of record that the intradermic test is now accepted, with some reservations, by all the States.

TUBERCULOSIS ERADICATION AND THE PUBLIC HEALTH*

The question of the transmissibility of bovine tuberculosis to the human family has been widely discussed since Koch made his famous statement in 1902 that bovine tuberculosis was not transmissible to the human family. He based this statement on the fact that he had been unable to transmit human tuberculosis to calves. This statement has been disproved many times, through the investigations of Park and Krumweide of the New York City Department of Health, also of Novick, Ravenel and many others. It can not be doubted that a large percentage of tuberculosis in children, some writers stating as high as 33 per cent, is directly traceable to bovine origin. When these facts are considered the question of the eradication of bovine tuberculosis assumes a prominent position in public health work.

When the Division was organized in 1917, its efforts were based especially on the economic importance of the eradication of tuberculosis. But many instances have been reported where tuberculosis of children on farms and in other places was traceable directly to tuberculous cattle on the premises. During 1920 and 1921 reports were received from the various field offices showing that many municipal health boards had enacted ordinances requiring the tuberculin test for dairy herds furnishing milk or other dairy products for consumption in cities and towns.

Efforts were made to engage the cooperation of agencies interested in the question of public health with a view to furthering sentiment favoring dairy products from tuberculosis-free herds of cattle. Attempts to ignore the public health phase of tuberculosis eradication would have been detrimental to the progress of a movement intended to eradicate bovine tuberculosis completely.

CONFERENCES—SHORT COURSES—PUBLICITY

In line with the general policy of the Tuberculosis Eradication Division in regard to cooperation and the dissemination of information, it was decided to hold a series of conferences. The first of these meetings, held at Chicago, Ill., on October 6, 7 and 8, 1919, was attended by a majority of the livestock officials of the various States and by Bureau officials, representatives of livestock organizations, veterinary practitioners and many livestock owners. The proceedings of this meeting were published in pamphlet form and widely distributed. The Chicago meeting was followed by a number of sectional conferences as follows: Portland, Maine, July 13, 14 and 15, 1920;

* See "Pathological Division," page 68.

Philadelphia, Pa., October 11, 12 and 13, 1920; Chicago, Ill., November 27 and 28, 1920; Atlanta, Ga., May 2, 3 and 4, 1921; Boston, Mass., June 22, 23 and 24, 1921; Chicago, Ill., November 25 and 26, 1921; Hartford, Conn., June 6, 7 and 8, 1922; Concord, N. H., June 12 and 13, 1923. These meetings were well attended and proved beneficial to the progress of the work and to all concerned.

In addition to these conferences the Bureau has given assistance in conducting short courses at State agricultural colleges on bovine tuberculosis, and has responded to many invitations from various State organizations, including State veterinary medical associations, to participate in the discussions at their meetings. Short courses were given at the following State colleges in preparation for the examinations in June and July, 1921, to establish a list of accredited veterinary practitioners: Alabama, Kentucky, Michigan, North Dakota, Nebraska.

Commencing July 1, 1918, the progress of the accredited-herd work was given publicity by the publication of the names of owners of accredited herds and those whose cattle had passed one free test in process of accreditation. Successive accredited-herd lists were published on April 1, 1919, and June 30, 1920. The names became so numerous after this date as to render further publication impracticable.

In order to determine the extent of favor with which the accredited-herd plan was regarded by owners of accredited herds and of herds that had successfully passed one tuberculin test, a questionnaire was sent out on January 12, 1921. Approximately 13,000 of these questionnaires were forwarded to the cooperating cattle owners, and about 6,500 replies were received. A request for suggestions as to the handling of the problem in the future and an invitation for criticism was placed in this paper. The replies received were extremely interesting and contained many valuable suggestions. They indicated that public sentiment was in favor of eradicating tuberculosis from the livestock of our country.

In October, 1919, a new Farmers' Bulletin, No. 1069, "Tuberculosis in Live Stock; Detection, Control and Eradication," was prepared by Drs. J. A. Kiernan and A. E. Wight. This bulletin has been widely distributed, the various issues totalling more than 450,000 copies.

At the tuberculosis eradication conference held in Chicago, Ill., November 25 and 26, 1921, the following resolution was adopted, and at the meeting of the United States Live Stock Sanitary Association in December, 1921, the same resolution was adopted:

We request the Bureau of Animal Industry to gather data on the different tests and at the next meeting called by the Bureau for this purpose, to present to this conference the data secured and to designate the proper technic to be used in all tests including the intradermic, ophthalmic and subcutaneous.

In accordance with this resolution a Department Circular, No. 249, "Tuberculin Testing of Livestock," was prepared by Drs. L. B. Ernest and Elmer Lash of the Bureau. This circular was distributed in December, 1922, with the object of standardizing all tuberculin test work.

A map was prepared on May 1, 1922, showing the extent of bovine tuberculosis in all the counties in the United States. The information collected was the first material of its kind ever obtained. It approximates with a fair degree of accuracy the number of tuberculous cattle throughout the entire country. The following table was prepared from this map:

Extent of Bovine Tuberculosis in the United States

	Total square miles	Per cent square miles	Total cattle	Per cent cattle	Per cent tuberculous
Approximate extent					
1 per cent or less.....	1,673,616	46.4	28,338,254	41.2	0.6
More than 1, not more than 3 per cent.....	780,856	21.7	17,484,566	25.4	2.1
More than 3, not more than 7 per cent.....	952,664	26.4	12,397,445	18.1	4.9
More than 7, not more than 15 per cent.....	143,827	4.0	7,590,487	11.0	10.4
More than 15 per cent.....	53,739	1.5	2,960,954	4.3	26.0
Total.....	3,604,702	100.	68,771,706	100.	4.

This table indicates that 46.4 per cent of the total area of the United States in square miles, which area contains 41.2 per cent of all the cattle in the United States, is infected with bovine tuberculosis to the extent of only 0.6 per cent. A further observation of the table shows that only 15.3 per cent of the cattle of the Nation, located in 5.5 per cent of the entire area, are regarded as being badly infected with the disease, these figures being taken from those areas containing more than 10 per cent of diseased cattle. This map has had a wide distribution and is valuable in estimating the extent of the problem involved in freeing the various areas from the disease.

SUMMARY OF IMPORTANT EVENTS

- March 4, 1917. Act of Congress providing \$75,000 for tuberculosis eradication work included in inspection and quarantine funds.
- May 1, 1917. Tuberculosis Eradication Division organized.
- Dec. 4, 1917. U. S. Live Stock Sanitary Association meeting, Chicago, Ill. Steps taken to effect a uniform method of conducting tuberculosis work.

- Dec. 23, 1917. Uniform rules and methods for tuberculosis-free accredited herds approved by Bureau.
- May 4, 1918. State veterinarian of Missouri requested Federal Bureau to provide regulations governing the interstate movement of cattle to protect Missouri against tuberculosis.
- July 1, 1918. Accredited Herd List No. 1 published.
- Oct. 1, 1918. Act of Congress appropriated \$500,000 for tuberculosis eradication work; first specific appropriation for this purpose.
- Oct. 1, 1918. Appropriation act passed by Congress provided for movement interstate of known tuberculous cattle, which had previously been prohibited under act of 1884.
- April 1, 1919. Accredited Herd List No. 2 published.
- July 1, 1919. Regulation 7, B. A. I. Order 263, governing interstate movement of livestock in reference to tuberculosis, became effective.
- July 24, 1919. Act of Congress provided \$1,500,000 for operating expense and indemnity in tuberculosis eradication work for fiscal year 1920.
- Oct. 1, 1919. Farmers' Bulletin 1069, "Tuberculosis in Live Stock," published.
- Oct. 6, 1919. Conference of Bureau and State livestock sanitary officials and others on tuberculosis, Chicago, Ill.
- Nov. 1, 1919. Circumscribed area work inaugurated in Clay County, Miss. This was the first county in the United States to undertake area work under the "Uniform Methods and Rules" plan of eradicating tuberculosis.
- Dec. 3, 1919. U. S. Live Stock Sanitary Association meeting, Chicago, Ill. Uniform methods and rules amended enabling the Bureau and State authorities to include practicing veterinarians in the accredited herd plan, after herds had been accredited for a period of two years.
- Jan. 31, 1920. Circumscribed area work completed in Clay County, Miss.
- March 1, 1920. Intradermic test officially recognized by the Bureau.
- May 31, 1920. Act of Congress provided \$1,480,440 for operating expense and indemnity in tuberculosis eradication work for fiscal year 1921.
- June 26, 1920. First examination for "accredited veterinarians." This examination was held in Virginia and North Carolina.
- June 30, 1920. Accredited Herd List No. 3 and supplements published.
- July 13, 1920. Sectional conference on tuberculosis eradication at Portland, Maine.
- Oct. 11, 1920. Sectional conference on tuberculosis at Philadelphia, Pa.
- Nov. 27, 1920. Conference on tuberculosis at Chicago, Ill.
- Dec. 3, 1920. Uniform plan again amended so that accredited herds may be turned over immediately to accredited veterinarians. Amendment also provided that a herd to be fully accredited must as its final test satisfactorily pass a combination of at least two tests.
- Jan. 12, 1921. Questionnaire on tuberculosis sent to owners of accredited and once-tested herds.

- March 3, 1921. Act of Congress provided \$1,978,800 for operating expense and indemnity in tuberculosis eradication work for fiscal year 1922.
- May 2, 1921. Sectional conference on tuberculosis at Atlanta, Ga.
- June 15, 1921. Congress appropriated \$405,000 deficiency appropriation for tuberculosis eradication work.
- June 22, 1921. Sectional conference on tuberculosis at Boston, Mass.
- June 30, 1921. Data compiled on tuberculin testing of calves under 6 months of age indicated that 8.4 per cent were reactors.
- Sept. 23, 1921. Conference of Bureau inspectors in charge held at Washington, D. C.
- Nov. 29, 1921. U. S. Live Stock Sanitary Association meeting, Chicago, Ill. Uniform methods and rules amended.
- Dec. 15, 1921. Congress appropriated \$600,000 emergency appropriation for payment of indemnity.
- Jan. 24, 1922. Examinations for "accredited veterinarians" held in 29 States.
- May 11, 1922. Appropriation providing \$2,027,600 for indemnity and \$850,000 for operating expenses for fiscal year 1923 approved.
- June 6-8, 1922. Third annual New England conference held at Hartford, Conn.
- Dec. 8, 1922. U. S. Livestock Sanitary Association meeting at Chicago, Ill. Uniform methods and rules amended and "modified accredited area" described.
- Feb. 26, 1923. Appropriation providing \$2,027,600 for indemnity and \$850,000 for operation for fiscal year 1924 approved.
- March 1, 1923. B. A. I. Order 282 making some changes in method of paying indemnity effective.
- June 12, 13, 1923. Fourth annual New England conference at Concord, N. H.
- July 16, 1923. Amendment 2 to B. A. I. Order 273 issued, permitting interstate movement of cattle from modified accredited areas without tuberculin test.
- July 23, 1923. B. A. I. Order 283, placing the following counties in "Modified Accredited Area": INDIANA: Dearborn; MICHIGAN: Hillsdale, Charlevoix, Antrim, Emmet; NORTH CAROLINA: Scotland, Rowan, Pender, New Hanover, Davie, Davidson, Cumberland, Cabarrus, Buncombe, Forsythe; TENNESSEE: Bradley, Marshall.
- Feb. 5, 1924. Amendment 1 to B. A. I. Order 283 "modified" following counties: ILLINOIS: Edgar; INDIANA: Ohio; MICHIGAN: Grand Traverse; NORTH CAROLINA: Alamance, Greene, Iredell, Robeson, Wayne; TENNESSEE: Giles.

PERSONNEL OF THE TUBERCULOSIS ERADICATION DIVISION

Division Chief:

Dr. J. A. KIERNAN..... May 1, 1917, to date

Assistant Chief:

Dr. A. E. WIGHT..... Dec. 24, 1917, to date

Tuberculosis Eradication Investigations:

Dr. L. B. ERNEST..... Dec. 1, 1917, to date

In Charge of Enforcement of Regulation 7:

Dr. ELMER LASH..... July 7, 1919, to date

Bureau Personnel and Veterinary Education

BUREAU PERSONNEL

On January 16, 1883, Congress passed what is known as the Civil Service Law, which created the United States Civil Service Commission. Gradually the jurisdiction of the Commission was extended to include the different branches of the Government service.

By an Executive Order of President Cleveland dated May 28, 1894, and effective July 1, 1894, the 69 veterinarians already in the employ of the Bureau were brought into the classified service.

The Executive Order of President Cleveland dated May 24, 1895, brought under civil service control 787 employees of the Bureau, including the chiefs of divisions, experts, artists, statistical agents, microscopists, assistant microscopists, taggers, stock examiners, clerks and certain agents.

There yet remained in the Bureau 115 employees, such as experts and agents, who had been appointed without competitive examination. These employees were transferred to a civil-service status by an Executive Order of President Taft dated August 26, 1912.

The Bureau has engaged in a variety of activities which has made it necessary to employ chemists, pathologists, bacteriologists, zoologists, animal husbandmen, dairymen, veterinarians, etc., but always laymen have constituted the largest group of employees. The Bureau had in its employ a number of laymen whose duties were to assist the veterinarians in the work of meat inspection. Some were employed regularly in tagging inspected and passed carcasses or quarters, and from the nature of their work they were designated as "taggers." Others were designated "stock examiners," as their duties consisted chiefly of inspecting live animals in the stockyards and tagging those that showed evidence of disease or other objectionable conditions, so that the veterinarians on the killing floors would be able to identify them before making the post-mortem inspections. Other laymen were given field assignments where they assisted veterinarians in the control or eradication of animal diseases, such as dourine, sheep and cattle scabies and the Texas fever tick.

On April 9, 1898, the Secretary of Agriculture designated Dr. A. D. Melvin, Assistant Chief of the Bureau, and Col. S. R. Burch, Chief Clerk of the Bureau, to be appointed by the Civil Service Commission as auxiliary members of the Promotion Board for the Department of Agriculture to represent the Bureau of Animal Industry. Under this designation Dr. Melvin and Col. Burch were instructed

to hold examinations for the promotion of taggers to the position of stock examiners. The first examination of that kind was held at Indianapolis, Ind., April 11 and 12, 1898, under authorization of the Civil Service Commission which was granted early in that year.

The title of tagger was used officially until July, 1907, when an order was issued by the Secretary of Agriculture to change the designation to inspector's assistant or skilled laborer, depending on the result of an examination. The examination was held July 30, 1907; and the titles were changed March 1, 1908. If a tagger passed the examination with a mark of 70 or over, his designation was changed to inspector's assistant; if he failed to make a mark of 70, his designation was changed to skilled laborer. The title of stock examiner was not changed at that time.

With the inauguration of the Meat Inspection Law in 1906, a new class of employees was created, known as meat inspectors, who entered the service through civil-service examination. In October, 1909, steps were taken to discontinue examinations for meat inspectors and to fill such positions through the promotion of inspectors' assistants. However, it is of record that meat inspectors were appointed from the names that remained on the eligible list as late as March, 1914.

On November 1, 1914, all existing titles of lay employees in the Bureau, except clerks, mechanics and laborers, were changed to lay inspector. The stock examiners and meat inspectors became lay inspectors, grade 2, and the inspectors' assistants became lay inspectors, grade 1. On April 1, 1920, the qualifying term grade 1 and grade 2, designating different classes of lay inspectors, were eliminated, and since that date all in this class of employees have been designated as lay inspectors.

In June, 1891, there was added to the Bureau force a class of employees known as microscopists and assistant microscopists. This group was made up of female employees whose duties consisted in making a microscopical inspection of certain cuts and carcasses of hogs to ascertain if they were free from trichinæ. This inspection was authorized by a law passed by Congress in March, 1891, by which pork shipped to certain foreign countries might be examined microscopically and certified if found free from trichinæ, in order to meet the requirements of those countries. This force was gradually increased until 1901, when it numbered 268. Beginning with 1902 this work was gradually decreased until in June, 1906, it was entirely discontinued.

Veterinarians in the employ of the Bureau were originally designated "inspector" and "assistant inspector," according to the importance of their assignments. The title of inspector was given to those in charge of projects, or who performed work of a special character, and assistant inspector to those assigned to routine duties under immediate supervision. On January 1, 1907, the designations of all assistant inspectors and all inspectors were changed to "veterinary inspector."

In June, 1894, just prior to the date that Bureau veterinarians were placed in the classified service, the first examination of veterinarians for positions in the Bureau was held under civil-service regulations. The following are the subjects, with their relative weights, which that examination covered.

Subjects	Weights
1. Veterinary anatomy and physiology.....	20
2. Veterinary pathology.....	30
3. Meat inspection.....	50

First Subject.—Veterinary Anatomy and Physiology

Question 1. Through what passage does the peritoneal cavity communicate with exterior of the body? Describe fully.

Question 2. Name and give the situation of the most important groups of lymphatic glands which should be examined for the detection of tuberculosis in the bovine species.

Second Subject.—Veterinary Pathology

Question 1. Starting from the mesenteric gland, in what direction and through what channels might an infectious organism be carried, and in what organs might it finally lodge?

Question 2. What pathological condition may be the cause of fluid in the abdomen?

Question 3. What is inflammation and to what different conditions may it lead?

Question 4. What is pus made up of, and how does it appear to the naked eye?

Third Subject.—Meat Inspection

Question 1. Under what general pathological conditions is the flesh of animals to be considered unfit for human food?

Question 2. Where are the lesions of hog cholera chiefly found?

Question 3. In what diseases are lesions found which may be mistaken for tuberculosis? How would the diagnosis be made by the meat inspector after the animal's death?

Question 4. In what stage of tuberculosis must the flesh be regarded as infected?

Dr. John Forbes was among those who took this examination and was the first to be appointed under civil-service regulations. Dr. Forbes's appointment became effective August 16, 1894.

From the beginning the Bureau cooperated with the Civil Service Commission in conducting examinations for entrance to the Bureau Service. Dr. William S. Washburn and Dr. E. G. Seibert, physicians, were

commissioned and employed by the Civil Service Commission to conduct these examinations, but as their education and training were in human medicine, pathology and anatomy, the Commission relied to some extent on the Bureau for assistance. In 1901, Dr. R. W. Hickman, of the Bureau, was detailed to assist the representatives of the Civil Service Commission in grading the papers of veterinarians competing in examinations for the position of assistant inspector, a duty which he performed for several years, until he was relieved by other officials of the Bureau.

VETERINARY EDUCATION

As the work of the Bureau increased and became more exacting, and the problems dealing with animal plagues became more intricate, increased efforts were made by the Department to procure the best-trained veterinarians available. The scope of the examination was broadened and the questions were made somewhat more comprehensive in order to eliminate those applicants whose limited veterinary education and training did not qualify them to perform efficiently the responsible duties that would be required of them in the Bureau. There were a number of private veterinary schools in the United States at this time which were not equipped to give thorough instruction in veterinary subjects. The faculties were not complete, and in some instances not competent; the courses of study were too short. As a consequence the graduates of some schools were not up to the standard desired for Bureau work. Veterinary education generally in the United States was progressing, but some schools were lagging.

In order to obtain men thoroughly qualified by education to fill positions in the Bureau, it was deemed advisable to prescribe a standard of veterinary education for schools that desired to prepare their graduates to qualify to take the civil-service examination for positions in the Bureau. The Civil Service Commission approved this arrangement, and in February, 1908, the Secretary of Agriculture appointed a committee consisting of five leading veterinarians of the country for the purpose of obtaining information regarding the courses of instruction then given at the various veterinary colleges, and to make recommendations as to lengthening and arranging the courses of instruction properly to qualify graduates of these colleges for positions in the Bureau. The members of this committee were Dr. Richard P. Lyman, Secretary of the American Veterinary Medical Association; Dr. Joseph Hughes, President of the Chicago Veterinary College; Dr. Tait Butler, Secretary of the Association of Veterinary

Faculties and Examining Boards of North America and State Veterinarian of North Carolina; Dr. Paul Fischer, State Veterinarian of Ohio; and Dr. A. M. Farrington, then Assistant Chief of the Bureau.

The committee met in Chicago February 27, 1908, and organized with Dr. Lyman as chairman and Dr. Farrington as secretary. At this meeting a definite plan was formulated for visiting the colleges and obtaining the desired information, and on February 28 the committee commenced its investigations. The veterinary colleges of the United States and one in Canada, comprising in all seven State institutions and fourteen private schools, were visited. On April 20, 1908, the committee met in Washington and submitted to the Secretary of Agriculture its report, which specified the minimum course of instruction which the committee considered necessary to qualify graduates to become eligible for the position of veterinary inspector. The report embodied also recommendations as to faculties, equipment and teaching. This report and recommendations were published in Bureau Circular 133, dated July 6, 1908, and sent to the veterinary colleges in the United States and Canada. In September of the same year these recommendations were approved by the American Veterinary Medical Association.

On January 21, 1909, the Chief of the Bureau invited the representatives of the various veterinary colleges to Washington to discuss with Department officials the report of the committee, including the recommendations. The following institutions were represented at the conference:

Chicago Veterinary College
Colorado State College
Indiana Veterinary College
Kansas City Veterinary College
New York State College
Ohio State University
San Francisco Veterinary College
Grand Rapids Veterinary College
McPhillip Veterinary College
University of Pennsylvania Veterinary Department
Cincinnati Veterinary College
United States College of Veterinary Surgeons

After a two days' conference and a full discussion of the problems, the recommendations made by the committee were approved by the officials of the colleges represented at the conference.

In March, 1909, there was appointed within the Bureau a committee on veterinary education consisting of Dr. R. W. Hickman and Dr. A. M. Farrington. Commencing March 17 of that year, this commit-

tee-visited the principal veterinary colleges in the United States and Canada. The work of the committee consisted of examining matriculation papers and credentials, making inquiry concerning the subjects studied, number of hours devoted to each, and inspecting the facilities and equipment for teaching and for laboratory work. All possible information was obtained regarding the manner in which each college was complying with the provisions of Circular 133, and delinquencies were brought to the attention of the proper college officials. Generally the veterinary colleges cooperated willingly with the Bureau, and they deserve much credit for the splendid spirit displayed and the effective manner in which they met the Bureau's requirements.

Private schools predominated in number up to the year 1918, when there were 23 schools in the United States which gave full courses in veterinary medicine. Twelve of these schools were private institutions and eleven were connected with State colleges or received State aid. There were also two State agricultural colleges which gave two-year courses on veterinary subjects. As the private schools were sustained entirely by tuition fees, there was keen rivalry among them, and this, in some instances, led to a laxity in accepting matriculants. Usually the private schools did not maintain such high standards of veterinary education as the colleges which received State aid. At present (July 1, 1923) there are only three private veterinary schools in the United States and it may be expected that eventually they will cease to exist, as it is difficult for a private veterinary school to maintain the required standard and compete with colleges that receive financial aid from the States.

Following are the names of the veterinary colleges in the United States and foreign countries which were on the accredited list July 1, 1923:

- Alabama Polytechnic Institute, College of Veterinary Medicine, Auburn, Ala.
- Colorado State College, Division of Veterinary Medicine, Fort Collins, Colo.
- Georgia State College of Agriculture, Veterinary Division, Athens, Ga.
- Indiana Veterinary College, Indianapolis, Ind.
- Iowa State College, Division of Veterinary Medicine, Ames, Iowa.
- Kansas State Agricultural College, Veterinary Department, Manhattan, Kans.
- Michigan Agricultural College, Division of Veterinary Science, East Lansing, Mich.
- New York State Veterinary College, Cornell University, Ithaca, N. Y.
- Ohio State University, College of Veterinary Medicine, Columbus, Ohio.
- St. Joseph Veterinary College, St. Joseph, Mo.
- State College of Washington, Veterinary Department, Pullman, Wash.
- Texas Agricultural and Mechanical College, School of Veterinary Medicine, College Station, Texas.

United States College of Veterinary Surgeons, Washington, D. C.
University of Pennsylvania, School of Veterinary Medicine, Philadelphia, Pa.

University of Toronto, Ontario Veterinary College, Toronto, Ontario, Canada (to include those graduated during or prior to 1897 and those in attendance beginning session 1918-19).

Graduates of the following-named colleges which no longer exist are admitted to civil-service examinations:

American Veterinary College, New York, N. Y.
Columbia Veterinary College, New York, N. Y.
Chicago Veterinary College, Chicago, Ill.
Cincinnati Veterinary College, Cincinnati, Ohio.
New York State Veterinary College, New York University, New York, N. Y.
Columbian University, Veterinary School, Washington, D. C.
George Washington University, College of Veterinary Medicine, Washington, D. C.
Grand Rapids Veterinary College, Grand Rapids, Mich.
Harvard University, School of Veterinary Medicine, Boston, Mass.
Kansas City Veterinary College, Kansas City, Mo.
McGill University, Veterinary Department, Montreal, Canada.
McKillip Veterinary College, Chicago, Ill.
National Veterinary College, Washington, D. C.
New York College of Veterinary Surgeons, New York, N. Y.
New York-American Veterinary College, New York, N. Y.
San Francisco Veterinary College, San Francisco, Calif.
Terre Haute Veterinary College, Terre Haute, Ind.

Graduates of the following-named foreign colleges are admitted to civil-service examinations:

Glasgow Veterinary College, Glasgow, Scotland.
Royal Veterinary College, London, England.
Royal Veterinary College of Ireland, Dublin, Ireland.
Royal (Dick) Veterinary College, Edinburgh, Scotland.
The New Veterinary College, Liverpool, England.
Veterinary College of Lemberg, Poland.
University of Melbourne Veterinary School, Melbourne, Australia.
University of the Philippines, College of Veterinary Science, Manila, P. I.
Royal College of Veterinary Science and Agriculture, Copenhagen, Denmark.
Royal Superior Veterinary School, Naples, Italy.

From 1908 to the present time the Bureau has spared no efforts to help our veterinary colleges increase the efficiency of veterinary education and elevate the standard of the veterinary profession in this country.

Beginning with the school year of 1908, it was required, in accordance with the recommendations contained in Circular 133, dated May 28, 1908, that the course in veterinary science should cover a period of three years of not less than six months in each year, exclusive of final examinations and holidays, and have a minimum of 150 days in each year of actual teaching, and a minimum of 3,200 actual teaching hours for the entire three years.

These regulations were modified on September 1, 1909 (Circular

150), increasing the three-year course to not less than six and one-half months in each year, exclusive of final examinations and holidays, and reducing the number of actual teaching hours of the 150 days from 3,200 to 3,000.

The regulations governing entrance to the veterinary inspector examination which became effective on and after March 1, 1917, increased the course of study to a period of four years of not less than six and one-half months in each year, exclusive of final examinations and holidays, and required that the course of instruction should have a minimum of 150 days of actual teaching in each year and a minimum of 3,380 actual teaching hours in the entire four years.

The matriculation requirement for admission to accredited veterinary colleges was raised to not less than four years' high school education of at least fourteen full units or their equivalent.

It was also required that at least five graduate veterinarians be on the faculty of each accredited veterinary college teaching major subjects, "each of whom shall have had not less than one year's additional training in some accredited veterinary college, or three years' experience in teaching or in practicing veterinary science, subsequent to graduation from an accredited veterinary college." "Not more than three of the five veterinarians in charge of major subjects on each college faculty shall be graduates of any one veterinary college, unless they have had at least one year's additional training in another veterinary college." "The five veterinarians on the faculty of each veterinary college shall have charge of the following major subjects: (1) Anatomy; (2) Practice of Comparative Medicine; (3) Surgery, and any two of the following three subjects: Pathology, *Materia Medica*, or Physiology."

The regulations prescribed and adopted for the education of veterinary students who might desire to seek appointment under civil service are applied by all of the leading veterinary colleges, and as their courses of instruction are made uniform it follows that those graduates who enter the field of practice, as well as those who enter the Bureau, receive the benefits of a higher standard of veterinary education and training. As a result of the Bureau's action, higher veterinary education has been given increased impetus which helped greatly in elevating the veterinary profession in the United States to its present position.

Editorial Office

THE BUREAU'S PUBLICATIONS

The printed page has always been an important factor in carrying on the work of the Bureau of Animal Industry. In the forty years of the Bureau's existence it has issued nearly 2,000 different publications, ranging all the way from one-page leaflets to books of several hundred pages. This literature has served to disseminate much valuable information for the development and improvement of the livestock industry and contains the record of some notable discoveries in the field of science.

In the early years the publications consisted mainly of reports of investigations by veterinarians and others into the prevalence and nature of animal diseases in the United States and reports of the progress of the work of eradicating contagious pleuropneumonia, with occasional regulatory orders. During the few years prior to the formation of the Bureau (1879-1884) five volumes of reports of investigations by Dr. D. E. Salmon and others were issued by the Department. With the creation of the Bureau there was begun a series of Annual Reports which for twenty-eight years reflected the Bureau's varied activities and recorded its work. These reports contained accounts of the Bureau's operations and special articles on various livestock subjects and were volumes varying in size from 127 to 706 pages with numerous illustrations. Their value was soon recognized by Congress and provision was made for printing them as Congressional publications for distribution by Senators and Representatives.

With the growth and expansion of the Bureau's activities the publications became more numerous and covered a wider range of subjects. There were reports of scientific investigations of animal diseases and parasites and breeding and dairy problems; technical and popular treatises on diseases and parasites of animals; orders and regulations for carrying out sanitary regulatory measures; administrative reports; and bulletins and leaflets on stock raising and dairying.

The Special Report on Diseases of the Horse, commonly known as the Government "Horse Book," issued in 1890, has been one of the most popular and widely circulated of the Bureau's numerous publications. This work, made up of chapters written by several veterinary authorities, with many illustrations, has gone through several editions, including five revisions. No less than a million and a half copies have been printed. A companion volume on Diseases of

Cattle, first published in 1892, has enjoyed almost as great popularity. Most of the copies of these books have been distributed free by Senators and Representatives in Congress, but thousands have been bought at \$1 each from the Government Printing Office by persons unable to get them otherwise because the free supply was often exhausted.

A notable publication from the scientific standpoint was the report by Smith and Kilborne of their investigations in which they discovered the cause and mode of transmission of Texas or tick fever of cattle and established the principle of the transmission of disease by intermediate parasitic hosts. This work was included in the Eighth and Ninth Annual Reports (for 1891 and 1892) and was also issued separately as No. 1 in the series of Bureau Bulletins begun in 1893. A series of Bureau Circulars, comprising minor publications, usually of a popular nature, was also begun in 1893.

Regulations for the control and eradication of animal diseases and for other regulatory work in connection with the livestock industry were issued for several years without serial numbers, but in 1897 the series of B. A. I. Orders was established in order to systematize the numerous publications of this character.

The enlargement of the meat inspection following the passage of the law of 1906 showed the need of a convenient medium for communicating information and instructions to the members of the enlarged field force of the Bureau. This need was met by establishing in May, 1907, a monthly publication known as Service Announcements. At first this periodical was intended only for Bureau employees, but later its distribution was extended to meat-packing firms under inspection, to public officers dealing with livestock matters, and to the press. This publication was found so helpful in the conduct of administrative work that at the beginning of 1914 the Secretary of Agriculture extended the plan to other branches of the Department that were doing regulatory work, and the uniform title of Service and Regulatory Announcements was adopted.

In 1889 the Department began a series of Farmers' Bulletins, consisting of brief, popular treatises on various subjects relating to agriculture. These bulletins have had an enormous circulation running up into many millions of copies. The Bureau of Animal Industry has contributed a large proportion of them. Those on poultry raising have had the largest distribution of any in the series. The Bureau has also supplied numerous papers of a popular nature for the Department Yearbooks.

In 1913 the Secretary of Agriculture decided on a change in the

plan of the Department's publications. Most of the series of the various bureaus were discontinued, and two new series, known as Department Bulletins and Circulars, were begun. The Journal of Agricultural Research was established as a medium for publishing the results of research work. As a result of this rearrangement the series of Annual Reports, Bulletins and Circulars of the Bureau of Animal Industry were discontinued, and thenceforth most of the material of the kinds that had gone into these publications was issued in the new Department series and in the Journal, while the Farmers' Bulletins were continued. The brief administrative annual report of the Chief of the Bureau and the B. A. I. Orders were continued as before.

THE OUTPUT OF PUBLICATIONS

An idea of the amount of literature put out by the Bureau in the forty years of its history may be gained from the accompanying table, which shows the number of new and revised publications issued each year and the number of pages, with data as to material contributed to the news service and to outside periodicals during the latter part of the period.

For the first five years the literary output consisted only of the Annual Reports and a few regulatory orders. After the first three years the Annual Reports were issued biennially for a time, the reports for two years being combined in one volume. This fact, and the occasional issuance of special publications of considerable size, accounts for the large variation in the number of pages for several years. The activities for promoting food production during the World War and in eradicating an outbreak of foot-and-mouth disease during the same period are reflected in the large numbers of publications issued in the fiscal years 1915 to 1917. The tendency in recent years has been to issue publications of fewer pages but in larger editions.

PUBLICATIONS OF THE BUREAU OF ANIMAL INDUSTRY

Fiscal year.	Number of publications (new and revised).	Pages.	Articles contributed to Department's news service.	Articles contributed to outside periodicals.
1885.....	2	880	.....	.....
1886.....	3	693	.....	.....
7887.....	5	472	.....	.....
1888.....	1	11	.....	.....
1889.....	2	707	.....	.....
1890.....	6	105	.....	.....
1891.....	8	1,481	.....	.....
1892.....	10	290	.....	.....
1893.....	11	1,850	.....	.....

1894.....	14	1,003	.....	.....
1895.....	17	284	.....	.....
1896.....	54	728	.....	.....
1897.....	42	851	.....	.....
1898.....	32	462	.....	.....
1899.....	30	1,119	.....	.....
1900.....	48	1,221	.....	.....
1901.....	55	1,782	.....	.....
1902.....	65	2,052	.....	.....
1903.....	85	1,497	.....	.....
1904.....	76	3,251	.....	.....
1905.....	100	3,094	.....	.....
1906.....	78	2,108	5	.....
1907.....	83	2,290	7	.....
1908.....	79	2,446	28	.....
1909.....	111	2,953	50	.....
1910.....	89	1,970	14	.....
1911.....	105	2,891	12	.....
1912.....	89	3,773	9	.....
1913.....	95	2,208	22	3
1914.....	89	1,653	88	16
1915.....	159	1,678	31	11
1916.....	119	1,186	62	26
1917.....	107	2,791	61	46
1918.....	95	1,753	90	37
1919.....	85	1,321	247	(a)
1920.....	78	1,302	323	(a)
1921.....	94	1,958	196	78
1922.....	71	1,304	270	71
1923.....	76	1,691	190	62

(a) Record incomplete.

The publications may be classified as follows:

- Annual Reports, Nos. 1 to 28 (1884 to 1911).
 - Reports of the Chief of the Bureau (in separate pamphlet form, 1889 to date).
 - Special Reports.
 - Bureau Bulletins, Nos. 1 to 167 (1893 to 1913).
 - Bureau Circulars, Nos. 1 to 218 (1893 to 1913).
 - Unnumbered orders and regulations (1885 to 1896).
 - B. A. I. Orders, Nos. 1 to 287, with numerous amendments (1897 to date).
 - Service Announcements, Nos. 1 to 80 (1907 to 1913).
 - Service and Regulatory Announcements, Nos. 81 to 204 (1914 to date).
 - Farmers' Bulletins (1889 to date).
 - Department Bulletins (1913 to date).
 - Department Circulars (1913 to date).
 - Circulars of the Secretary's Office.
 - A. I. Leaflets, Nos. 1 to 38 (1914 to 1922).
 - Separates from Annual Reports.
 - Yearbook Separates.
 - Papers in Journal of Agricultural Research and separates of same (1913 to date).
 - Miscellaneous publications (leaflets, documents, reports, etc., numbered and unnumbered).
 - Posters.
 - Maps.
 - Pictures in Livestock Improvement Series.
- (The last three groups are not included in the statistical table.)

ESTABLISHMENT AND WORK OF THE BUREAU EDITORIAL OFFICE

For the first several years of the Bureau's existence the publications were personally supervised and in large part written by the Chief, Dr. D. E. Salmon, who was an accomplished writer as well as a capable research worker and executive. The increasing demands on his time, however, and the growing volume of the Bureau's literature led him to arrange for the transfer of a member of the Department's editorial staff, George Fayette Thompson, from the Division of Publications of the Department to the Bureau of Animal Industry on March 1, 1898. One of Mr. Thompson's first tasks under the new assignment was the preparation of the Fourteenth Annual Report for 1897. Assistants were added as the work grew in volume and extent. Mr. Thompson died January 6, 1906.*

The principal work of the Editorial Office has consisted in editing manuscripts for the various publications; compiling and preparing some of the material for these publications; reading proof; reviewing manuscripts for outside publication; reviewing forms and ordering job printing; compiling data for various uses in connection with the Bureau's work; keeping records of manuscripts and printing; supervising the Bureau's mailing lists and the distribution of its publications, and attending to correspondence on publication matters and miscellaneous subjects. Translating and the supervision of duplicating work have been minor activities. Other functions and duties have been added from time to time.

For the first twenty years very little was done in the way of preparing material for the agricultural and general press. Beginning about 1907, more attention was given to this means of disseminating information in the interest of the livestock industry and making the Bureau's work better known to those concerned. Following the formation in 1913 of the Department's Office of Information (later the Press Service), the Bureau through its Editorial Office cooperated actively in preparing and supplying material for publicity purposes. This activity has been considerably enlarged in recent years.

For many years the Editorial Office has made compilations, from meat-inspection records and other sources, of statistical data on meat production, consumption and foreign trade. This information is much sought by the meat trade, by statistical organizations and by other branches of the Government.

For the information of Bureau and Department officials the office

* See "Quarantine Division," page 136, and "Animal Husbandry Division," page 243.

issues periodically a mimeographed summary of public opinion known as "The Range Finder." This contains extracts of news items, both foreign and domestic, and a digest of editorials and leading articles in the agricultural press relating to subjects in which the Bureau is concerned.

In addition to representing the Chief of the Bureau in publication matters, the Editorial Office has worked closely with the various divisions in making suggestions for presentation of subject matter. Such work has included the preparation of charts, assistance in gathering and arranging material for addresses, and the development of motion picture scenarios.

It has rendered assistance also on special occasions in obtaining information for immediate use of the various divisions. For instance, at the time of a visit of a foreign commission desiring to purchase cattle, the Editorial Office issued in one day a unique Farmers' Bulletin composed of typewritten material, interspersed with photographs, dealing with the determination of the age of cattle by the teeth. Copies of this "publication" served the immediate purpose and proved so useful that it was later published in printed form as a Farmers' Bulletin.

An example of miscellaneous nature of editorial work was the preparation of an outline for conducting mock trials for scrub sires, a plan which has been largely used by extension workers.

MOTION PICTURES AND LANTERN SLIDES

In 1913 the Department undertook the production of motion pictures as a means of giving information and instruction, and the Editor of the Bureau of Animal Industry was made a member of the Department's Committee on Motion Picture Activities.

The Editorial Office has continued to aid the Motion Picture Office of the Department in the preparation and making of motion pictures and in planning new films and revising old ones, and has prepared the scenarios of several of the Bureau's pictures.

The greater popularity of motion pictures which have human interest, compared with those of strictly educational nature, has resulted in the preferred policy of combining a story with subject matter wherever possible. Such stories often involve dramatic scenes and a progressive plot, thereby making the picture more impressive and of interest to mixed audiences rather than merely to groups of persons interested only in the particular subject shown. The Editorial Office has aided specialists in various divisions in developing pictures along these lines.

The office has also selected pictures for making sets of lantern slides illustrating various phases of the Bureau' work. The motion pictures and lantern slides have been of special value in promoting tick eradication and tuberculosis eradication.

LIVESTOCK IMPROVEMENT CAMPAIGNS

In 1919 the Chief of the Bureau requested the Editorial Office to cooperate with the Animal Husbandry and Dairy Divisions in planning and inaugurating an educational campaign for livestock improvement by the use of purebred sires. The campaign is carried on locally by county agricultural agents and livestock organizations in most States. It includes all classes of farm animals and poultry. The plan involves an enrollment blank which the participant fills out and which entitles him to a certificate and also to a sign, "Purebred Sires Exclusively Used on This Farm." More than 13,000 farmers, owning nearly two million head of livestock and poultry, have enrolled. Records show that the use of purebred sires quickly results in improved herds and flocks. The need for such work is indicated by the very small proportion of purebred livestock in the United States. According to the last census, purebred livestock was approximately only 3 per cent of the total.

As adjuncts to the plan of work the Editorial Office, in cooperation with other branches of the Bureau and of the Department, has developed posters, bulletins, exhibits, etc., that are used in promoting interest and giving information.

The Editorial Office has likewise made some statistical studies and analyses of the relative merits of purebred and common livestock. The efficiency of purebred livestock on a utility basis is shown to be approximately 40 per cent greater than that of ordinary livestock.

In 1923 the Editorial Office, in cooperating with other branches of the Department, developed a feeding service for individual farmers whereby their feeding problems are analyzed and advice is given by mail. This service is supplemented by posters and by a handbook giving information for the better feeding of livestock.

EXHIBITS

In cooperation with the Department's Office of Exhibits and the exhibit specialist of the Bureau, the Editorial Office has designed a large number of exhibits and has aided in the development of plans for special exhibits at interstate, national and international events.

RADIO TALKS

With the development of radio the Editorial Office has prepared a series of talks for broadcasting. Most of these have been prepared by request and deal with the activities of various divisions of the Bureau and also with specific topics. This field is being developed, and it is now a common occurrence to receive requests for literature of which livestock owners have learned through "listening in" by radio.

SUMMARY OF IMPORTANT EVENTS

- 1885. First Annual Report of the Bureau (for 1884) issued.
- 1890. Special Report on Diseases of the Horse issued.
- 1892. Special Report on Diseases of Cattle issued.
- 1893. Series of Bureau Bulletins begun with No. 1, "Investigations Into the Nature, Causation, and Prevention of Texas or Southern Cattle Fever," by Theobald Smith and F. L. Kilborne.
Series of Bureau Circulars begun.
- 1897. Series of B. A. I. Orders begun.
- 1898. March 1. George F. Thompson transferred from Division of Publications to Bureau of Animal Industry to do editorial work.
- 1907. May 15. Issuance of monthly Service Announcements begun.
- 1913. New plan adopted for Department publications. Bureau Annual Reports, Bulletins and Circulars discontinued. Department series of Bulletins, Circulars and Journal of Agricultural Research established.
Department's motion picture activities begun. First Bureau film, "Cooperative Cow Testing in Vermont," produced in 1914.
- 1919. "Better Sires—Better Stock" campaign inaugurated.
Publicity service broadened.
- 1922. Radio talks begun.
- 1923. Feeding service inaugurated.

PERSONNEL OF THE EDITORIAL OFFICE

Editors in Charge:

GEORGE FAYETTE THOMPSON, from March 1, 1898, to Jan. 6, 1906.

JAMES M. PICKENS, from Jan. 16, 1906, to Oct. 21, 1918.

JOHN ROBERTS (acting), from Oct. 22, 1918, to Dec. 4, 1918.

D. S. BURCH, from Dec. 5, 1918, to date.

Conclusion

A Bureau of Animal Industry became a national necessity by 1884. The horses, cattle, sheep and hogs on the farms of the United States at that time were valued at more than two and one-half billion dollars. This large national industry had been neglected, both by National and by State Governments. Destructive animal diseases were spreading, and unorganized veterinary opposition was not making satisfactory progress in coping with them. Farmers were constantly asking for information and advice which the Department of Agriculture was not in position to furnish. Our cattle had been denied admission into Great Britain since early in 1879 on the ground that contagious pleuropneumonia existed in the United States, and the markets of Continental Europe had been closed to our pork products since 1879 with the explanation that our swine were infected with trichinæ.

The extension and improvement of transportation facilities and the rapid development of our export trade in animals and their products from 1870 to 1879 gave an impetus to the livestock industry, and it became essential to find an outlet for the surplus. The closing of foreign markets to our animals and their products aroused considerable indignation among our livestock producers and allied interests, and there was an insistent demand for assistance from the National Government. Thus the attitude of foreign governments toward our export trade hastened the action of Congress in establishing the Bureau of Animal Industry.

The new Bureau proceeded immediately to meet the objections of foreign governments. Contagious pleuropneumonia was eradicated and a system of microscopic examination of pork for export was established, which resulted in reclaiming much of our export meat trade.

Since its establishment the Bureau has been called on from time to time to assume many duties varying widely in character, and its responsibilities have been increased, until it has become one of the most important organizations of the National Government.

As a result of the zealous efforts of the members of the scientific staff, able administration, harmony and cooperation, it is able to point with satisfaction to many important achievements, among which are the following:

The eradication of contagious pleuropneumonia, in cooperation with the livestock sanitary authorities of the infected States.

The discovery of the nature of Texas fever and how it is conveyed from infected to susceptible bovines by an intermediate host.

The development of a practicable method of ridding the Southern States of the ticks which convey the infection of Texas fever from infected to susceptible animals.

The discovery that hog cholera is caused by a filtrable virus.

The development of a serum which when used with virus produces lasting immunity against hog cholera.

The speedy eradication of every outbreak of foot-and-mouth disease that has occurred in the United States.

The practical eradication of tuberculosis from livestock in the District of Columbia, demonstrating the possibility and practicability of eradicating this disease.

The perfection of a serological method of diagnosing dourine in horses.

The success achieved in preventing livestock plagues of foreign countries from reaching the United States.

The establishment of a national meat-inspection service in the United States that is not surpassed in efficiency by that of any other country.

The discovery of a new species of human hookworm in the South, and recently the discovery of a new remedy for hookworm, carbon tetrachloride.

The development of a method of controlling the losses caused by roundworms in swine.

The development of a method of destroying the vitality of trichinæ in pork by refrigeration, whereby pork infested with trichinæ can be rendered harmless.

The development of a method of making butter of uniform quality with exceptional keeping qualities by churning sweet pasteurized cream.

Extensive contributions to our knowledge of the bacteriology of milk; the factors which influence the thickening of sweetened condensed milk, and the abnormal coagulation of evaporated milk in sterilizing, etc.

Experiments revealing the importance of the true chemical reaction of the medium in which bacteria are grown and accurate methods for its determination.

The determination of the relation of certain bacteria to the normal ripening and to the abnormal fermentation of Swiss cheese.

The development of a method applicable to American conditions for making from cow's milk a cheese of the Roquefort type.

The development of cow-testing associations and bull associations as organized efforts toward more profitable dairying.

The studies made of feeds and feeding and the production and handling of milk.

The improvement of horse stock in the United States.

The investigational work on farm power conducted in cooperation with the Bureau of Public Roads and the Bureau of Agricultural Economics.

Stimulation of the beef-cattle industry in the Southern States through the aid of specialists.

The determination, in cooperation with the Bureau of Agricultural Economics, of the cost of beef production in the Corn Belt.

The development of the Columbia breed of sheep and the Lamona variety of chickens.

Development of practical systems of watering sheep on dry grazing lands and shed lambing on the range.

Development of a practical method of determining grease and dirt in wool, and a system of sampling fleeces to determine clean wool content.

Important work in animal genetics.

The development of improved methods of making tuberculin for diagnosing tuberculosis in cattle and swine.

Improvement of methods of handling livestock in interstate and export trade.

The development of suitable dips for freeing animals of ticks, lice and other external parasites, and means for testing at any time the strength of the dips in vats.

The investigations of tuberculosis, contagious abortion, blackleg, anthrax, glanders and many other diseases of animals, which have contributed much of importance to our knowledge concerning these destructive diseases and the means for combating them.

It would be of historical interest to record in detail the Bureau's efforts in behalf of the livestock and allied industries, the various devices that have been developed or perfected by the employees to facilitate their work, all the discoveries that have been made, and the methods that have been worked out and employed in the laboratories and in the field which have served so well in accomplishing the results that have helped to make the Bureau's record; but we have aimed to mention only the more important activities, events and achievements which have marked the development and progress of its work.

Among the workers of the Bureau, past and present, many earnest, energetic, capable men and women have devoted all the useful years of their lives to this branch of the public service. Love for their work has imbued and held them rather than the inadequate remuneration which they received. Many have figured so prominently in the activities of the Bureau that they deserve special consideration in preparing a history of the organization, for its success has been largely due to the application of their ability and the exercise of their energy and perseverance under able direction.

It was fortunate for the livestock industry of the country that a veterinarian with the qualifications of Dr. D. E. Salmon was found to head the Bureau when it was first established. It was largely due to his keen perception in selecting able assistants, his ability as an organizer, his capacity as an executive, and, above all, his genius as an investigator, that the Bureau came so rapidly into prominence and has been able, independently and in cooperation with the States, to accomplish so many useful things.

It is a great compliment to the veterinary profession of the United States that it was able to supply such men as Dr. A. D. Melvin and Dr. John R. Mohler, who proved worthy successors of the first Chief of the Bureau. Dr. Salmon laid a good, firm foundation, upon which his successors have continued to build up an organization that has become known throughout the civilized world and which universally commands confidence and respect. And the prospects are that with the proper support of the livestock producers of the country the Bureau of Animal Industry will continue to grow in importance and usefulness.

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