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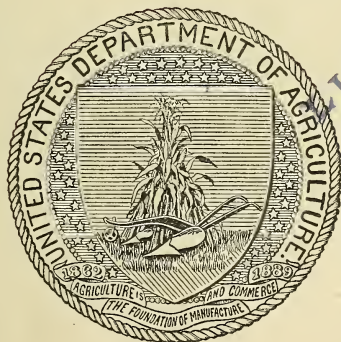
U. S. DEPARTMENT OF AGRICULTURE.

REPORT
OF
THE CHEMIST

FOR
1904.

BY
H. W. WILEY.

[FROM ANNUAL REPORTS, DEPARTMENT OF AGRICULTURE.]



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GOVERNMENT PRINTING OFFICE.

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REPORT OF THE CHEMIST.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY,
Washington, D. C., September 19, 1904.

SIR: I have the honor to submit herewith my report of the operations of the Bureau of Chemistry for the fiscal year ended June 30, 1904, together with an outline of the proposed work for the fiscal year ending June 30, 1905, and an estimate of the probable expenses of the Bureau for the fiscal year ending June 30, 1906.

Respectfully,

H. W. WILEY, *Chemist.*

HON. JAMES WILSON, *Secretary.*

WORK OF THE YEAR, WITH RECOMMENDATIONS.

The lines of investigation, indicated in the last annual report, relating to problems connected with the application of chemistry to agriculture were followed with little change during the year ended June 30, 1904. The science of chemistry is connected with scientific agriculture in almost all of its aspects, and thus there is little difficulty in utilizing all the forces at the command of the Bureau of Chemistry in these investigations.

In order to secure economy as well as efficiency in this work the endeavor has been made for many years to collaborate with other scientific investigators in the problems which are under consideration. In this collaboration the Bureau has had the continued help of many of the agricultural experiment stations. This has been particularly true in connection with investigations undertaken to determine the effect of environment upon chemical composition in sugar-producing plants. This work, which was commenced nearly a quarter of a century ago, was confined for a long time to the evolution of a sorghum plant containing a high content of sugar and a low content of melassigenic substances. Later the same lines of investigation were applied to the sugar beet in a general way, and in the last few years these investigations have been specialized in order to determine which one of the factors producing chemical changes in the sugar beet exerts the greatest influence in respect of the content of sugar. During the year the fourth annual series of investigations in this direction was completed. In the study of this problem not only has the Bureau had the helpful aid of the agricultural stations, but also

of the Weather Bureau, which has cordially cooperated by furnishing the meteorological data at or near the various stations at which the experimental work has been conducted.

For lack of funds similar experiments authorized by Congress in the study of the effect of environment upon the composition of the cereal grains have not been pushed as vigorously as desired. Nevertheless numerous comparative determinations have been made of the effect of the environment on the protein content of wheat. These data, which have been collected over a series of several years, have for their chief purpose to indicate the general character of the study necessary to determine more accurately those conditions which affect so seriously the composition of the wheat kernel. The purposes which should be kept in view in the growing of wheat include those particularly relating to the possibilities of panification. A scientific miller desires to produce a grade of flour just as uniform as possible in its composition. Inasmuch, however, as the character of the grain which he purchases varies from year to year and from locality to locality, it has become a necessity to scientific milling to know the general characteristics of the grain in bulk. This having been accomplished, it is possible to so blend grains of different character as to produce the uniform result required. Especially is it necessary for the miller to have at hand grains of wheat with a high content of protein, and particularly in the form which produces during the preliminary process of panification the agglutinating materials known under the common name of "gluten." The studies of the Bureau on this line have added much to our knowledge of those conditions of growth which are favorable to the production of a wheat grain with a high protein, and a correspondingly high gluten content.

While it is generally true in the case of wheat that the gluten content increases *pari passu* with the content of protein, such is not always the case. The causes which disturb the equilibrium existing between the gluten and the protein are worthy of serious and careful study. The ultimate object of the studies which the Bureau has now in hand is to indicate the conditions which are favorable to the production of a grain of any desired quality. It is evident that in this work the well-known principle of selection of seed is of the highest utility, but still more important is it to discover the conditions which will tend to conserve and increase the good qualities which the selected seed is known to possess. This investigation requires not only the constant services of the chemist, but also those of the botanist and the advice and collaboration of the agronomist experienced in the production of cereal grains. The data already collected on this subject are preparing for publication, and will soon be ready to be issued as a preliminary bulletin.

During the past year the demand which has been made upon the Bureau of Chemistry for information in regard to technical problems of a chemical character relating to the production of paper and leather has been very great. The diminishing supplies of raw material in the production of paper and the consequent increase in price have made the agricultural problem of the production of this material one of great importance. Forests suitable for the production of paper pulp are rapidly disappearing, and the deficiency of the material which arises from this cause must be supplied from other agri-

cultural sources. The fibers of many plants which have heretofore been only waste material offer promising sources of supply. Among these may be mentioned the Indian corn stalk, the cotton stalk, and the bagasse, resulting from the manufacture of sugar and sirup from sugar cane. During the year a large amount of work was done in this direction, and, by order of the Secretary, an expert was sent to paper mills to study the practical manufacture of paper pulp from materials of this kind.

The importance of the supply of tanning materials and of the study of leathers in regard to composition, strength, appearance, and durability is also growing, and constant demands are made upon the Bureau of Chemistry for information on these points. The miscellaneous work which has been done in this direction during the year was of such a magnitude as to warrant its organization into some more definite form, and this led to the establishment by the Secretary, on the 1st day of July of the present fiscal year, of a laboratory in the Bureau of Chemistry charged with investigation of problems of a chemical and chemical-technical nature relating to the paper and leather industries.

Most important of the new work which was undertaken during the past year is the inspection of imported food products. Under the act voting supplies to the Department of Agriculture, which took effect on the 1st of July, 1903, the Secretary of Agriculture was authorized to inspect invoices of food products offered for entry into the country and to ascertain whether such foods were adulterated in any particular with substances injurious to health or otherwise; whether they were mislabeled in any respect, either in regard to the character of the goods, of the countries in which they were made, or whether they were of a character forbidden or restricted in sale in the country where they were manufactured, or from which they were exported. The funds which were placed at the disposal of the Bureau for this inspection were limited in amount and were entirely insufficient to provide for a complete inspection, even if such had been desirable at the start. It was therefore decided to confine the inspection to articles which were known to have been, by former inspections, subject to frequent adulteration.

The law provided for collaboration with the Treasury Department, which secured the samples upon request and transmitted them for examination to Washington. The Secretary of the Treasury, also, is the official authorized by the law to exclude invoices from entry after inspection and certification by the Secretary of Agriculture that they fail to comply with the provisions of the law.

Most valuable collaboration was also secured through the State Department by instructions furnished our consuls in foreign ports to require declarations on the part of exporters of food products to the United States regarding the character and origin of the materials offered for export.

The available funds not being sufficient to establish laboratories at the various ports of entry, samples taken at the Atlantic and interior ports were analyzed at Washington. By reason of the great distance from the Pacific ports, however, it was found necessary to establish a laboratory in San Francisco, and this was done in connection with

the laboratories of the agricultural college of the University of California. Experience has shown the great desirability of other laboratories, especially at the port of New York, where by far the greatest number of invoices of food products are liquidated. Fortunately, for the fiscal year 1905 Congress has given a sufficient sum of money to establish a laboratory at New York and to enlarge the one at the Pacific coast. As the work of inspection becomes more thorough it will doubtless be advisable to establish laboratories at other points, especially one at some interior point for the convenience of the interior ports of entry. The character and the amount of work done in the inspection of food products during the year are shown in the following tabular statement:

Statement of imported food samples received by the Bureau of Chemistry and results of inspection reported from July 1, 1903, to July 1, 1904.

Result of inspection.	Wine.	Meat.	Olive oil.	Miscellaneous.	Total.
Admitted with a caution, on the ground of being first offense	50	9	11	38	108
Admitted after the labels were changed to harmonize with the law	1	9	10	17	37
Required to be reshipped beyond the jurisdiction of the United States	37	2	14	3	56
Condemned, but not disposed of	4	11	2	5	22
Total violations of law	92	31	37	63	223
Found to comply with the law	776	150	476	255	1,657
Total number of samples examined from invoices detained	868	181	513	318	1,880
Samples taken from invoices not detained	300	2	3	61	366

The inspection work above outlined has been confined, as is seen, to a very few articles of commerce. The force at our disposal was insufficient to inspect even all the shipments of the particular kinds of merchandise indicated. The result of the inspection, however, is a pointed illustration of the necessity of the supervision which has been exercised. But little attempt was made during the year to consider some of the most important kinds of adulteration which are practiced. These relate especially to the using of false labels, particularly with wines and spirits. In many cases such use of false labels can not be detected by an inspection of any of the physical or chemical qualities of the goods. It can only be determined by some method of securing a certification of the validity of the name employed. This is especially true in the case of classed wines; that is, wines which are entitled to bear the name of a certain locality, vineyard, or chateau. Wines of a similar chemical character may be substituted for these classed wines, and the differences in chemical composition are not sufficient to determine the fraud. In these cases we shall have to rely upon some system of certification such as has been mentioned above. During the year a great deal of attention was given to this subject with the idea of developing for the next fiscal year some system which would be just and efficient.

In a similar manner the use of the term "brandy," as applied to distilled spirits not wholly made, or even made at all, by the distillation of wine, is a fraud of very wide extent. In this case both

the chemical and physical properties, however, may be utilized. There are certain physical and chemical properties which are connected with the distillate of wine which has not been rectified but stored in wood for the purpose of ripening which will enable the chemist to distinguish these products from those of an artificial character. On the other hand, it must be admitted that the expert blender and mixer is able to make a product from alcohol of other origin, coloring matters, oils, ethers, and other aromatic substances which closely imitates in chemical composition the genuine article. During the year this problem was studied both from its chemical and commercial points of view and plans were matured which will be soon placed in operation for the purpose of protecting our trade against spurious articles of this description.

What is said of brandies may be said with almost equal truth of whiskies, and these will be subjected to similar examinations for the purpose of determining whether any fraudulent label has been employed. It is considered that a brandy, in a potable sense, is the total distillate from wine, having an alcoholic content of between 45 and 55 volume per cent, and which has been stored in wooden casks for a period (probably not less than four years) sufficient to oxidize the aldehydes or other components of fusel oils into ethers and other aromatic bodies. The total content of fusel oil should not exceed 0.25 per cent. From a similar point of view a whisky, in a potable sense, is the distillate from fermented cereal grains stored and ripened in the manner just described.

Problems connected with the use of artificial colors, glucoses, and preservatives have also been studied with a view to making the law more efficient. It is held that these bodies should not be used without notification; otherwise they would be considered to be misbranded. Further than this, they must be bodies of a nature not considered deleterious to health, either as determined by actual experiment or in the opinion of the greater weight of expert evidence. When such bodies are by either of these means found to be deleterious to health their presence in minute quantities is considered no excuse. The principles which are enunciated in Circular 15, giving the result of the experiments with borax and boric acid, are held to apply to other bodies of similar character in relation to the execution of the law.

The salutary results which have followed the execution of the law so far are a convincing evidence of its utility and value. While it is not probable that the practice of food adulteration in imported articles can be wholly eliminated, it is quite certain that it may be reduced to minimum proportions and the character of our imported food products be fully assured. Unfortunately, the law does not follow the food products after they are admitted into the country, and subsequent false branding, mixing, or sophistication of any kind must be prevented by the application of the laws of the different States. The extension of the principle of food inspection to interstate commerce would enable the States in the execution of their own laws and with the help of such an inspection to protect their people entirely from the evils of food adulteration.

THE EFFECT OF FOOD PRESERVATIVES ON DIGESTION AND HEALTH.

The work which was begun the preceding year to determine the effect of borax and boric acid on digestion and health was completed, tabulated, and the results prepared for publication. They will appear in detail in Bulletin No. 84. A summary of these results, to be offered for distribution, has been published as Circular No. 15.

The most interesting of the observations which were made during the progress of the experiments was in the study of the direct effect of boric acid and borax, when administered in food, upon the digestion and health. When boric acid, or its equivalent in borax, is taken into the food in small quantities, not exceeding half a gram ($7\frac{1}{2}$ grains) a day, no notable effects are immediately produced. The medical symptoms of the cases in long-continued exhibitions of small doses, or in large doses extending over a shorter period, show in many instances a manifest tendency to diminish the appetite and to produce a feeling of fullness and uneasiness in the stomach, which in some cases results in nausea with a very general tendency to a sense of fullness in the head, which is often manifested as a dull and persistent headache. In addition to the uneasiness produced in the region of the stomach there appear in some instances sharp and well-located pains, which, however, are not persistent. Although the depression in the weight of the body and some of the other symptoms produced persist in the after periods, there is a uniform final tendency manifested after the withdrawal of the preservative toward the removal of the unpleasant sensations in the stomach and head, above mentioned.

The administration of boric acid to the amount of 4 or 5 grams per day, or borax equivalent thereto, continued for some time, results in most cases in loss of appetite and inability to perform work of any kind. In many cases the person becomes ill and unfit for duty. Four grams per day may be regarded then as the limit of exhibition beyond which the normal man may not go. The administration of 3 grams per day produced the same symptoms in many cases, although it appeared that a majority of the men under observation were able to take 3 grams a day for a somewhat protracted period and still perform their duties. They commonly felt injurious effects from the dose, however, and it is certain that the normal man could not long continue to receive 3 grams per day.

In many cases the same results, though less marked, followed the administration of borax to the extent of 2 grams, and even of 1 gram, per day, although the illness following the administration of borax and boric acid in those proportions may be explained in some cases by other causes, chiefly grippe.

The administration of borax and boric acid to the extent of one-half gram per day yielded results markedly different from those obtained with larger quantities of the preservatives. This experiment, Series V, conducted as it was for a period of fifty days, was a rather severe test, and it appeared that in some instances a somewhat unfavorable result attended it. On the whole, the results show that one-half gram per day is too much for the normal man to receive regularly. On the other hand, it is evident that the normal man can receive one-half gram per day of boric acid, or of borax expressed in terms of boric acid, for a limited period of time without much danger of impairment of health.

It is, of course, not to be denied that both borax and boric acid are recognized as valuable remedies in medicine. There are certain diseases in which these remedies are regularly prescribed, both for internal and external use. The value which they possess in these cases does not seem to have any relation to their use in the healthy organism, except when properly prescribed as prophylactics. The fact that any remedy is useful in disease does not appear to logically warrant its use at any other time.

It appears, therefore, that both boric acid and borax, when continuously administered in small doses for a long period, or when given in large quantities for a short period, create disturbances of appetite, of digestion, and of health.

During the year the work was prosecuted on the same lines as were followed during the preceding year. The preservatives which were used during the year were salicylic acid, sulphurous acid and sulphites, and benzoic acid and benzoates. Although the experiments were concluded on the 30th of June, the tabulation and study of the data will be a part of the present year's work. No conclusions, therefore, can be given at the present time respecting the results of the investigation.

THE FOOD LABORATORY.

The study of tropical fruits and fruit products has been concluded and the results embodied in a bulletin which is now in press. The study of the composition of fruit with special reference to the changes of composition during ripening and the different methods of storage has been continued in collaboration with the Pomologist. Three varieties of summer apples and three varieties of winter apples were picked at different times during the growing season and their composition determined. Much attention has been given to the study of analytical methods employed in this work and to the study of pectin bodies with a view of determining their nature and establishing methods for their determination. The literature relating to this subject has been carefully reviewed, and a bulletin including this review and the laboratory results on this subject up to date is now in manuscript. At the beginning of the present growing season the work was extended to other varieties of fruits, special attention being given to peaches and bananas, and the study of the ripening of citrus fruits has also been begun.

During the last fiscal year, as heretofore, the Food Laboratory has done important work in studying and comparing methods for the examination of various classes of foods. This work has been in connection with the Association of Official Agricultural Chemists, in which the chief of the Food Laboratory is at present referee on food adulteration. It has also been influenced to some extent by the requirements of the work of the laboratory in connection with the enforcement of the imported-food law. As referee on food adulteration for the Association of Official Agricultural Chemists the chief of the Food Laboratory has worked in collaboration with nineteen prominent food chemists in the United States and Canada, and in addition to this he and his collaborators, each in his special field, have had the cooperation of a much larger body of food chemists. Among the contributions of the Food Laboratory to this subject during the last fiscal year may be mentioned the collaborative work relating to

the Dalican titer test and the study of the methods for the determination of iodine absorption, which were reported to the last meeting of the Association of Official Agricultural Chemists and published in the proceedings of that meeting. Since the meeting of the association this work has been continued on a larger scale than before, and attention has also been given to the Belfield test for the detection of beef stearin in lard. Fifteen samples of lard from hogs that had been fed with varying amounts of cotton seed were also examined to detect the presence of phytosterol.

The study of methods for identifying nitrogenous compounds in meat extracts and other foods was taken up for the Association of Official Agricultural Chemists, and a number of methods that have been suggested for this purpose were carefully compared. A report on this subject was made at the last meeting of the association, and after the meeting the work was continued on a somewhat increased scale to secure material for a report which will be presented at the coming meeting.

A method was also worked out for the detection of basic aluminum acetate, which was found as a preservative in imported sausage. This method was published in the *Journal of the American Chemical Society*.

Considerable attention has also been given, in connection with the Association of Official Agricultural Chemists, to the study of methods for the detection of various chemical preservatives in food. This study is made necessary by controversies that have arisen between manufacturers of food products and those charged with their examination with a view to enforcing food laws. It has been charged in some quarters that these disputes have been due to the unreliability of the methods employed. Again, attention has recently been called to the fact that the natural occurrence in fruits and vegetables of certain chemicals used for the preservation of food is much more widely distributed than was previously supposed, and it has even been claimed that they were sometimes found in fruit in such quantities as might lead to erroneous reports regarding their presence in preserved food. Again, it has even been claimed that some of these compounds were formed in the foods by the methods employed for their sterilization. When we consider the importance of these questions and the extent to which they have been discussed we may naturally expect that some of the claims made will prove to have been exaggerated. At the same time the careful study of all questions involved is important and has been taken up by the Food Laboratory.

In addition to the publications mentioned above there have been published from the Food Laboratory during the last fiscal year a summary of the Federal and State food laws in force in the United States up to July 1, 1902, the full text of the food laws enacted during the winter of 1902-3, a paper relating to the determination of sulphur and phosphorus in food in the *Journal of the American Chemical Society*, and a paper relating to the methods for the detection of sesame oil in the same journal.

During the entire year a great deal of the time of the chief of the Food Laboratory has been taken up with the exhibit of the Bureau of Chemistry at the Louisiana Purchase Exposition. This exhibit consists of a working laboratory illustrating the nature of the work

of the Bureau of Chemistry. The time required in planning the laboratory, securing the complete equipment, and installing it was considerable, in addition to the time occupied in conducting the laboratory after the beginning of the Exposition.

The enforcement of the law relating to imported foods, which went into effect at the beginning of the last fiscal year, has greatly increased the work of the Food Laboratory. Usually the examinations made were somewhat superficial, being confined to two or three tests on each sample. In a great many instances, however, a much more complete examination was made. Owing to the large number of samples the system of indexing, recording, and reporting in itself required careful and constant attention. In addition to the examinations mentioned, which were for the purpose of deciding whether or not the shipments represented by the samples could be imported into the United States in conformity with the law of March 3, 1903, a complete examination of about 400 samples of imported wine has been undertaken.

By far the greatest amount of the time and energy of the force of the Food Laboratory was occupied with the investigation of the influence of preservatives on nutrition. The fact that the determinations were largely of a routine nature made it possible to systematize the work in such a manner that it could be conducted by a much smaller force than would at first be supposed. At the same time, the great volume of the work in itself presented many serious problems. The work on this subject alone during the fiscal year included more than 15,000 single determinations. Owing to the necessity of calculating the income and outgo of the bodies of the men under experiment a large amount of calculation was necessary after the percentage composition of the various foods was determined. Although this calculation has been greatly simplified by means of regular forms, the development of the latter in connection with the work has required considerable time and attention. After the percentage composition of the food, feces, and urine was determined by the analysts and the results entered on forms prepared for that purpose, there were necessary for the calculation of those results into such form as could be used for comparison something more than 335,000 multiplications of numbers varying from 2 to 4 figures, usually 3 figures each; 40,000 divisions; 17,000 additions, 12,600 of which were columns of about 25 numbers each, and 4,200 subtractions. In this calculation the laboratory has had a very large amount of most valuable assistance from the Bureau of Statistics. Notwithstanding the great volume of work, it has been so systematized that the figures relating to any individual for any day are always accessible and may be referred to instantly without inconvenience.

During the last fiscal year, in addition to the investigation of methods and other comparative studies for which materials in the laboratory were used and special samples were not required, the Food Laboratory examined 1,952 samples secured in the enforcement of the food law, 2,786 samples relating to the hygienic table, and 1,769 miscellaneous samples, making a total of 6,507 samples. At the close of the last fiscal year, owing to the increased amount and importance of its work, the Food Laboratory was converted by the Secretary of Agriculture into the Division of Foods of the Bureau of Chemistry.

ROAD MATERIAL LABORATORY.

During the fiscal year ending June 30, 1904, 228 routine samples were received by the laboratory. Of these, 133 were rock, 35 clay, 15 gravel, 11 brick, 4 floor tile, and 30 miscellaneous material. On these samples the following tests were made: One hundred and six abrasion tests, 154 cementation tests, 51 hardness tests, 35 toughness tests, 12 compression tests, 1 rattler test. Over 100 thin rock sections were cut, 95 petrographical analyses and 37 complete chemical analyses were made, and 10 samples identified. Besides these routine tests, a bulletin entitled "The testing of road materials" has been published and another, on "The cementing value of road materials," has been prepared and is now ready for publication. Among the several investigations pursued during the year probably more time has been devoted to the cementing value of road materials than to any other. The chief results of this investigation are contained in the bulletin just referred to. A number of experiments have been conducted on waterproofing cement and mortar, and also on the tensile strength of clay. This work has not yet been completed, and will be reported on later.

On the 1st of July the Road Material Laboratory was made a division and its name changed to the Division of Tests. The main object of this change was to embrace the testing of all materials of construction relating to agriculture. During the present year it is the intention of this Division not only to make routine tests and investigations of road materials, but to carry on extensive work on the uses of concrete both in road building and its application to farm work. In connection with the experiment stations it is hoped that this Division will be able to render assistance in testing materials used in irrigation work.

A great dearth exists in this country of engineers familiar with the practice of road building. If a school of road building should be established in the Department, which would afford to young men holding degrees in civil engineering at least a year's course in road building, with adequate instruction in the proper use of different road-building materials, the character of rural highways throughout the country would be vastly improved.

There are many other lines of useful work which could be taken up with profit, but the available funds are too small at present to undertake more. I sincerely hope, however, a larger appropriation will be obtained for next year, as the field of work is one which can be made most instructive.

CONTRACTS LABORATORY.

The object of this laboratory is to determine the quality of materials offered under contract to the Department of Agriculture and to such other Departments as may ask for assistance in this direction. It is evident that unless some physical and chemical control be exercised over articles offered under contract the only methods of ascertaining whether the materials offered are of the proper character are those depending upon appearance and general character. Nearly every article which is purchased by the Department of Agriculture and the other Departments of the Government should have certain

physical and chemical properties corresponding to those required in the contract, and it is to determine this correspondence that the aid of this laboratory is invoked.

The work of the past year has been largely the examination of samples of materials submitted with bids for contracts, or furnished upon contracts for the various Executive Departments, and investigations undertaken at the request of the different Executive Departments. In addition to the above, however, some miscellaneous work has been done. The investigation of typewriter ribbons has been started.

The chief of the laboratory is now sugar referee for the Association of Official Agricultural Chemists. This latter work has required considerable attention in the way of preparing pure cane sugar for use in verifying quartz plate values.

The following is a résumé of the work done in this laboratory for the Executive Departments:

DEPARTMENT OF AGRICULTURE.

Early in the year chemical examination and practical tests were made of fire powders for the guidance of this Department, which at that time was considering the advisability of using these powders for fire protection. Practical tests showed that these powders were inefficient in extinguishing fires such as are most likely to occur in laboratory or office buildings.

The investigation of typewriter ribbons has been given considerable attention, with gratifying results; and this work is to be continued, in cooperation with the other Executive Departments, for the purpose of determining the efficiency of the so-called "record ribbons" in producing indelible copies and of outlining specifications for the guidance of this and other Departments in the purchase of these materials.

DEPARTMENT OF COMMERCE AND LABOR.

Five samples of disinfectants furnished with bids for contract and one sample of disinfectant furnished on contract were examined for the Census Office of the Department of Commerce and Labor.

INTERIOR DEPARTMENT.

Two samples of coal furnished with bids for contract of the Government Hospital for the Insane were analyzed for the Department of the Interior.

NAVY DEPARTMENT.

The examination of two samples of linen, to determine whether the material furnished on contract was of the same quality as the sample furnished with the bid, and of four samples of salt-water soap submitted with bids, constitutes the work done for the Navy Department.

POST-OFFICE DEPARTMENT.

The work for the Post-Office Department has been the examination of inks and stamping pads furnished on contract, and of inks, stamping pads, and ingredients used in making stamping pads, submitted

with bids for contracts for the present fiscal year, and the investigation of the relative resistance of the dyes used in making canceling inks for use with rubber stamps, and of the dyes used in printing postage stamps. The awards of contracts for stamping inks, canceling inks, and stamping pads are made upon the basis of results obtained in this laboratory, and these materials, when furnished, are here submitted to chemical and physical tests. The work on the relative resistance of the dyes used in canceling inks for use with rubber stamps has developed the fact that these dyes are generally less resistant to reagents than the dyes used in printing some of the higher denomination stamps, and this has necessitated extreme care in the examination of inks of this class. During the year 62 samples have been examined for the Post-Office Department.

TREASURY DEPARTMENT.

The greater part of the work for this Department has been in connection with the levying of duties. This laboratory has had charge, in collaboration with the Sugar Laboratory, of the comparative sugar tests made in cooperation with the ports of New York, Boston, Philadelphia, and New Orleans. With the exception of 355 sugar samples, the analytical part of this work has been done in the Sugar Laboratory, with the exception of the polariscopic readings. Another important line of work for the Treasury Department has been the examination of soap stocks, machinery oils, and miscellaneous oils, for the purpose of determining whether any of such were for use as alizarin assistants. One hundred and sixty-eight samples were examined in this investigation. Thirteen samples of miscellaneous materials were also examined. These included three samples each of "shoyu" and lead dross, two samples each of listerine, catch, and "barley-brew base," and one sample of pineapples. At the request of the Director of the Bureau of Engraving and Printing the analysis was made of ten samples of "hard black" and two samples of milori green, regarding which there had arisen a question about the standard of these materials furnished on contract. In all 191 samples, exclusive of sugar samples, were examined for the Treasury Department during the year.

WAR DEPARTMENT.

Eighteen samples of miscellaneous food products for the Commissary Office and one sample each of hay, flour, and forage biscuit were examined for the War Department.

MISCELLANEOUS.

In addition to the above work for the Executive Departments, one sample of fireproofing was examined at the request of the Commissioners of the District of Columbia, and 18 miscellaneous samples were examined in this laboratory. The latter consisted of one sample each of turpentine, vermouth color, paraffin, honey, zinc nails, oxalic acid, and paper, two samples of bagasse, and nine samples of seal and cod-liver oils.

Of the samples reported from this laboratory 26 were examined in other laboratories—three in the Dairy Laboratory, twelve in the Food

Laboratory, eight in the Insecticide and Agricultural Water Laboratory, two in the Sugar Laboratory, and one in the laboratory of the microscopist. Exclusive of sugar samples and samples used in the investigation of typewriter ribbons, 311 samples have been sent to the Contracts Laboratory for analysis, and of this number all but 26 have been examined in this laboratory.

INSECTICIDE AND AGRICULTURAL WATER LABORATORY.

During the past year 38 samples of mineral waters were examined, 19 of which, along with some 40 previous analyses, are to be used in the preparation of a bulletin upon the composition of mineral waters of the United States.

A complete examination of three irrigation waters was made for the office of Irrigation Investigations.

Thirty-eight sanitary examinations of waters were made, 19 of which are to be published in a bulletin. The remaining 19 samples of water were examined either for other Departments of the National Government or for the health officers of small towns where the water supply was suspected to be the cause of disease.

Thirty-two samples of insecticides were examined, some of which were sent in by farmers, but the most of which were analyzed at the request of the Bureau of Entomology. For the Bureau of Plant Industry 8 samples of fungicides were examined, and for the United States Census Office 7 samples of disinfectants.

A determination of the arsenic content of 22 samples of carpet was made. These results, along with some 700 previously obtained, have been incorporated in a bulletin.

Fifty-three samples of chemicals and drugs were examined for the Drug Laboratory as regards their arsenic content.

Eight toxicological examinations were made of samples from the Bureau of Entomology and other sources.

A nearly complete examination has been made of 209 samples of cattle foods and a partial analysis of 106 samples. Twenty-six of these analyses were made for other Bureaus of the United States Department of Agriculture. The remainder are to be reported in a bulletin upon the "Composition of American cattle foods."

The analysis of 13 samples of gases was made by this laboratory for the United States Bureau of Fisheries.

In connection with a study of the injury to vegetation by smelter fumes, undertaken at the request of the United States Department of Justice, some 300 determinations of the sulphur trioxid, moisture, ash, etc., in the water, soil, and foliage of trees surrounding the smelter were made.

Besides the above, 15 miscellaneous examinations were made for the National Government and individuals.

INVESTIGATIONS AND RESULTS.

The chemical examinations of from 65 to 75 prominent mineral waters now sold upon the American market have been completed and the calculations, etc., in connection with the work are now in progress.

A study of the arsenic content of wall papers, furs, fabrics, etc., has been completed and a bulletin reporting the results of the work is

now in press. Since the health of the whole community depends upon healthful surroundings which can not be obtained as long as the air of dwellings is poisoned by volatile arsenical compounds from wall paper and articles of dress contain excessive amounts of this poisonous metalloid, this bulletin is important from a hygienic standpoint. The results of this work may be briefly summarized as follows:

(1) If 0.1 grain per square yard is adopted as the maximum amount of arsenic allowable in wall papers the condition of the market is quite satisfactory.

(2) The arsenic content of glazed shelf and crape papers is as small as could be reasonably expected.

(3) Entirely too large a percentage of the dress goods, stockings, dress furs, and fur rugs sold on the American market contain excessive amounts of arsenic.

(4) The presence of excessive amounts of arsenic in such goods as are described in (3) is dangerous to the health of a large number of people, especially those who are susceptible to arsenic poisoning, and should be prohibited by proper legislation.

The results of our study of the amount of free arsenious oxid in Paris green that can be endured by various classes of fruit trees has been completed and reported in bulletin form. This bulletin is of great value both to practical farmers and to entomologists and chemists who are called upon to judge the value of samples of Paris green to be used in spraying.

At the request of the Department of Justice this laboratory during the past year undertook to prove whether or not certain Government forests in northern California were being killed by the fumes from a copper-smelting plant. The entire time of one chemist for about three months, including two trips to California to collect samples, testify, etc., was necessary before the work was completed.

The results of this investigation, which showed undoubted injury to vegetation by smelter fumes, are nearly ready for press, and will shortly be printed in bulletin form. They will be very valuable to owners of forests and to lawyers who have cases depending on injury from the cause mentioned above.

One of the assistants in this laboratory has been appointed referee on insecticides, fungicides, and disinfectants for the Association of Official Agricultural Chemists, and has during the past year devoted considerable time to comparing and improving the methods of analysis of these classes of compounds.

In addition to the above investigations the chief of this laboratory has completed all analytical work in connection with a method of determining chlorine, bromine, and iodine in mineral waters. The results will soon be published. With the help of one of the assistant chemists the chief of this laboratory is also making an extended study of the chemical composition of the lime-salt-sulphur wash and its probable method of action on scale insects. This laboratory has also during the past year issued an article entitled "Report of the referee on insecticides and fungicides for 1903."

SUGAR LABORATORY.

The work of the Sugar Laboratory during the year included a study of the composition of the juices of a large number of samples of

sugar cane grown upon the experimental plats at Cairo and Waycross, Ga. Samples of sirup made from these canes were also examined chemically.

The samples of sugar beets obtained in collaboration with the agricultural experiment stations in studying the effect of environment upon composition comprised a part of the work.

A systematic study of the composition of maple sugar and maple sirup was undertaken on samples of certified purity secured by the agricultural experiment stations of Vermont, Ohio, and Pennsylvania. These analyses were only partially completed at the end of the year.

The preparation for polarization of all the samples of sugar from the ports of New Orleans, Philadelphia, New York, and Boston formed an important part of the work of the laboratory. One sample from each of these ports is received each working day throughout the year, making altogether during the year 1,216 samples.

The total number of analyses made in the laboratory during the year was over 2,000, which included the miscellaneous examinations of various character relating to the sugar industry.

The vacancy caused by the resignation of Dr. G. L. Spencer, former chief of this laboratory, has not been filled, and the work of the laboratory is conducted under the immediate supervision of the Chief of the Bureau.

DAIRY LABORATORY.

In this laboratory the general work in the investigation of the composition of dairy products is carried on and also, under specific authority of Congress, all the chemical work in connection with the enforcement of the law regulating the manufacture and sale of renovated butter.

During the year ended June 30, 1904, the Dairy Laboratory has examined a total of 320 samples of butter, cheese, and milk, including condensed milk and milk powders or dried milk. Of this number 103 were analyzed or otherwise examined for the Bureau of Animal Industry, in connection with the enforcement of the Federal butter laws; 179 were analyzed in connection with the preservative investigations (hygienic table) of the Bureau of Chemistry; and 38 were from miscellaneous sources.

Because of the diminished amount of help in this laboratory during the past year, due to the long-continued illness of the assistant, the research work that was proposed in the last annual report has not been undertaken, but has been postponed until adequate laboratory assistance shall be secured.

DRUG LABORATORY.

During the fiscal year ended June 30, 1904, 460 samples of material were examined by the Drug Laboratory. Of this number 352 were chemical reagents, 77 crude medicinal plant products, 21 proprietary remedies, 2 materials used for poisoning, and the remaining 8 miscellaneous in character.

The chemical reagents examined were such as were delivered to the Bureau of Chemistry on contract and special purchase. This included not only the highest grade goods, but also many of the ordinary chemicals used for analytical work. The objects of these examinations are:

First, to insure reliable chemicals for analytical work; second, to secure data from which standards of purity can be constructed; and last, to place competitors on an equal footing.

The members of the Association of Official Agricultural Chemists recognized the necessity of securing standards for chemical reagents and directed the appointment of a committee on the testing of chemical reagents, of which the chief of the Drug Laboratory is chairman. The work is well under way and the first report was made at the last regular meeting, September 26, 1904.

Of the crude medicinal plant products 35 were examined for the Bureau of Plant Industry, mostly for the purpose of determining the amount of active medicinal agents present in plants grown and cured under known conditions, to serve as a guide for future work. Others were examined for the presence of certain poisonous agents, said to be present and to have caused the death of many domesticated animals in our Western States.

The remaining crude medicinal plant products in part represented the goods as received at the United States custom-house, being the medicinal herbs supplied to retail druggists. The object of this work is to ascertain to what extent these various products are adulterated, and if free from adulteration and of good quality, the data are to form the nucleus of a basis for standards, the establishment of which now forms part of the cooperative work with the Association of Official Agricultural Chemists.

A few proprietary remedies were examined at the instance of the Post-Office Department and Senator Heyburn, chairman of the Committee on Manufactures. These examinations were made to determine whether these remedies contained any medicinal agents which would warrant the extravagant statements contained in the advertising literature. The results showed that the advertising literature contained many false and misleading statements and that money was in this manner fraudulently obtained. The privilege of the use of mails was withdrawn in every such case.

The Department of Justice submitted two samples of material that were supposed to contain poisonous agents which caused the death of two persons. One contained morphine sulphate and caused the death of a child, and the other was "Rough on Rats," a portion of which is said to have caused the death of one adult.

The miscellaneous samples were examined as to composition and whether the labels were true representations of the contents of the various packages.

MICROCHEMICAL LABORATORY.

The kind of analysis conducted by this laboratory requires that the work shall be largely collaborative with the other branches of the Bureau of Chemistry and with other branches of the Department of Agriculture or the other Departments of the Government desiring such investigations as come within its scope of work.

During the last year the greatest amount of work in any one line has been done in connection with the physiological experiments conducted by the Bureau. This has required the microscopical examination of about 250 urine samples for the following substances: Uric acid crystals: urates: oxalate of lime: phosphates—(a) crystalline

phosphates, (*b*) amorphous phosphates; epithelium cells of all kinds; leucocytes; red blood cells; casts—(*a*) hyaline, (*b*) finely granular, (*c*) coarsely granular, (*d*) epithelial, (*e*) other forms; mucous cylinders; mucous strands.

In connection with these same experiments samples of blood were examined for the estimation of (*a*) the number of red corpuscles, (*b*) the number of white corpuscles, and (*c*) the amount of hemoglobin, requiring in all over 300 analyses.

In collaboration with the Food Laboratory in the enforcement of the imported food inspection law, 30 samples have been examined, such as mustards, chocolates, coffee substitutes, and some fruit products.

Work has been continued during the last year in collaboration with the Food Laboratory and the office of Pomological Investigations of the Bureau of Plant Industry upon the microscopical changes occurring in the ripening of fruits; and in this connection about 65 negatives and photographs have been made.

For certain branches of the Government, especially the Government Printing Office and the Post-Office Department, about 20 samples of paper have been examined to determine the kind of pulp of which they were composed, length of fibers, and the kind of size used. Part of them were also tested for weight, thickness, and opaqueness to light. Work has been begun on a large number of paper-pulp samples recently analyzed by the Bureau, and it is expected that the results will appear, together with the chemical analyses, some time in the near future, in a bulletin upon the subject.

For the Post-Office Department there has been examined a number of samples in connection with the fraudulent use of the mails in offering clothing and certain medicines for sale. The latter class, however, were examined in conjunction with the Drug Laboratory, which made the chemical analyses.

In collaboration with the Insecticide and Agricultural Water Laboratory work has been begun upon a number of samples of cattle feeds, the microscopical work consisting of the identification of the ingredients used in making up the material.

The making of nearly 240 photo-micrographic negatives has taken a considerable amount of time during the past year. The subjects photographed were varied in character, but the larger number were various textile fibers, starches, and a considerable number of crystals of lard and fat products, together with cholesterol and phytosterol mixtures, in connection with work carried on by the Food Laboratory looking to the perfecting of the analytical methods commonly in use. Besides this and some other miscellaneous work, a number of photo-micrographs were made of raphidian crystals and honey glands from various plants for the Bureau of Plant Industry.

The amount of routine work required of the laboratory has prevented during the past year accomplishing much research work. A method has been perfected, however, for the detection of turmeric in mustard, which shows a greater degree of sensitiveness than the tests commonly used.

Material has been collected for a study upon the micro-chemical structure of the sugar beet to determine what relation exists between the cell structure and the sugar content. Samples of wheat being collected in connection with the investigations upon the changes in

composition of given varieties when grown under varying climatic conditions are stored in the laboratory awaiting microscopic examination. The urgency of calls upon the laboratory, however, has required postponement of active work upon both of the above series during the past year, though it is expected that active work will be carried out as soon as possible.

The working out of plans and details in connection with the installing of the exhibit of the Bureau of Chemistry at the Louisiana Purchase Exposition has entailed at times considerable attention from the chief of the laboratory as well as taking up nearly all his time in demonstration in connection with the exhibit during the last part of the fiscal year.

PLANT ANALYSIS LABORATORY.

By the order of the Secretary the Soil and Fertilizer Laboratory was discontinued in the last fiscal year, and in its place was established a Plant Analysis Laboratory. In another section of this report will be found a summary of the work proposed for this new laboratory for the coming fiscal year. This report, in so far as it relates to the work of the Soil and Fertilizer Laboratory, covers only the work previously undertaken and which has been accomplished therein during the year under consideration. The said work may be classed under the following heads:

(1) A continuation of the investigation of typical soils to determine their relative fertility, this being the investigation inaugurated in 1894 under act of Congress.

(2) A continuation of the cooperative study of available plant food in soils with the State experiment stations, as under the authorization of the Secretary, dated January 3, 1902.

(3) A continuation of the investigation as to the acid condition of some soils and the neutralization thereof by the use of lime.

(4) An investigation as to the comparative feeding ability of various crops, upon the same soil, under identical conditions, in pot culture.

(5) An investigation of basic slag, to establish a chemical method for estimating the amount of "available" phosphate for use as a commercial fertilizer.

(6) Miscellaneous work.

In detail the work comprised the following:

(1) A continuation of the investigation of typical soils to determine their relative fertility. This consists of a series of 30-pot culture tests, which has been continued in annual cropping since 1895. Some of these soils are from the Rothamsted station in England and have a crop history of more than fifty years. The data on these soils up to 1903 have been embodied in a bulletin which has been prepared for publication and which will include the entire series of 180 pots, all but 30 being discontinued during that year. The crops for the past year have been analyzed and the results compiled, together with complete field data, such as notes on planting and harvesting, weight of soil used, amount of water added, etc.

(2) Cooperative study of the available plant food in soils. This was the second year of cooperation with some twenty-five State experiment stations in the study of available plant food in soils. The pur-

pose of this has been to establish a relation between pot culture and plot culture, in order that the results of the investigation through eight years of pot culture may be compared to plot study, as the first step toward a practical application of similar data in the science of agriculture.

The method of procedure has been to have the cooperating stations grow a series of plot experiments, and from these plots to take 500 trial samples of soil, which were sent to the Bureau of Chemistry for pot-culture tests, according to the method in use. In addition, laboratory samples from each plot were supplied all stations cooperating or desiring the samples.

During the past year eight plots of 400 square feet each were grown at each station. Four plots were grown in oats, one being treated with phosphate and potash, one with phosphate, one with potash, and one with no fertilizer. Two plots were grown in clover, one being treated with lime, the other not treated. One plot was grown in cowpeas, not treated. One plot was grown in maize, not treated, the maize being sown in rows, as is done for ensilage. The samples of soil that were potted were grown in oats, without treatment.

From each plot a sample of the crop, taken in triangular form, the equivalent of 4 square feet, was cut even with the ground. These samples were forwarded to the Bureau of Chemistry, where they were weighed, subsampled, and analyzed—nitrogen, phosphoric acid, potash, lime, and magnesia being determined.

From the plot study in oats the possible deficiency of potash or phosphoric acid was determined by the fertilization experiments. In the clover plots special studies of the acid condition of the soil were made.

The cowpeas were grown as a type of legume and the maize as a type of cereal. The yield per acre of these various plots was computed as to complete crop, pounds of potash, phosphoric acid, nitrogen, lime, and magnesia. These are compared with the yield of the same soil in pot culture. The results obtained indicate that much care and judgment must be used in taking samples from the field for the purpose of estimating their available food supply for crops. In pot culture the crop has a limited depth to which it can feed, and to estimate by chemical analysis the supply for such conditions is comparatively easy. In plot culture the depth of feeding is indefinite. The greater part of the available supply may be found in the first 6 inches or it may be distributed uniformly even beyond the depth of feeding. It is seen that the taking of the soil samples must be done with reference to the plant which is intended to be grown. Had the work been continued it was the purpose to grow crops representing the various root systems and depths through which the plants feed, provided the subsoil is sufficiently permeable.

(3) Investigations as to the acid condition and remedy in certain soils. This work was prosecuted with much vigor during the past year. Many determinations as to acidity were made in the course of systematic study. Pot-culture experiments were made in which clover was grown as an index to the presence of acid conditions. Thirty-five pots were used for this work. Soils which were known to be very acid were treated with varying quantities of lime, according to the laboratory results as obtained by various proposed methods

for estimating the lime requirements. The results obtained give a practical comparison of the proposed theoretical methods of treatment.

(4) Investigations on the comparative feeding ability of various crops in the same soil. This line of work was inaugurated at the beginning of the past year. Most of the soil investigations that had been undertaken in the laboratory were in conjunction with the culture of oats, this plant having been used in similar investigations perhaps more than any other. The methods of analysis proposed had been based upon the feeding capacity of oats. In order to extend the results of the research to other crops, a scheme was planned for the growing of different crops upon the same weight of the same soil under identical conditions in order to ascertain the plant food supplied to each.

The soil used for this purpose was a superior piece of sod land taken from the Department farm at Arlington. It was put through a quarter-inch mesh sieve and mixed on a sampling floor. The soil was protected from too rapid drying, being worked when it appeared to be in best working condition. It was put through a sampling process and with the greatest care potted in 30 pots in such a way that each contained the same weight of soil, and as far as possible alike in every respect.

These pots were seeded in timothy, clover, vetch, oats (Swedish), wheat, barley, rye, corn, tobacco (White Burley), tobacco (Sumatra), beans (Lima), beans (wax), hemp, cowpeas, beets, buckwheat, potatoes, turnips, cabbage, peas, tomatoes, lettuce, and okra. Duplicate croppings were made in some crops, and one pot was left fallow.

These crops were analyzed and the amounts of the various plant-food elements removed were calculated.

Samples of the soil taken for laboratory study were in process of analysis at the close of the year.

(5) Investigation as to the available phosphoric acid in basic slag. As the laboratory was charged with the investigation of fertilizers, there was inaugurated a study on basic slag. This product is rapidly becoming an important factor as a commercial fertilizer. When methods of fertilizer analysis were defined by the Association of Official Agricultural Chemists this product had not come into the markets. In consequence the standard methods are not suitable for a correct valuation of this substance.

The plan of procedure was to select a soil that was notably deficient in phosphoric acid. The soil was collected near the Maryland Experiment Station. This was prepared for potting as described above, fifteen pots being used for the work, being alike in every detail. Lime, potash, and nitrogen were supplied in all pots excepting two, which were not treated, the same quantities being used in each pot. Two samples of basic slag were used in the experiment, these being secured by putting one sample which was purchased in the market through a sieve of such mesh that it divided the sample into two equal portions, one representing the fine, the other the remaining coarse portion. Varying quantities of these samples were added to the pots, such that the range was from 0 up to 7 grams per pot of the fine and from 0 up to 12 grams of the coarse.

The entire series of pots was seeded in oats. These crops have been analyzed and the amounts of phosphoric acid removed calcu-

lated. From these data it was ascertained at what point the amount of phosphoric acid removed became constant. This represents the minimum amount of slag essential to produce a maximum constant yield.

The amount of phosphoric acid contained in the crop at this point was computed in terms of percentage of the amount of slag supplied that pot, correction being made for the phosphoric acid which may have been supplied from the soil, as indicated by the pots to which everything but slag was added. This percentage was selected as representing the available phosphoric acid in the slag, based on the culture of oats.

A method of chemical analysis was then outlined for obtaining a series of varying results on the slag samples. This consisted in making arbitrary digestion under constant conditions excepting one, the variation of which was to give the variation in the results. The solvent selected was hydrochloric acid, the strength being variable; the digestions were made by boiling 2 grams of slag in 100 cc of solvent for fifteen minutes, the sample being added to the boiling liquid and a reflux condenser used. The results obtained were compared with the results found in the culture experiment. The results of digestion which agreed in the corresponding series were studied minutely. The strengths of solvent were very different, but the filtrates were of the same strength. Accordingly it was assumed that the strength of the solvent should be such that the filtrate of the digestion should have the standard acidity above mentioned. This method of valuation gave the finer sample about 1.8 times as much available phosphoric acid as the coarse.

(6) *Miscellaneous work.*—This comprises work on soils that are sent in for analysis from private parties, that done in conjunction with the sugar-beet investigation, and that in cooperation with the Association of Official Agricultural Chemists on soils and fertilizers, as well as potash, phosphoric acid, and ash analysis.

About 350 crop samples were analyzed during the year in conjunction with a study of the soils which produced them.

EDITORIAL WORK.

The publications and miscellaneous printing of the Bureau for the past year were as follows:

BULLETINS.—Nos. 77, Olive oil and its substitutes; 78, The influence of environment upon the composition of the sugar beet, 1902, including a study of irrigated sections; 79, The testing of road materials, including methods used and results obtained in the road-material laboratory; 80, Adulterated drugs and chemicals; 81, Proceedings of the twentieth annual convention of the Association of Official Agricultural Chemists; 82, Paris green spraying experiments; 83, Foods and Food Control—Legislation during the year ended July 1, 1903; 69, Part VI—Digest and index of food legislation to July 1, 1902; 84, Influence of food preservatives and artificial colors on digestion and health—Part I, Boric acid and borax (in press). Total pages, 1,200.

CIRCULARS.—Nos. 13, Extract from the Proceedings of the Association of Official Agricultural Chemists, 1903; 14, Organization of the Bureau of Chemistry; 15, Results of borax experiments; 16, Officials charged with the enforcement of food laws in the United States and Canada (in press). Total pages, 71.

ARTICLES IN 1903 YEARBOOK.—Determination of effect of preservatives in foods on health and digestion; The adulteration of drugs. Total pages, 20.

Total of original matter printed (pages), 1,291.

REPRINTS.—*Bulletins*: Nos 46, Methods of analysis (2); 73, Proceedings of the Nineteenth Annual Convention of the Association of Official Agricultural Chemists; 77, Olive oil and its substitutes; 65, Provisional methods of food analysis; 13, Part 9, Cereals and cereal products; 13, Part 10, Preserved meats; 71, Cider making—total pages, 978. *Miscellaneous*: Farmers' Bulletin No. 52, The sugar beet; Circular No. 8, Official method for the analysis of tanning materials (revised); Yearbook articles, (1) Determination of effect of preservatives in foods on health and digestion, and (2) The adulteration of drugs; separate from Proceedings, 1903 (Bulletin 81), Determination of gliadin and glutenin in flour—total pages, 77.

Total pages of reprints, 1,055.

JOB PRINTING.—A total of 192 orders, distributed approximately as follows: Miscellaneous (announcements of Association of Official Agricultural Chemists, circulars, reference forms, index cards, etc.), 49; stationery, 50; circular letters, 16; labels, 18; forms, 19; blueprints, 40.

There is urgent need for an assistant editorial clerk. The material offered for printing by the Bureau of Chemistry is of exceptional difficulty for editing. It is largely tabular in its nature, giving the results of analytical processes, together with the comments upon these results. The enormous quantity of work in connection with the experiments to determine the effect of preservatives and colors upon the health and digestion gives to the editor a task which is entirely too great for one person. We were fortunately able to secure, through the courtesy of the Division of Publications, expert assistance in the special preparation of the bulletin containing the data of the food experiment. Without this assistance the editor's task would have been almost too great to finish within any reasonable time. There is constantly a large amount of material on hand to be prepared for publication. This may be illustrated by the fact that results of researches carried on during a part of the fiscal year ended June 30, 1903, are still unpublished by reason of inability to put the data in proper form. The urgent need of additional assistance in this line is apparent.

CLERICAL WORK.

The clerical work of the Bureau is of such a varied and miscellaneous character that it is practically impossible to give a detailed statement of the amount performed. During the fiscal year ended June 30, 1904, there have been, in round numbers, about 18,000 pages of typewriting done, of which about 12,000 pages were letters. A large amount of miscellaneous typewriting has been done, such as papers for publication in the scientific journals, material for use in the various laboratories, etc., of which no record was kept.

In addition to the above, 1,823 detentions of imported food products have been made out and 1,269 releases of the same.

A large proportion of the clerical work consists of calculating and tabulating the results of the hygienic experiments, making out reports of analyses and tests, keeping up the various card indexes, revision of mailing lists and other work pertaining to sending out of publications, and a multitude of details connected with the accounts of the Bureau, work of such a character that it is impossible to keep even an appropriate record of the quantity done. It needs no argument to show that the clerical force is entirely inadequate in numbers to handle in a proper manner the work necessary to the conduct of the Bureau.

What has been said regarding the character of the editorial work applies with equal force to the work of the clerical force. The mere

work of taking dictation in the answering of letters and writing out the notes is one of the least important parts of the clerical work in this Bureau. In the preparation of manuscript to accompany the results of chemical research the work is of much more difficult character and requires higher skill than that pertaining to ordinary correspondence. The result of all this is that while we are able, as a rule, to keep our letter writing up to date, there is a great deal of work in the preparation of manuscripts for the editorial clerk which is behind. It is found necessary to detail one of the clerical force for service in connection with the new laboratory in the Appraiser's stores at New York. The wants of the Bureau in this line should receive attention in the near future.

SUPPLIES AND ACCOUNTS.

We are in urgent need of more and better situated space for store-rooms. At present our supplies are scattered over four floors and two buildings. In addition to the great inconvenience of storing and distributing the supplies when so scattered it is almost impossible for one storekeeper to look after them properly and keep an accurate record of their distribution. The working laboratories are gradually encroaching on the space. The volume of the work of the Bureau is increasing and becoming more diversified, which necessitates both larger quantities and a greater variety of supplies.

A systematic record of the quantity of each item of supplies used is being kept and enables us to estimate very accurately the amount that should be purchased for any given period.

Since the establishment of the Drug Laboratory and the Contracts Laboratory a system for testing apparatus and chemicals has been installed. When a supply of chemicals is received a sample of each kind is submitted to the Drug Laboratory, where it is tested and approved before being accepted. Apparatus before being put in stock is examined in the Contracts Laboratory. This system insures a grade of chemicals and apparatus of the required standard.

Formerly a part of the contingent fund of the Department was available for the purchase of certain items for the use of the Bureau. Under the present arrangement these items are now paid for out of the general fund of the Bureau. The amounts thus expended during the year are given in the following statement:

Furniture	\$252. 25	Tickets, car	\$40. 00
Lumber	55. 33	Typewriters	402. 85
Painters' supplies.....	44. 23		
Stationery	143. 47	Total	1, 001. 20
Soap	63. 07		

Following is an itemized statement showing for what purposes the appropriations for the year were expended:

LABORATORY FUND.

Total amount appropriated.....	\$70, 300. 00
Salaries:	
Statutory roll.....	\$14, 800. 00
Miscellaneous roll	34, 660. 46
Special agents.....	1, 834. 00
	<hr/> \$51, 294. 46

Rent -----		\$2,800.00
Requisitions:		
Chemicals -----	\$2,696.98	
Apparatus -----	4,809.78	
Machinery and hardware -----	695.81	
Lumber -----	55.33	
Office supplies and furniture -----	\$11.21	
Miscellaneous -----	538.88	
		9,607.99
Travel and expense letters:		
Food standards committee -----	679.79	
Food inspection—		
H. W. Wiley -----	41.65	
W. D. Bigelow -----	87.41	
Miscellaneous, H. W. Wiley -----	141.25	
Drug laboratory, L. F. Kebler -----	51.77	
Soil and fertilizer, F. P. Veitch -----	68.37	
Special agent, William Alwood -----	21.90	
Insecticide and water, B. H. Smith -----	28.25	
		1,120.39
Miscellaneous letters:		
Hygienic table -----	2,440.00	
Enforcing food law—		
Samples -----	\$694.21	
Cablegrams -----	375.79	
		1,070.00
Reporting meetings of Association of Official Agricultural Chemists -----	100.00	
Food samples, W. D. Bigelow -----	99.92	
Water samples, J. K. Haywood -----	40.00	
Dairy samples, G. E. Patrick -----	9.95	
Sugar samples, Arthur Given -----	24.40	
		3,784.27
Gas -----		576.40
Electricity -----		171.33
Telegraph -----		27.61
Telephone -----		25.00
Express and freight:		
Enforcing food law -----	454.80	
Miscellaneous -----	400.00	
Balance -----		37.75
		\$70,300.00

SIBUP FUND.

Total amount appropriated -----		\$15,000.00
Salaries -----	\$2,652.95	
Contracts:		
Building -----	1,479.78	
Mill -----	2,470.00	
Equipment, etc. -----	7,074.64	
Letters:		
Travel and expenses -----	658.24	
Supplies -----	609.36	
Freight and express -----	35.00	
Balance -----	20.03	
		15,000.00

ROAD MATERIAL LABORATORY FUND.

Amount transferred from road appropriation -----		\$10,000.00
Salaries -----	\$9,443.88	
Requisitions: Apparatus and supplies -----	396.07	
Letters: Travel and expenses -----	98.00	
Balance -----	62.05	
		10,000.00
Receipts from sale of imported food samples not used in analysis for fiscal year ending June 30, 1904 -----		224.64

OUTLINE OF WORK FOR THE FISCAL YEAR ENDING JUNE 30,
1905.

DIVISION OF FOODS.

The work of the Division of Foods will be largely devoted to the experiments on the influence of preservatives on health and to the enforcement of the imported-food law. The former study will occupy the attention of by far the greater part of the force of the Division of Foods for eight months of the year and of a number of the force for the whole year.

Considerable attention must also be given to certain studies of analytical methods for the purpose of enabling us to do more efficient work in the two lines mentioned. Among the methods that must be studied with this in view are those relating to olive oil, vinegar, and the detection of preservatives.

In our past work on the enforcement of the foreign-food law we have found that a large amount of attention was especially demanded by the olive oils brought into this country. In many instances it was noted that oils were imported which contained additions of oils other than olive oil, and had been mixed with a view to being subjected to the analysis ordinarily given to food products. A careful study of all known methods for the examination of olive oil and certain improvements in some of the methods which the Division of Foods was able to make have enabled us to detect forms of adulterations which had previously escaped notice. Our decisions led to several controversies with the manufacturers, and in some cases with commercial chemists, but in every case the first decision of the Department based on these examinations was found to be correct.

Controversies have frequently arisen between some manufacturers of vinegar and officers charged with the enforcement of State laws regarding the purity of certain lots of vinegar. A careful examination into this question has brought the Bureau of Chemistry to the decision that the difficulty was due to the fact that vinegar was made from riper apples than were ordinarily employed, and that for this reason the tests employed which have ordinarily been admitted as standard tests were not applicable. Progress in this study has been made during the past year, and the results obtained up to the present time indicate that we will be able to overcome the difficulty. Considerable time must be devoted to the question, however, before it can be understood from all standpoints.

The question of preservatives is also one that requires much attention. The recent publication of the discovery that salicylic acid is widely distributed in very small amounts throughout the vegetable kingdom, especially in many of the fruits with which it is commonly employed as a preservative, makes it necessary that the amount of salicylic acid which can occur naturally in these fruits be distinctly ascertained in order that a maximum limit for salicylic acid in preserved fruit products may be established. In addition to this it has been claimed during the last few months that certain of the chemicals ordinarily used for the preservation of foods are produced during the process of the canning and sterilizing of the preserved articles. This claim has been publicly made as the result of experimental evi-

dence, although the experiments have not been given in detail. The work must be carefully repeated, as it will necessarily figure in any prosecution based on laws forbidding or regulating the preservation of preserved foods of any kind in hermetically sealed receptacles.

During the early part of the present fiscal year a large number of standard brands of European wines will be examined for the purpose of determining their composition. Considerable attention will be given to the study of methods for the detection of adulterants in foods. This last work will be in collaboration with the Association of Official Agricultural Chemists, for which the chief of the Division of Foods is referee on food adulteration. Some work is also planned for the standards committee of the same association.

The importance of knowing the average chemical constitution of genuine whiskies and brandies, especially in connection with the execution of the law relating to imported food products, is readily recognized. In order that the average character of products of this kind, of American origin, may be ascertained, a request has been made upon the Commissioner of Internal Revenue for 50 samples each of genuine old whisky and brandy and 20 samples each of genuine apple and peach brandy. These samples are taken out of bond under the supervision of an officer of the internal revenue, and are thus guaranteed to be exactly what they are represented to be. A most careful chemical and physical examination, as well as physiological, will be made of these samples in order that a standard of purity may be determined. This work will not only be of value to the officials in charge of the execution of the law relating to imported foods, but will also be of great help to the committee on food standards in formulating proper standards for these products.

A large amount of work will also be done in the Division of Foods during the coming fiscal year in connection with the study of cold storage on the wholesomeness of foods. This work will require a large number of analyses and determinations of heat and nutritive value, as well as direct experiments similar to those conducted on the hygienic table. The actual quantity of work of this kind can not be foreseen, but will depend upon the extent to which we are able to push the investigations in this direction during the fiscal year.

DIVISION OF TESTS.

The usual routine work on the testing of road materials will be carried on as in the past; also several lines of investigation bearing directly on road materials, which in the main will consist in collaborative work on the use of oil and asphaltum for determining the most effective mixtures. Experiments with burnt clays and oil will also be taken up.

Besides the work directly bearing on the testing of road materials, we intend during the coming fiscal year to equip and operate a ceramic laboratory, where clays and other materials used in the ceramic arts may be tested and investigative work carried on. We also propose taking up extensive research work on cements and cement concretes; armored concrete in particular will be investigated, with special reference to its application to agriculture.

CONTRACTS LABORATORY.

It is impossible to foretell just the character of the work which will be required in this laboratory on the request of other Departments of the Government. The collaboration with the other Departments under the authority now existing is rapidly increasing, and it is hoped that Congress will give ample funds to provide for the largest collaboration which the various Departments of the Government may desire. The wisdom of the control so exercised is, it seems to me, undoubted.

During the present year the investigation of canceling inks for the Post-Office Department has been given much attention, and this work should be continued next year, as there is still much to be accomplished in that line. The investigation of typewriter ribbons has been taken up, and results thus far obtained will warrant a more thorough investigation of the subject at an early date. In this connection it seems advisable that the question of record writing inks for use in the various Executive Departments should receive attention as soon as opportunity permits.

The necessity of some control of the chemical glassware furnished to this Department is obvious, and a large amount of work should be done before the specifications are made out for next year to determine the wearing qualities and adaptability to chemical work of the more common glassware.

In addition, therefore, to the routine work of this laboratory, the investigation of canceling inks and of typewriter ribbons should be continued and the examination of writing fluids and of chemical glassware should be taken up during the present year.

INSECTICIDE AND AGRICULTURAL WATER LABORATORY.

This laboratory, in addition to its functions as indicated by its name, has collected during the last two months a representative lot of about 300 cattle foods sold on the American market. The composition of these will be studied during the present year with the especial idea in view of detecting adulterants and improving our knowledge of those compounds now grouped as nitrogen-free extract.

A bulletin on American mineral waters, which has occupied the time of one chemist for nearly a year, will, it is expected, be completed some time during the present year.

Our collaboration with the Bureau of Entomology, which is constantly increasing, will very likely occupy a large part of the time of one of the chemists in this laboratory.

At the request of the office of Irrigation Investigations a study of a large number of irrigation waters from all parts of the rice region of Texas and Louisiana, and from other southern and western regions, will be undertaken.

If time permits, our studies of the effect of soluble arsenical insecticides upon the foliage of various varieties of common fruit trees will be continued.

We will continue to study the composition of new insecticides as they come upon the market and will extend our work so as to cover disinfectants and like preparations.

Since beverages are now included authoritatively under "foods," the examination of waters becomes a part of the regular food work. Imported mineral waters, therefore, will be subjected to inspection the same as other food products, and the work of this inspection, in so far as its chemical character is concerned, will be given to the Water Laboratory. It is advisable, therefore, that the work of the laboratory be extended, in harmony with the suggestions in regard to estimates which are made further along. Efforts are making, moreover, to collaborate with the Hydrographic Division of the Geological Survey in collection of samples of water directly from their sources in order that there may be no mistake in regard to the character of the water as it comes from the springs and before it is possible that it should have received any chemical treatment. These waters will not only be those of a potable character, but also those which it is proposed to use in the irrigation work.

SUGAR LABORATORY.

The work of the Sugar Laboratory during the present year will be directed, with the collaboration of the agricultural experiment stations, to the examination of sugar beets, with reference to the effect of environment on their composition.

Polarizations in the collaborative work with the Treasury Department will be continued in this laboratory.

The examination of certified samples of pure maple sugar and sirup will be continued and completed in order to form a basis of fixing a standard for such products. The chemical work in connection with the experiments in the manufacture of pure table sirup will be done in this laboratory.

In general, the work will be directed to the investigations above mentioned and also to the further investigations of starch in sugar-producing plants as affected by environment. It is hoped that the study of sweet potatoes as a possible source of starch, glucose, and alcohol may soon be taken up in this laboratory.

DAIRY LABORATORY.

The lines of research which at present seem the most important for this laboratory to take up, either alone or in collaboration with the Bureau of Animal Industry, are the following:

(1) A study of the butters produced in the South by heavy feeding of cotton-seed products, since butters so produced bear strong resemblance to adulterated butters.

(2) A study of the condensed milks and milk powders or dried milks manufactured in the United States, and the methods of their manufacture.

(3) Examination of methods proposed for the rapid estimation of the amount of water in butters, methods of possible usefulness at creameries and renovating factories in controlling the water content of the output.

(4) Examination of methods proposed for the detection of moderate or slight adulteration of butters. One of the most pressing needs

of dairy laboratories the world over is a reliable method for detecting such adulteration.

It is hoped that provision can be made for at least making a start upon some of these lines of research during the present year. To make such a start in a creditable manner, and at the same time to carry on the regular work of the laboratory—consisting of the analysis of renovated and other butters for the Bureau of Animal Industry in its work of enforcing the law, the analysis of all dairy foods used at the hygienic table in the food and preservative investigations of the Bureau of Chemistry, and any work required by other branches of the Government, by State institutions, by the Association of Official Agricultural Chemists, or by individuals when the work promises public benefit—will require a laboratory force of four persons—the chief of the laboratory and three assistants.

DRUG LABORATORY.

The investigation of chemical reagents begun in this laboratory, and for which a special committee was appointed last November by the Association of Official Agricultural Chemists, will be continued during the present fiscal year. The publication of a bulletin containing the very interesting results obtained in the examination of chemical reagents by this laboratory will soon be made. The cooperative work of the referee on medicinal plants and drugs at present in progress by the Association of Official Agricultural Chemists is to be prosecuted with vigor. A bulletin will be published embodying the investigations of crude medicinal drugs by this laboratory and the methods employed in this work.

During the past year this laboratory has made 30 analyses of the so-called "medical nostrums" for the Post-Office Department, which is making an effort to weed out some of these obnoxious products by denying the manufacturers of them the use of the United States mails. The analysis of these medicinal products is a new field and involves the necessity of devising methods of analysis. This collaborative work with the Post-Office Department is one of great usefulness, and its continuation will be the means of protecting the public from many misstatements and deceptions.

During the past year the Drug Laboratory made 33 analyses of plants for the Bureau of Plant Industry, 2 for the Department of Justice, and 1 for the Division of Entomology. At least the same amount of work can be expected from these departments during the next year.

The next revision of the United States Pharmacopœia will probably become effective January 1, 1905. This book is the standard of numerous medicinal remedies recognized by most of the State laws, and an investigation along the lines laid down by this volume is contemplated.

Arrangements have been made for the purpose of studying the quality of the various cod-liver oils on the market to determine in what manner the American oil differs from the European, what the causes of these differences are, how they may be eliminated, and to establish a standard for genuine cod-liver oil.

MICROCHEMICAL LABORATORY.

During the present fiscal year the work of this laboratory will be continued on the same general lines as during the past year. Special attention will be given to the micro-chemical study of cereal grains as affected by different environments. The distribution of the starch and protein cells, it is known, is profoundly changed by the different environments in which the grains are grown. The extent and character of these changes will be made a special study.

This laboratory will also assist the Leather and Paper Laboratory in the examination of fibers and in the micro-chemical testing of the same in order to determine their origin.

In connection with the Drug Laboratory work will be prosecuted in the determination of minute quantities of active principles in drugs which are so small as to escape the ordinary methods of determination. This work will consist in the study of their color reactions and crystalline characters.

In general, all micro-chemical work pertaining to any of the divisions or laboratories of the Bureau will be conducted in this laboratory.

PLANT ANALYSIS LABORATORY.

The purposes of this laboratory are the study of the composition of plants and, to a limited extent, of fertilizers. The work will be materially different from that of the Soil and Fertilizer Laboratory.

The laboratory has concluded and presented for publication the results of an eight years' experiment on a study of the condition of available plant food in soils and in pot culture.

As a supplement to the work of the Soil and Fertilizer Laboratory it is the purpose to investigate the composition of economic plants with reference to the plant food contained as an index to the drain upon the soil and means for reducing this drain through a return of the waste products to the soil.

In conjunction with this work it will prove desirable to collaborate with the other Divisions and Bureaus of the Department, especially the Bureau of Plant Industry, in the chemical study of plants. The laboratory will conduct such investigations as may be desired in this direction.

Some of the investigations in which collaboration is contemplated for this year are as follows, the scope and plan being dependent upon the investigations in the Bureau of Plant Industry: Investigation of cereals with reference to the chemistry of their milling, and other properties; investigations of canaigre and other tannin-bearing plants; study of the composition of alkali-resisting cereals; study of the composition of the cotton plant with reference to the effect of environment upon its oil content; in fruit investigations, the chemical examination of the products and changes, with reference to the nutritive chemical and digestive properties; the composition of grasses, forage crops, and other animal foods, as related to their food value; the investigation of hemp as to its chemical composition, with reference to the plant food removed and the conservation of the same in the waste products; methods of retting, the chemistry of the process, and its products.

In addition to the above, the laboratory will conduct pot-culture

experiments on the use of basic slag, with reference to the establishment of a method for determining the value of this product as a commercial fertilizer; an investigation of the composition of the tobacco plant, with especial reference to the heavy drain this crop makes upon the plant food, and methods for replacing this loss through the waste products of the crop as far as possible.

LEATHER AND PAPER LABORATORY.

SCOPE OF THE WORK.

It is proposed to include in the work of this laboratory chemical investigations and analysis of the raw materials and products of tanning, of paper making, and of wood products which are themselves chemical products or the result of chemical processes. This would cover chemical work on tanning materials, leathers, the waste products of tanning, paper-making materials, papers, chemicals and wastes, turpentine, rosin, and the products of the destructive distillation of wood.

GENERAL LINES OF WORK.

It is perhaps a little remarkable that in this country we have no Government research institutions nor testing laboratories devoted to the leather, paper, or turpentine industries. In this the United States is behind the nations of Europe, and with decreasing raw materials there is need of such laboratories. As the raw materials used in these industries are chiefly agricultural products of national importance, it is highly fitting that such work should be done by the Department of Agriculture, and as the foundation processes involved are purely chemical, the work belongs to the Bureau of Chemistry.

TANNING AND LEATHER.—The leather trades, having an invested capital of approximately \$355,000,000, constitute one of the largest industries of the country, and yet we have but little insight into the nature of the various processes and reactions which take place in the making of leather, or of the points at which serious losses do and may occur. The value of the various tanning materials as to the quality and quantity of leather produced is known only in a very general way. Our domestic tanning materials are being used up at a rapid rate, and we are now importing large quantities, a considerable amount of which could be produced at home by the improvement and utilization of some little-known domestic materials.

An examination of the tanning value of the more promising of these materials, such as the western hemlock or the western tanbark oak, both of which contain considerably more tannin than eastern barks, would yield results of immediate practical value, while a thorough examination of the leather produced by various tannages would extend and broaden the work thus started. The losses of weight during manufacture are often a serious matter in the production of leather, and the determination of their nature and the conditions producing them, with methods of prevention, would add thousands of dollars to the value of the products.

The oils used in currying range in price from 22 cents per gallon for mehaden oil to 40 cents per gallon for cod oils, and are so adul-

terated that detection is very difficult; while the causes for the widely different currying powers of these oils is known only in a general way, though that there is a marked difference in their value is well recognized in the finished product.

The quantity of certain tanning extracts imported is steadily increasing, and, owing to the fact that these extracts so closely resemble the tannin-containing extracts which are used in dyeing and come in duty free, there seems to be some effort to import the first mentioned under the name of of the latter extract. Effort should be made to develop tests which will enable us to differentiate with certainty between these substances.

PAPER.—Our well-known pulp woods are being used up faster than they are growing, and as a consequence the demand for new materials has led to efforts to utilize many waste products, among which bagasse, cornstalks, Southern pine refuse, rice straw, and hemp stalks all present exceedingly promising fields for investigations for the purpose.

TURPENTINE.—The continued rise in the price of turpentine, due to the constantly widening field of use and the constantly decreasing supply, has led to two things, viz. the adulteration of the regular article and the recovery by distillation of that contained in the dead trees, sawdust, stumps, and other refuse.

The detection of adulterants is a very difficult problem, as no reliable methods are yet known that enable us to detect with certainty small additions of even the more common adulterants, and investigation along this line is very desirable.

The processes of distillation, both of ordinary spirits and particularly of that from dead wood, are far from economical and are productive of spirits of not the highest grade. The value of the product could be materially increased by a careful investigation of the processes of distillation.

PROPOSED WORK FOR THE PRESENT YEAR.

The following is the proposed scheme of work for the present fiscal year given in detail:

(1) Study of the extraction of tannin from tanning materials, with a view to reducing materially the large losses in this process. From one-eighth to one-third of the tannin contained in bark and other tanning materials is now lost annually.

(2) Study of quick-growing or hitherto but little used tanning materials for the purpose of determining their leather-making value and also their susceptibility to improvement with a view to supplementing our rapidly decreasing materials now generally used.

(3) Investigation and valuation of *degras*, or wool grease, and of methods for the detection of its adulterants.

(4) Investigation of the physical and chemical qualities of various leathers.

(5) Investigation of the chemical and physical properties of the more important kinds of papers and from this and other data the preparation of standard specifications for papers designed for various uses.

(6) Investigation of new raw materials for pulp and paper making and demonstration of the value of such materials.

(7) Investigations of the distillation of turpentine, with particular reference to improving the yield and quality of the product from waste pine.

(8) Investigation of the adulteration of turpentine.

(9) Investigation of the destructive distillation of wood.

The laboratory will hold itself in readiness to cooperate, so far as its facilities will permit, with the other bureaus and divisions of this and other Departments in work which comes within its province.

On many of the subjects outlined above nothing more than the preliminary work can be undertaken this year. Indeed, some of them are so wide in their scope that they will furnish work for several years, and to handle them properly will require additional force, equipment, and supplies.

ESTIMATES FOR THE FISCAL YEAR ENDING JUNE 30, 1906.

I submit herewith the estimates for this Bureau for the year ending June 30, 1906. I call attention first to the fact that I have recommended that there be transferred to the statutory roll a number of chiefs of divisions and laboratories who are now paid from the general fund. This apparently makes considerable increase in the statutory roll, but it is only a transfer from one fund to another. The only increases recommended in the statutory roll are of \$1,000 for the salary of the Chief of the Bureau, \$1,080 for custodian of records and files, and \$1,400 for an editorial clerk. The manifold duties of the Chief of the Bureau and his relations, as chief, to all the Departments of the Government, and his duties in execution of the laws relating to foods, seem to warrant without question the increase in his compensation. The necessity for the editorial clerk has been fully set forth in the body of the report. There is also urgent need of a custodian of records and files.

In order that an idea may be had of the way in which the money asked for is to be expended, the amount for general expenses has been itemized. The amounts asked for are practically the same as the present year, except for the three new laboratories which have just been established. For these special estimates amounting in all to \$19,000 have been made. The amount for supplies, apparatus, etc., is based on the expenditure of the past year, namely, \$12,000. The total amount for general expenses is thus brought up by the \$19,000 estimate for new laboratories to \$96,000.

In the execution of the law relating to imported food products there is first given an itemized statement of the expenditures at the present time of the \$30,000 available for this purpose. I submit an additional estimate of \$16,000 for the establishment of four additional laboratories of inspection, namely, at Boston, Philadelphia, New Orleans, and Chicago, making the total amount required for inspection of imported food products \$46,000.

I submit also special estimates for work, part of which has been authorized by Congress, namely, the investigation of the effect of cold storage upon the wholesomeness of foods, for which Congress

gave no special appropriation. It will require at least \$15,000 to carry out properly the wishes of Congress in this particular.

I submit also an estimate of \$15,000 for an investigation of the sweet potato and yam with reference to their suitability for the manufacture of starch, glucose, and alcohol. This is an investigation which has been asked for repeatedly by the agricultural interests of the Southern States. During the present year we will complete the investigation of the problem of the manufacture of table sirups from sugar cane, for which Congress the present year has given \$15,000. I recommend, therefore, a similar amount to be devoted to the study of the sweet potato for the purposes above mentioned.

The increased estimates as submitted for the Bureau amount to \$48,080. I beg to call especial attention to the fact that these estimates have been made on a basis of actual work which can be done to the great benefit of agricultural science. No item has been given at a larger figure than is necessary with the idea that it will be cut down to a lower sum. I suggest, therefore, that the sums mentioned be asked for without decrease. While the items have been given for the information of those interested, it is suggested that the bill be prepared in substantially the same form as the present law, with one general appropriation for the Bureau, modifying the language to suit the new work provided for and omitting those portions relating to work already accomplished.

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