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REPORT U. S. Department of Agriculture.

OF

THE CHEMIST

FOR

1899.

BY

H. W. WILEY.

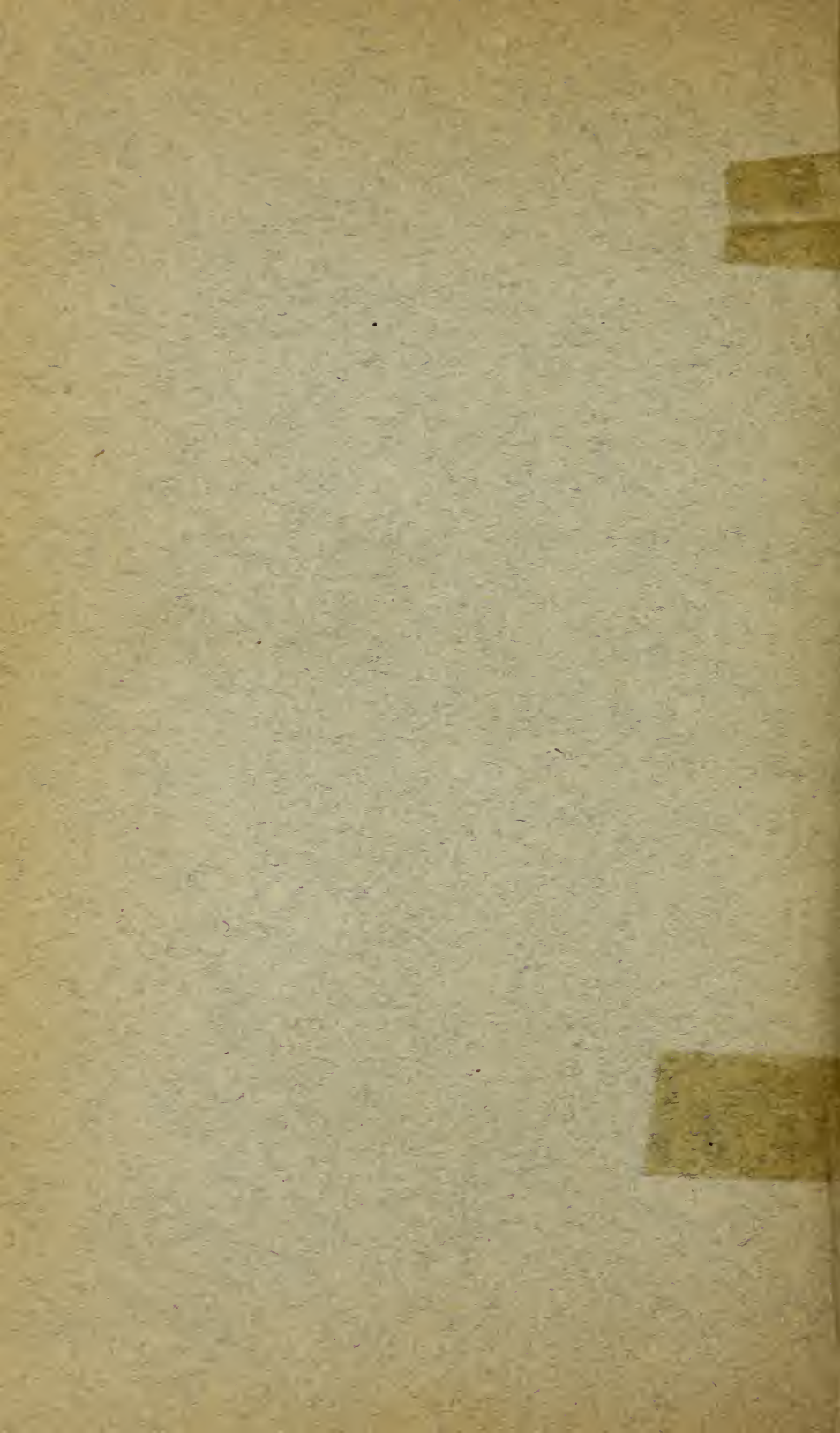
[FROM THE REPORT OF THE SECRETARY OF AGRICULTURE.]



WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1899.



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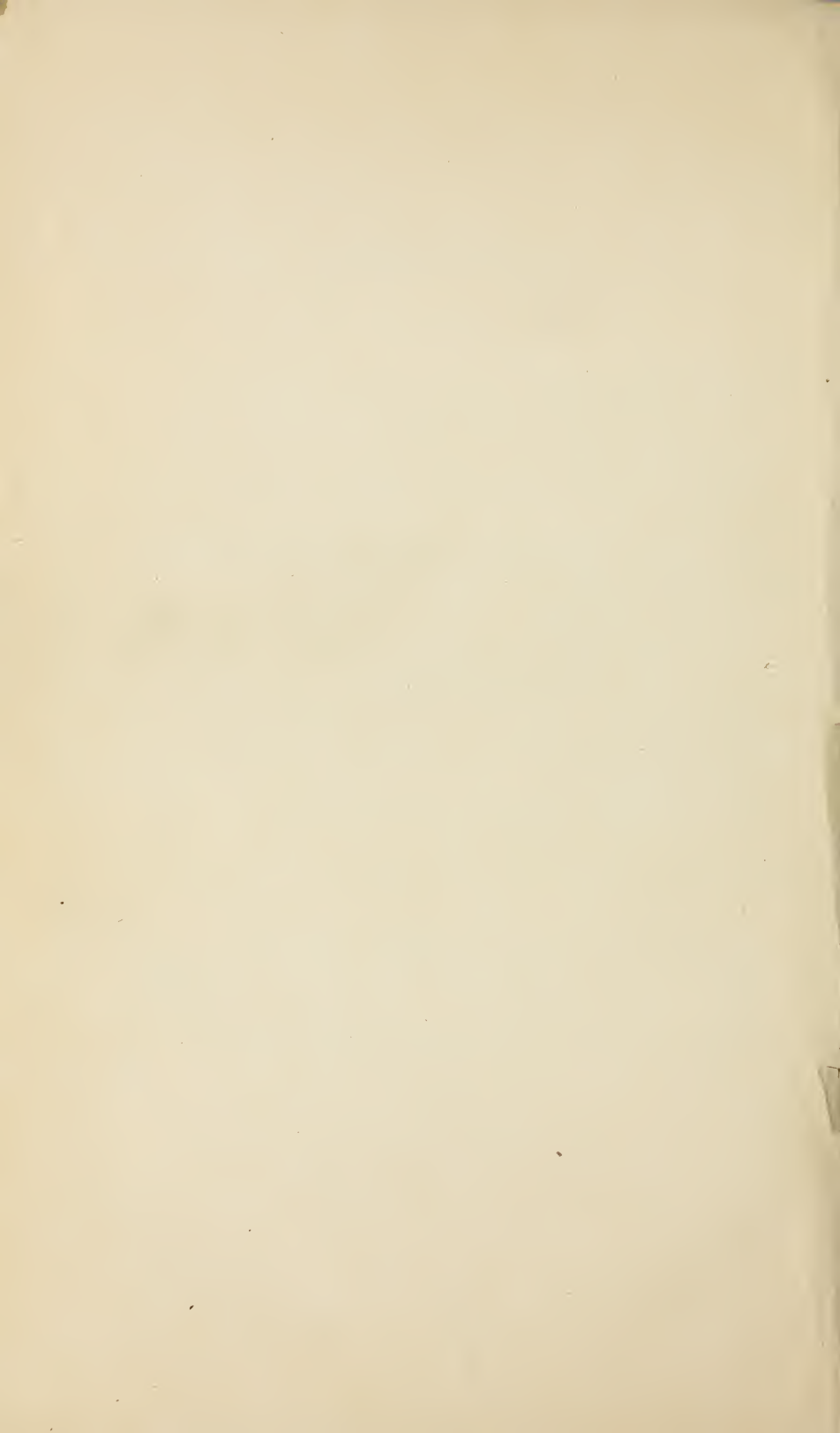
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REPORT OF THE CHEMIST.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF CHEMISTRY,
Washington, D. C., September 1, 1899.

SIR: In harmony with the requirements of your circular letter of June 27 ultimo, I beg to submit the following report of the Division of Chemistry for the fiscal year ended June 30, 1899. I also include, in accordance with your request, an outline of the work for the current year and plans for the fiscal year ending June 30, 1901.

Respectfully,

H. W. WILEY,
Chemist.

Hon. JAMES WILSON, *Secretary.*

WORK OF THE YEAR.

NEW LABORATORY BUILDING.

The work in the laboratory for the past fiscal year was interrupted somewhat by the erection of a new laboratory building. The old quarters had been found to be totally inadequate for the increasing work of the Division. It was therefore necessary either to seek new and more commodious quarters or to tear down the old building and erect a new one in its place better suited to the wants of the Division. The proprietors of the building consented to erect a new structure on plans drawn by an expert in this Division. Accordingly, at the beginning of the fiscal year, July 1, 1898, the old building was vacated. Temporary quarters were found for the force of the Division in various localities. The office work was transferred to the attic of the main building. Through the courtesy of the authorities of the Columbian University the laboratories of that institution were opened for the use of the chemists of the Division during the college vacation. As much of the material and apparatus as was necessary for the work was transferred to the Columbian University, and the laboratory work of the Division was continued there during the summer. On the opening of the college in the latter part of September, it was found necessary to vacate the laboratories, but the authorities kindly turned over for our use a room in the basement formerly used for assaying purposes. Here temporary desks were provided and the laboratory work was continued until the latter part of October, at which period our laboratory work was transferred to the Division of Soils, where facilities for carrying on the analytical work were extended by Professor Whitney until the new building was ready for occupation, toward the end of November, 1898. The laboratories in the new building, however, were incomplete, and thus the work was again retarded pending the

fitting up of the rooms and desks. Further, owing to a misapprehension in regard to the terms of rental, all work in fitting up the new laboratories was suspended during the months of April, May, and June. In spite of the inadequate facilities for laboratory work, a great deal was accomplished during the fiscal year in the following lines:

COOPERATIVE WORK WITH THE OFFICIAL CHEMISTS OF THE UNITED STATES.

The association known as the Association of Official Agricultural Chemists has been in existence for about fifteen years. This association is comprised primarily of the chemists of the agricultural experiment stations and agricultural colleges. It also admits to membership all chemists employed in the control of food or drug products by any State or municipality. This class of members includes chiefly chemists of the State and municipal boards of health and State boards of agriculture. The membership of this association is about three hundred, representing every State and Territory in the Union. The meetings of this association from the first have been held under the auspices of the Department of Agriculture, and its work has thus assumed a degree of authority which may be regarded as official.

The methods of analysis adopted by this association have been legalized by the courts in various parts of the country. The Secretary of Agriculture may be safely regarded as the patron of the association, and its work is therefore a part of the official work of the Department.

The Division of Chemistry continued during the fiscal year the collaboration with this association in its valuable work, and one of the assistant chemists of the Division acted as referee for the association on the subject of phosphoric acid. All official communications regarding this important fertilizing material during the year were therefore referred to and acted upon in the Division of Chemistry. Cooperative work was also done in connection with all the other referees of the association on all the subjects pertaining to agricultural products, soils, and fertilizers which come within the scope of its investigations.

The Chemist continues to be the secretary of the association, collects and edits its works, and prepares them for publication as bulletins of the Division of Chemistry. The chief work of this kind which was accomplished during the past fiscal year was the revision of the entire methods of analysis of the association on all of its subjects. This work is one of great magnitude and of the utmost importance to agricultural chemists, not only throughout the United States but the world. The revised edition of the methods of analysis has been published as a reprint of Bulletin No. 46, and this has been supplied to all agricultural chemical laboratories through the country. This bulletin is also accepted as authority in all parts of the world, and its contents have been reprinted in all the principal languages of science.

The happy effects of this organized effort on the part of the agricultural chemists of the United States on the results of chemical work have been so pronounced as to induce other nations to follow the example which this country has set. Other countries now have associations of agricultural chemists pursuing similar lines of investigations and reaching similar results. It is therefore possible at the

present time to compare with some degree of satisfaction the data obtained by agricultural analytical processes in various parts of the world. Previous to the formation of the American association such a comparison was impracticable. The data of analyses as obtained by different methods and processes had varied greatly on the same substances. As a result of this, there was a constant contention in regard to the character of the work, which tended to throw discredit upon it as a whole. Happily these differences have all been removed, and the data of agricultural chemical analyses now rest upon a substantial foundation and are generally accepted throughout the country without question.

In this country differences which may arise among agricultural analysts in various States are often referred to the Division of Chemistry as an arbiter, and the decision of this Division in all such cases has been universally accepted without question.

Since the courts of the country, all the agricultural colleges and experiment stations, and all the State and municipal chemists engaged in any way in the control of food products have accepted the work of the Association of Official Agricultural Chemists as final, it seems but proper that it should be recognized in some more emphatic way. This, of course, can only be done by act of Congress, either in acknowledging the association as an official adviser of the Government or in recognizing it in some way in the votes of supplies. Inasmuch as the association is unique in this respect, that it has neither a treasurer nor a fund, it does not seem necessary to recognize it in the appropriation bills, except, possibly, in the manner to be suggested further on in regard to stenographic services during its conventions.

One of the chief causes of discontent in the association heretofore has been the delay in issuing the proceedings and the methods of analysis. This has been due, almost solely, to lack of control over the stenographic and reportorial work. If a stenographer could be employed especially for reporting the conventions of the association, the proceedings could be promptly prepared for publication. It is for this reason that the small item has been inserted in the estimates for the fiscal year ending June 30, 1901, for stenographic services in connection with this association.

INVESTIGATION OF SOILS.

The study of various soils under identical conditions, referred to in the last report, has been continued with success, and data are rapidly accumulating of high scientific value, in regard to the behavior of soils of different constitution under identical conditions. This feature of the work has been sufficiently developed in preceding reports, and, since no change in the method of investigation has been introduced, it is not necessary to call further attention to the work at the present time, save, perhaps, to say that the assistants in the Division have devised more rapid and accurate methods of analysis. This is especially true with reference to the determination of potash and phosphoric acid. The thousands of analyses rendered necessary by these investigations are now dispatched with remarkable rapidity and with the highest degree of accuracy. The improvements in the methods which have been devised have been published in the chemical journals for the benefit of agricultural chemists throughout the country.

INVESTIGATION OF FOODS.

By far the greater part of the force of the Division during the past fiscal year has been employed in the investigation of food products. The particular character of foods studied has been the meat products preserved by sterilization or otherwise, and known to commerce as canned corn beef or canned roast beef. These two classes, however, do not comprise all the various kinds of canned meats or preserved meats which have been under investigation. Efforts have been made, by purchases in the open market, to secure samples of every kind of canned or preserved goods offered for sale. While it is hardly probable that we have succeeded in this, it is certain that by far the greater number which have any commercial importance has been included in our collection.

The scope of the investigation has been twofold. In the first place the chemical composition and nutritive value of the meats have been determined. This has been secured by the regular chemical analysis, as authorized by the Association of Official Agricultural Chemists, and with such additions as experience and the exigencies of the work have required. The results of these investigations have been to supply us with a definite idea of the food value of all the various products which have been examined.

In the second place, careful and systematic research has been made for preservatives of all kinds which may have been used in these meats. The attitude which the Department of Agriculture should take toward preservatives has been frequently outlined in official reports. Since, however, a great deal of misunderstanding still exists in regard to this matter, it is advisable to restate the position held by this Division in regard to this important subject. It is not regarded as a wise thing to absolutely prohibit the use of preservatives in foods. Since, however, all chemicals which have the properties of preserving foods also have a tendency to interfere with the processes of digestion, it is held to be imperative that no food should be offered for sale which contains a preservative without having this fact plainly stated upon the label of the package. Not only should the label state that the food product contains a preservative, but it should also give the name of the preservative and the quantity employed. In this way the intending purchaser is fully informed in regard to the character of the product which he buys. While it has been established that a healthy stomach can, from time to time, receive with impunity food containing small quantities of preservatives, it is by no means certain that the continued practice of ingesting preservatives in foods would not produce serious injury. On the other hand, it is also quite certain that weak or diseased stomachs may suffer temporary or permanent injury from even minute quantities of preservatives.

The work of the Division for the year past has been devoted almost exclusively to the determination of the character and quantities of different preservatives which the food products contain. An equally important work in regard to determining the effects of these preservatives on the digestive processes will be outlined under a subsequent caption of this report. The results of the work have now been tabulated and will soon be ready for publication as Part X of Bulletin No. 13.

INVESTIGATIONS IN THE CULTURE OF SUGAR BEETS AND THE PRODUCTION OF BEET SUGAR.

Under your direction, the Division of Chemistry continued during the fiscal year ended June 30, 1899, the investigation of the possibilities of extending the beet-sugar industry in the United States. To this end the Chemist was authorized to procure 20 tons of high-grade beet seed from different growers in Europe, representing the best varieties produced on that continent. These seeds were distributed mainly to the agricultural experiment stations of the various States interested in beet culture. Considerable quantities of seeds, however, were sent in response to miscellaneous requests and through Members of the Senate and House of Representatives.

In all cases, the active cooperation of the Division of Chemistry was offered in connection with the analysis of the beets. Data for planting, cultivating, and harvesting the beets were furnished to each person to whom seed was sent, and also descriptive blanks to be filled out at the time of harvesting. Franks were also furnished with which samples for analysis could be sent to the laboratory.

During the months from September to December, inclusive, a large part of the force of the Division, both clerical and chemical, was employed in this work. Many thousands of samples were received and careful analyses thereof made.

The results of this work were fruitful in defining with greater accuracy the limits of the most successful beet culture within the country. The previous work of the Division was corroborated by the data obtained, and little by little we are finding out the definite areas where beets can be most successfully grown.

In this connection, it should not be forgotten that the first attempts ever made by the Department of Agriculture to form a map showing the growth of any particular crop originated in the Division of Chemistry.¹ More than twenty years ago Dr. William McMurtrie, former Chemist, published a map showing the probable areas in the eastern part of the United States where beets could be grown successfully. This is the first biological map ever published by the Department. The Division of Chemistry has continued at intervals to elaborate this map and make it more accurate by basing it upon more scientific data. The history of beet culture in this country has been a most emphatic demonstration of the accuracy of the topographical work which has been accomplished, and all the successful beet-sugar factories in the United States at the present time are located directly within the area thus mapped out, or very near it. It is certain that no successful beet-sugar factories can be established at any great distance from the areas which have been described.

An encouraging fact in relation to the work which the Division of Chemistry has been conducting for so long in this line is that the careful beet-sugar makers of the country fully realize the value of this work and base their economic operations upon it.

MISCELLANEOUS WORK.

In the miscellaneous work of the Division various problems have been investigated, and especially the scientific problems underlying

¹Special report No. 28, "Report on the culture of the sugar beet and the manufacture of sugar therefrom in France and the United States."

the best methods of the polarization of sugars. This work has been conducted largely for the Secretary of the Treasury of the United States.

REVIEW OF WORK OF THE DIVISION FOR THE VARIOUS EXECUTIVE DEPARTMENTS.

As an illustration of the extent to which the cooperation of the Division of Chemistry has been sought by the other Departments of the Government, there is submitted below a statement showing the nature of the cooperation, the names of the Departments soliciting it, and the number of samples examined from November 28, 1896, to September 15, 1899, a period of nearly three years:

At the request of Gen. Joseph C. Breckinridge, Inspector-General of the United States Army, 46 food samples were analyzed, and the results of the analyses transmitted to the Inspector-General. The first samples were received on November 28, 1896, and the remaining portion on December 19, 1896. On January 4, 1897, 14 additional samples were received from the Inspector-General, analyzed, and the results transmitted to him.

On April 6, 1897, the Postmaster-General transmitted a sample marked "rauchsault," a proprietary article which had been offered for shipment through the mails. We were asked by the Postmaster-General to determine the character of this material, to see if it was of a poisonous, dangerous, or explosive nature, so that the Post-Office Department could have reliable data for admitting it or for excluding it from the mails. We reported as a result of our experiments that the material in question contained no poisonous matter, that it was not explosive, nor did its constitution show that it was in any way unsuited for transmission through the mails.

On April 6, 1897, we received from the War Department, from Maj. Henry G. Sharp, 7 samples of flour, which were supposed to be adulterated, with a request that they be examined. The samples, which were Indian corn and wheaten flours, were all found to be of standard composition and to be free from all adulteration.

On May 15, 1897, there were transmitted to this Division by the Secretary of Agriculture samples of shellac varnish from the Attorney-General of the United States. These samples were to be used as evidence in a suit which was brought against the Secretary of the Treasury of the United States to compel him to issue regulations permitting the free use of alcohol in the arts. It was claimed that in the samples of shellac varnish the alcohol used was denaturalized, so that it would be impossible to recover it for bibulous purposes. A thorough search was made into the subject, and it was proven to the satisfaction of the court that it would be perfectly possible to recover the alcohol from this varnish in such a state that it could be used again in the preparation of beverages. Since the law required that the alcohol be perfectly denaturalized before it could be used in the arts, it was evident in this case that no mandamus could issue compelling the Secretary of the Treasury to issue regulations for an impossible purpose. Many millions of dollars were involved in this suit, but as a result of the work performed in the chemical laboratory further prosecutions of this nature were abandoned.

On June 25, 1897, the United States Commissioner of Internal Revenue transmitted a sample of butter, which was supposed to be adulterated, with a request that a report be made thereon. The examination and report desired were made.

On October 27, 1897, samples of concentrated fruit juice were transmitted to the laboratory by the Secretary of the Treasury for examination and report. The object of this examination was to enable the appraisers of the custom-house of New York to determine the rates of duty which these concentrated fruit juices should pay. The examination and report were made to the entire satisfaction of the custom-house officials.

On August 16, 1897, a letter was received by the Secretary of Agriculture from the Secretary of the Treasury, written at the request of the minister of The Netherlands, who desired that certain Dutch sugars imported into this country, and which had been seized by the State food authorities of Ohio as having been adulterated, be examined by a chemist of the Department of Agriculture. The suspected samples of sugar were transmitted to this laboratory on September 10, and were examined in accordance with the request of the Secretary of the Treasury for the minister of The Netherlands. The sugars were found to be deeply blued, a process which is uniformly practiced by refiners, but were found not to contain any adulterants except the excess of bluing material mentioned.

On November 19, 1897, the Secretary of State addressed a request to the Secretary of Agriculture for the examination of certain butters shipped from the United States to Martinique and there condemned by the French authorities as adulterated. The butters were received by the Department on November 30, and consisted of 3 samples, the analyses of which were carefully made and the results transmitted to the Department of State. A research of this description is of the more importance because of the well-known fact that the authorities of foreign countries are disposed to apply very rigorously the rules regulating the importation of adulterated articles to all materials coming from the United States. It is important, therefore, that our articles of export be carefully examined and proven to be free of adulteration before being sent to foreign ports. Of the 3 samples mentioned, one appeared to be what is known as "process butter," namely, made from inferior butters, remelted and washed. The second sample was evidently a pure butter, no signs of adulteration of any kind having been detected. The third sample contained an abnormal quantity of water, namely, 18.42 per cent and nearly 7 per cent of carbohydrates, having the properties of liquid glucose or dextrin. The use of sugar other than milk sugar in the making of butter appears to be a growing practice, especially for butters which are intended for exportation to tropical countries. The above data are interesting, therefore, in showing the quality of butter prepared for export to tropical regions.

On December 16, 1897, 4 samples of butter, and on January 5, 1898, 18 samples of butter were received from the United States Commissioner of Internal Revenue, with a request that they be examined to determine whether or not they contained oleomargarine. The examination was duly made and reported.

On January 13, 1898, the Secretary of Agriculture received 6 samples of canceled postage stamps from the Postmaster-General, with the request that they be examined "to ascertain whether or not these stamps can be washed without destroying their surface and color, be reused and escape detection by the officials of the post-office service." An elaborate research was made in this direction, and a report was duly communicated to the Postmaster-General to the effect that "these cancellation marks have resisted every effort to make an

erasure without destroying the color of the stamp. The inks used in the cancellation appear to have oil for their basis and to contain two coloring matters, namely, lampblack and a blue dye, the latter soluble in oil or in a combination of oil and benzine. Both the blue dye and the lampblack penetrate the fiber of the paper so deeply that an erasure necessitates both a weakening of the color and an abrasion of the surface in order to completely remove all traces of the cancellation." The Post-Office Department was therefore assured that there was no possible danger of the fraudulent reissue of cancelled stamps if the cancellation was made with ink prepared after the manner described.

On January 21, 1898, the State Department transmitted to the Secretary of Agriculture a sample of oleomargarine from the United States consul at Martinique, with the request that it be examined for coloring matters. The sample was found to be colored with one of the yellow azo-dyes, commonly used for the purpose.

On January 22, 1898, 2 samples of ribbon and ink used for type-writing machines were transmitted by the Secretary of State, with a request that the character of the ink be investigated. It was found that the ink was composed of an oil serving as a basis, the coloring matters being lampblack and Prussian blue, with a small percentage of a sample of blue dye, which gave the reactions of methyl blue. Samples of writing were prepared with these inks and were submitted to the action of various reagents, many of which decolorize gallo-tannic inks instantly. The carbon of the ink is practically indestructible by any reagents which will not also destroy the paper, and the oil which forms the basis of the ink carries the finely divided carbon so deep into the tissue of the paper, even when the paper is glazed, that any attempted erasion necessitates an abrasion of the surface of the paper which can be readily detected by a lens, if not by the naked eye.

On May 3, 1898, the Secretary of the Interior submitted for examination a sample of lemon extract which was supposed to have been the cause of the death of an Indian on the Devil's Lake Reservation. The examination showed that the extract had been prepared with methyl, or wood alcohol, instead of with the ordinary ethyl, or spirit alcohol. A few months later two more deaths were caused at Ripley, W. Va., by drinking lemon extract. These deaths were evidently due to the same cause. The use of methyl alcohol in the preparation of extracts should never be permitted.

On July 14, 1898, 3 samples of inks used for cancellation purposes were submitted for examination by the Post-Office Department. It was reported that all three of the inks were very similar in composition, having a basis of an oil, with carbon, lampblack, and a blue coal-tar dye as the coloring matter. A complete quantitative examination of the inks was made and was reported to the Post-Office Department.

On July 5, 1898, a sample of baking powder was transmitted by the Secretary of War, who asked that an analysis of it be made. The analysis of the compound requested was transmitted by the Secretary of Agriculture to the Secretary of War.

On August 3, 1898, a sample of malt extract was received from the Department of Justice, which had been sent from the Indian Territory. The object of the examination was to enable United States Commissioner Bradford to know whether or not such malt extract could be legally sold on the Indian Reservation. The content of alcohol in the sample was determined, which, together with the other

data, was furnished to the United States judicial authorities for their guidance in the matter.

On August 3, 1898, the Superintendent of the United States Coast and Geodetic Survey transmitted to the Secretary of Agriculture a quantity of petroleum for the purpose of having it refined and prepared for use in the work of his office. A careful search for impurities was made and the necessary purifications performed and the refined material returned to the Coast Survey Office.

On August 3, 1898, a sample of saccharin was received from the Secretary of the Treasury for the purpose of having it identified for the guidance of the officials of the United States custom-house service. It was also requested that an opinion be given as to the desirability of prohibiting its importation. A careful research was made into American and foreign literature in regard to the medicinal properties of saccharin, and as a result of this inquiry the following recommendation was made:

In view of the prevalence of opinion just reviewed in American medical and pharmaceutical literature, it would seem both highly unnecessary and discourteous to the interests involved to prohibit the importation of saccharin at this time without giving its representatives an opportunity to present their side of the case.

Furthermore, it does not seem probable that the quantity of saccharin and allied substances prescribed by physicians and dispensed by pharmacists will greatly involve the interests of the producers, refiners, and merchants of sugar.

It was stated, however, in the report that the use of saccharin and similar sweetening agents in the preparation of foods should be strictly prohibited.

On September 27, 1898, a sample of sugar was received from the Navy Department, with a request for its examination. The request was complied with and the results of the analysis transmitted to the Navy Department.

On December 16, 1898, a sample of ink powder was received from the State Department. It was found that this ink was composed of an iron tannate compound containing some logwood. Samples of writing done with this ink were exposed to the action of sunlight for three weeks without exhibiting any signs of fading. The ink was undoubtedly as good as the ordinary iron and tannin inks and probably somewhat better, on account of the logwood which it contained.

On January 10, 1899, January 18, 1899, January 23, 1899, January 26, 1899, January 30, 1899, February 1, 1899, and February 3, 1899, various samples of canned, roast and preserved meats, canned beef, roast beef, and refrigerated beef were received from the War Department, in all 36 samples, with a request for their complete examination for preservatives and as to their nutritive properties. Careful search was made in all these samples for preservatives, but in no case was any found. Analyses to determine the nutritive properties of the samples showed that they were equal to the ordinary meats furnished in the markets. A full report was made on all these points through the Secretary of Agriculture to the War Department for the use of the commission investigating the conduct of the war with Spain.

On January 18, 1899, there were received from the Geological Survey 3 samples of soils from the forest reservation. The analyses of these samples have not yet been completed.

On February 20, 1899, there was received from the Postmaster-General a sample of medicinal tablets for the purpose of determining whether or not they should be allowed to be transmitted through

the mails. A careful examination of these tablets showed that for the purpose for which they were intended they were wholly and intentionally fraudulent. These facts were transmitted to the Post-Office Department for its guidance in the matter.

On March 10, 1899, there was received from the War Department a sample of the so-called crystallized egg for the purpose of determining its nutritive value as a part of the regular Army ration. The report of the investigation was sent to the Commissary-General of Subsistence.

On March 16, 1899, there were received from the United States Fish Commission 2 samples of water, which were promptly analyzed and the results reported.

On March 20, 1899, there were received from the War Department 7 samples of canned meats and fish for the purpose of having their nutritive values determined and to ascertain whether or not they contained preservatives. Also, from March 27 to April 8, inclusive, there were received from the War Department 36 additional samples of canned meats, fish, etc., for the purpose of determining whether or not preservatives had been employed in their preparation and for testing their nutritive value. The results of these investigations were transmitted to the commission investigating the conduct of the Hispano-American war.

On May 25, 1899, there were received from the State Department 6 samples of material used in Japan for fertilizing purposes, and sent by the United States consul at Nagasaki, Japan. The work on these samples has not yet been finished.

On June 19, 1899, there were received from the chairman of the Senate Committee on Manufactures 82 food samples to be examined for possible adulterations. The results of these examinations will be laid before the Senate committee at its next sitting.

On July 26, 1899, and August 30, 1899, there were received from the Post-Office Department 2 machines intended for refrigerating purposes, with a request that it be determined whether or not they were fraudulent, in order that letters relating to them be excluded from the mails. A careful study of the apparatus and the chemicals accompanying them showed that the claims made by their manufacturers had no justification in fact, and this report was duly transmitted to the Post-Office Department.

On September 2, 1899, there were received from the Executive Mansion 2 samples of pipe covering for use in the Executive Mansion and the greenhouses adjoining. It was requested that an examination be made of these samples of covering in order to determine whether or not they were in harmony with the specifications of the bidder. The result of these examinations has been duly reported.

On September 8, 1899, there were received from the Attorney-General 2 samples of "mist," or beer, which it was proposed to offer for sale in the Indian reservations. A request was made for an analysis, in order to determine the percentage of alcohol and other bodies contained therein, for the guidance of the Attorney-General. The data obtained were transmitted to the judge of the United States court for his information.

On September 9, 1899, there was received from the Commissioner of Fish and Fisheries a sample of well water, with a request for a complete chemical analysis of the same, which request was complied with.

On September 11, 1899, there was received from the Naval Museum of Hygiene a sample of fluid beef extract to be examined for preservatives. The examination of this sample has not yet been completed.

On September 15, 1899, there was received a request from the Secretary of the Interior for the examination of 73 samples of mineral water from the Hot Springs Reservation of Arkansas. The Secretary of Agriculture has replied to the Secretary of the Interior expressing a willingness to cooperate with him in this matter.

During the past three years many hundreds of samples of sugars have been analyzed for the Treasury Department for the purpose of enabling the Secretary of the Treasury to formulate regulations for the methods of ascertaining the duties on imported sugars. The results of the work performed by the Division of Chemistry have been accepted by the Treasury Department in the formulation of its regulations and by the Board of General Appraisers in New York in deciding an appeal from the rates of duty imposed. This collaboration is still being continued, the chief of the Division of Chemistry having been for the past three years, and still being, chairman of a committee appointed by the Secretaries of the Treasury and Agriculture for the purpose of formulating regulations governing the polarization of imported sugars, and also for the supervision of the laboratories engaged therein.

Excluding the samples of sugar during the time mentioned, it is seen from the above that in all 359 samples of materials have been submitted by the various Executive Departments to the Secretary of Agriculture, with requests that they be examined in the Division of Chemistry. It is evident, therefore, that the various Executive Departments regard the Division of Chemistry of the Department of Agriculture as holding a certain relation to them in the course of work which they have to do touching chemistry in any of its branches. It is true that many of the Executive Departments have chemical laboratories of their own, and this renders more emphatic the recognition which these Departments give to the Division of Chemistry of the Department of Agriculture in matters of public interest in which chemistry is concerned. The fact that all the Executive Departments apply directly to the Secretary of Agriculture in such matters shows that they recognize the primacy of the work done by its Division of Chemistry over all the other chemical work of the Government. This fact is illustrated in such a striking manner by the above résumé as to be of itself a sufficient reason for recognition in some special way of the standing which the Division of Chemistry has acquired through its work in the Government service.

OUTLINE OF PLANS OF WORK FOR THE CURRENT FISCAL YEAR.

The improved facilities for analytical work referred to in the first part of this report will be utilized to the fullest extent in the work which is now in progress. Briefly, the character of the work conducting during the present fiscal year is as follows:

INVESTIGATION OF SOILS.

The investigation of soils in relation to agricultural production will be continued on the lines already laid down. Cooperative work with the Division of Soils will be carried on in the same connection. Arrangements have been made between the chiefs of the Divisions of Soils and Chemistry for this work. All the chemical work of the Division of Soils will be done in the Division of Chemistry, under the immediate direction of the Chemist, in consultation and collaboration

with the chief of the Division of Soils. One chemist is already at work in this line, and another will be added on the 1st of September. It is hoped that when the laboratory is completely fitted up a separate room for this soil work can be secured.

SUGAR-BEET INVESTIGATIONS.

During the months of September, October, and November a large part of the force of the laboratory will be again employed in the analysis of sugar beets. Seeds were distributed, as indicated in the first part of the report, to all parts of the country, in the manner which has already been described. Samples of beets for analysis will begin to arrive about September 1, and during the three months following we expect to receive from 5,000 to 10,000 samples. So large a force as will be necessary to keep the work up to date will be assigned to this part of the investigation.

INVESTIGATION OF FOODS.

The chemical work in connection with the investigation of foods, their composition, nutritive properties, and adulteration, will be pushed forward as rapidly as possible. New problems are constantly arising in this connection, and attempts are made to solve them without unnecessary delay.

ANALYSES FOR THE SENATE COMMITTEE ON MANUFACTURES.

The investigations of the Senate Committee on Manufactures into the character and extent of food adulteration are awakening in Congress a lively interest on this subject, and will probably result in a national law regulating commerce in impure or adulterated foods between the States and in the Territories. The Division of Chemistry for more than fifteen years has pursued these investigations and has trained a large corps of chemists to be experts in such matters. The Senate committee, recognizing the work which has been done, has asked you to detail the Chemist of the Department as a scientific expert in these investigations, which are still continuing. It is expected that by the meeting of Congress, in December, the work of this committee will be completed and its report ready for submission. The chairman of the Senate Committee on Manufactures has procured several hundred samples of food products, purchased in the open market in various localities, and, with your approval and consent, submitted them to the Division of Chemistry for analysis. The greater part of this work, at this date, has been finished, but I am informed that it is the purpose of the chairman of the Senate committee to secure many other samples during the months of October and November for examination.

The samples of foods which have been purchased are those which are most subject to adulteration. Among these may be mentioned the various forms of jams, jellies, marmalades, and other preserved fruit products. These bodies are very commonly subject to adulteration, containing very little of the genuine product of the orchard. Many bottled beverages have also been purchased of the cheaper grades, with the special purpose of having them examined for deleterious preservatives. Among these articles may be mentioned beers,

ales, ginger ales, pops, and similar bodies. Many samples of canned soups, meat extracts, and other similar substances have also been secured for the purpose not only of determining the methods by which they are preserved, but also of ascertaining their nutritive values.

The Division of Chemistry holds itself in readiness to respond promptly to all the demands which the chairman of the Senate Committee on Manufactures may make upon it in connection with the investigations of this committee of the important subject of food adulteration.

REPRINT OF RECORD OF PREVIOUS INVESTIGATIONS.

The earlier investigations of the Department, published in the first parts of Bulletin No. 13, are out of print, but it is the purpose of the Division to bring these earlier investigations up to date and to rewrite for publication the first eight parts of Bulletin 13 as soon as possible. This work, however, on account of its magnitude, can not be accomplished rapidly, but it is hoped that one or two parts may be revised and made ready for publication during the current year.

PARIS EXPOSITION.

The Division of Chemistry proposes, under your direction, to take an active part during the current year in the preparation of the agricultural exhibit for the Paris Exposition in 1900. To this Division has been assigned the preparation of beverages of all descriptions, candies, confections, and sugars, and fertilizers. It is proposed to make an examination of each class of bodies prepared for exhibition, so that no impure or adulterated articles will be sent over. This will entail a considerable degree of analytical work upon the Division during the year.

COOPERATIVE WORK WITH THE OFFICIAL CHEMISTS OF THE UNITED STATES.

The cooperative work with the Association of Official Agricultural Chemists will be continued during the year. One of the referees and one of the associate referees are members of the Division, and cooperative work will be established with all the referees of the association. In order that the referees of the association may use the franks of the Department in distributing samples for analysis and in conducting correspondence on matters relating thereto, they have been appointed correspondents of the Department.

MISCELLANEOUS WORK.

Miscellaneous work will be continued in the investigations of problems which are of interest to agriculture as they may arise, and in collaboration with other Divisions and other Departments.

DETERIORATION OF WHEAT.

Complaints have reached the Department of the deterioration of wheat on the Pacific coast, especially in regard to its content of gluten. The Yosemite Flouring Mill, one of the largest on the Pacific coast, has addressed a letter to the Division of Chemistry asking for

cooperation in ascertaining the cause of this deterioration and the methods of restoring the wheat to its former content of gluten. With your consent and approval, I have arranged with the agricultural experiment stations of California, Colorado, Missouri, Indiana, Michigan, Kentucky, and Maryland to experiment with samples of wheat of known quality in the different climatic conditions prevailing in those States. The samples of wheat used for seed will first be carefully analyzed in the Department of Agriculture and then forwarded to the agricultural experiment stations named to be planted in different parts of the State and subjected thereby to different climatic conditions. It is evident that the deterioration complained of is due to the combined effects of soil and climate, and when the exact character and magnitude of the causes producing the deterioration are discovered we will be in a position to supply adequate relief.

I will also act on your suggestion to extend this investigation over a wider area as soon as practicable. All of the chemical work of this investigation will be done in the Division of Chemistry, while the agricultural work will be done by the agricultural experiment stations in different parts of the country. Only by chemical study can the character of the wheat kernel be ascertained, and thus it is evident that the conduct of work of this kind is properly vested in the Division most nearly related to it.

AGRICULTURAL FOOD PRODUCTS FROM FOREIGN COUNTRIES.

The Division will continue the investigations of agricultural food products from foreign countries in regard to their purity and wholesomeness. The general methods pursued in the work of the past fiscal year will be continued and extended. One of the important problems now presented is the composition of American oats in respect of their admission into foreign markets. There appears to be a disposition on the part of some of the large milling companies in Europe to discriminate against American oats, on the ground that they have not the nutritive properties of the Scottish oats. An elaborate and thorough investigation of this problem is now under way and will be pushed to completion as rapidly as possible.

COOPERATION WITH OTHER DIVISIONS.

Arrangements have been completed, in accordance with your suggestion, for the active cooperation of the Division of Chemistry with some of the other scientific Divisions of the Department during the present fiscal year. Attention has already been called to the arrangements which have been completed between the Division of Chemistry and the Division of Soils for this collaborative work. Similar arrangements are under consideration with the Division of Forestry. By reason of the fact that chemical investigations are required in almost every branch of scientific investigation relating to agriculture it is evident that the extension of this collaborative work will prove of the highest benefit to all parties concerned. In order that the status of this work may be fully established and acknowledged it seems desirable that some further action be taken toward defining the functions of the collaborators. Unity of purpose and harmony of effort are essential to the highest achievements and are required by the principles of economy. Any misunderstanding, therefore, which might arise would be productive of harm. For this reason, I have called your attention, in another part of this report, to certain changes in the title and

compensation of the chief of the Division of Chemistry in order to establish in a definite form the principles of the collaboration above outlined.

COOPERATIVE WORK WITH OTHER DEPARTMENTS.

With your approval and consent, the Division of Chemistry will continue during the present fiscal year the collaborative work with other Departments of the Government which has been carried on in the past. Chief among these investigations is the work in conjunction with the Treasury Department in relation to standards and methods of polarization of imported sugars, and other problems relating to chemical products in connection with the revenue of the Government. The collaborative work with the Treasury Department in the way of securing samples of imported food products at the different ports of entry will be continued.

The Division of Chemistry will also continue to collaborate with the Post-Office Department in matters relating to the transmission of chemicals in the mails, and also in connection with the determination of fraudulent advertisements of remedies and other bodies of a chemical nature. This widely extended collaboration with other Departments of the Government is also an additional reason for the changes in the title and status of the Chief Chemist of the Department, referred to in another paragraph.

PLAN OF WORK FOR THE FISCAL YEAR ENDING JUNE 30, 1901.

All the lines of investigation which have been mentioned in the foregoing parts of this report, it is hoped, may be continued during the fiscal year ending June 30, 1901. The special portions of the work for that year which demand your attention in the preparation of the estimates are as follows:

IMPROVEMENT IN THE COMPOSITION OF CEREALS.

The elaborate work which was conducted by the Division of Chemistry for the eight years ended in 1894 on the improvement of the sugar content of sorghum affords an illustration of what may be accomplished in the improvement in the composition of cereals. Attention has been called, in a previous part of this report, to the deterioration of the gluten content in the wheat grown on the Pacific coast. It is evident that the causes of this deterioration are to be sought for in climatic or soil influences, or both. With your approval, arrangements have already been made for beginning a study of this problem in California and some other localities. The expense attending this investigation will be slight, but still some provision should be made for meeting it. Not only in the case of wheat, but also in the case of oats, which has been mentioned, the content of protein is a factor of the highest economic importance. It is also quite certain that Indian corn may be greatly improved as a human food product by systematic efforts to increase the amount of protein which it contains.

In order that the Division of Chemistry may carefully conduct this work and make all necessary analyses and other investigations, a small sum should be set apart for this specific purpose. I therefore suggest that you ask the committee to insert in the appropriation

bill the following clause in connection with the appropriation for the Division of Chemistry:

To enable the Secretary of Agriculture to investigate the causes of the deterioration in the gluten content of wheat on the Pacific coast and in other parts of the country, and to study methods for increasing the content of valuable food constituents in wheat and other cereals, and for necessary supplies, chemical services, labor, and traveling expenses, three thousand dollars.

PERMISSIBLE FOOD PRESERVATIVES.

In the investigations which have been conducted in the adulteration of foods, the Division of Chemistry has had occasion to study the effect of preservatives from a hygienic point of view. It is evident that substances which paralyze microorganisms and thus prevent decay, when mixed with foods would have a general tendency to interfere with the fermentations which, collectively, are called digestion. On the other hand, there are certain foods or condiments, used in minute quantities, which seem to require a certain amount of preservatives in order to make them effective. Investigations of the qualities of substances proposed as preservatives show that these bodies have very different relations to digestive ferments. It seems desirable, therefore, that the Department of Agriculture should undertake an investigation which will prove of an authoritative nature to determine the question whether preservatives should ever be used or not, and if so, what preservatives and in what quantities. This determination can only be accomplished by actual experiment, continued over a sufficient length of time to reach definite results. The impor-

ance of the investigation is of such a nature as to warrant the Department in undertaking the work, and therefore I recommend that a specific appropriation be set aside for this purpose by having inserted in the appropriation bill the following clause:

To enable the Secretary of Agriculture to investigate the character of proposed food preservatives and coloring matters, to determine their relation to digestion and to health, and to establish the principles which should guide their use, for the purchase of the necessary apparatus and supplies, employment of experts and assistants in the conduct of the investigation, and for necessary labor, supplies, and traveling expenses in connection therewith, five thousand dollars.

ESTABLISHMENT OF THE OFFICE OF DIRECTOR OF CHEMISTRY.

It is evident, from the statements which have been made in the foregoing report, that the Division of Chemistry is brought into constant connection, not only with the other Divisions of the Department, but also with the other Departments of the Government. In addition to this, it should be remembered that the Division of Chemistry was the first scientific Division established in the Department, and that by right of seniority it stands at the head of all the scientific Divisions. A further consideration, which must not be lost sight of, is that in the organic act establishing the Department of Agriculture it was provided that the Commissioner of Agriculture should employ such scientific aids as might be necessary, and that they should receive the same compensation as is paid to similar officers in other Departments of the Government.

In view of all these conditions, it seems only just that some recognition should be made of the Division of Chemistry in its relations to other Divisions and other Departments. It is admitted that it would be difficult to secure at the same time for all the chiefs of scientific

Divisions in the Department of Agriculture that recognition in standing and salary which the organic law evidently intended they should receive. I believe, however, that it is an opportune time to recognize the senior Division, and this would open the way finally for the recognition of the other scientific Divisions in the order in which they were formed. The chief of the Division of Chemistry, it is evident, has duties in connection with the collaborative work already mentioned which entitle him to a further recognition, both in the name of his office and in his compensation. I venture to propose, therefore, that the title of the office be made to read in future appropriation bills "one Director of Chemistry, who shall be chief of the Division of Chemistry," in recognition both of the seniority of the establishment of his Division and the seniority of his service as chief of a scientific Division. It is now nearly seventeen years since the chief of the Division of Chemistry assumed his present office, and a term of service of that length, provided it has been of an acceptable nature, is, without argument, a cause of a just claim for some promotion. It is believed that such a recognition would meet with the approval of the other chiefs of Divisions. I suggest, therefore, that in the appropriation bill next to be submitted to Congress, the Division of Chemistry be mentioned first after the Bureaus of the Department, in order to show its seniority as a scientific Division of the Department, and that the wording of the bill be changed in the first paragraph to read as follows:

One Director of Chemistry, who shall be chief of the Division of Chemistry, and shall be director of the collaborative work arranged for between the Division of Chemistry and other Bureaus and Divisions of the Department, and of all such chemical investigations as the heads of other Departments may request the Secretary of Agriculture to make, four thousand dollars.

ENGINEERS, FIREMEN, MESSENGERS, WATCHMEN, AND CHARWOMEN.

The desirability of placing all the employees of the above classes on the general fund and not having them charged to the rolls of the strictly scientific service has been emphasized in former reports. I believe it would add much to the efficiency of the public service if the general fund for this purpose were made large enough to include all employees of this kind. At the present time the Division of Chemistry receives no benefit from the funds appropriated by Congress for the services mentioned above, but all such services are charged to the funds appropriated by Congress for the scientific investigations and other expenses of the Division. If the general fund would provide for this service the sum remaining for scientific services in connection with agricultural work would be correspondingly increased.

CLERK OF CLASS TWO.

In a former report I have called attention to the fact that the Division of Chemistry is entitled to the services of a clerk of class two. The correspondence and other clerical work of the Division have grown enormously within the past few years, and yet no additional provision has been made by Congress for increased clerical services for many years. I therefore ask that there be inserted in the appropriation bill the amount of \$1,400 for the compensation of a clerk of class two in the Division of Chemistry. The Division is clearly entitled to this increased clerical service, both on account of the magnitude of

its work and of its age. Other Divisions established subsequent to that of this Division have clerical service of this class, and justly so, and the Division of Chemistry, therefore, only asks for a proper appreciation of its clerical service in this direction.

RENT OF NEW LABORATORY BUILDING.

I have carefully gone over the expenditures, in so far as they have been accessible to me, incurred by the owners in erecting the new building now occupied by the Division of Chemistry. I have also made inquiries in regard to rentals paid for buildings used for Government purposes in various parts of the city. The result of these investigations has been to convince me that a just rental for the building now occupied by the Division of Chemistry is \$2,500 per annum. It has been agreed, I believe, to recommend a rental of \$1,800 for the building adjoining the Division of Chemistry and occupied by the Bureau of Animal Industry. A careful study of the comparative investments in the two buildings shows that on that basis the chemical laboratory is worth at least \$2,500 per annum. Inasmuch as the amount appropriated for the current fiscal year is only \$1,200 per annum, it is only justice to the owners to recommend for the deficiency bill an item of \$1,300 as additional rental for the current fiscal year in order to bring the total rental requested by the owners up to the sum mentioned, viz, \$2,500.

STENOGRAPHIC SERVICES FOR THE ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS.

The delays which have frequently arisen in the printing of the proceedings and method of analysis of the Association of Official Agricultural Chemists have been due largely to the impossibility of securing proper stenographic services. Since these publications are accepted as official, not only by the Department, but by the country, it is of importance that the proceedings be reported with accuracy and dispatch. I therefore recommend that an item of \$200 be inserted in the appropriation bill annually for the compensation of a stenographer for reporting the proceedings of the Association of Official Agricultural Chemists.

I believe that in the above suggestions I have presented to you the outline of the plans of work for the fiscal year ending June 30, 1901, in sufficient detail to enable you to appreciate the needs of the Division in formulating the estimates for that year.