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U. S. DEPARTMENT OF AGRICULTURE.

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REPORT  
OF  
**THE CHEMIST**  
FOR  
1906.  
BY  
H. W. WILEY.

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[FROM ANNUAL REPORTS, DEPARTMENT OF AGRICULTURE.]



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## REPORT OF THE CHEMIST.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF CHEMISTRY,  
*Washington, D. C., September 1, 1906.*

SIR: I have the honor to transmit herewith the annual report of the work done in the Bureau of Chemistry during the fiscal year ended June 30, 1906, accompanied by a statement of the work proposed for the current fiscal year.

Respectfully,

H. W. WILEY, *Chief.*

HON. JAMES WILSON, *Secretary.*

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### BRIEF REVIEW OF THE YEAR'S WORK.

The activities of the Bureau during the fiscal year ended June 30, 1906, extended over a great variety of investigations connected with the progress of agriculture and the utilization of its products for food and other purposes.

In the dairy industry, the work authorized by law in connection with the Bureau of Animal Industry for the enforcement of the act relating to renovated butter was continued in the investigation of over 800 samples for the purpose of seeing if they complied with the requirements of the law. Many other investigations looking to the improvement of dairy products were also inaugurated. Chief among these has been the study of the effects of cold storage upon the chemical composition of milk and cream. The object of these investigations was to determine the length of time during which such products could be safely kept in cold storage.

Studies looking to the determination of the effect of environment upon the content of sugar in Indian sweet corn were made in the Sugar Laboratory under the supervision of the Chief of Bureau. The almost universal use of this product for food purposes throughout the whole country renders such an investigation of peculiar interest to the consumers as well as to the producers of sweet Indian corn. A single variety of seed was planted over a wide extent of territory from South Carolina to Maine, and the content of sugar in the product carefully determined. At the same time, meteorological data were secured, which are utilized in determining the effect of environment in all of its factors upon the composition of the product. These studies are a continuation of those concluded last year upon the effect of environment on the chemical composition of the sugar beet.

One of the most important results of this investigation has been the determination of the rapidity with which the sugar disappears

from the grains of the corn after the ear is separated from the stalk. Within twenty-four hours after harvest, if exposed to ordinary temperatures, a very considerable percentage of the sugar has disappeared. This has led to the observation that it is necessary to market the product as soon as possible after harvest, and meanwhile to keep it at as low a temperature as can be secured.

Further studies of the same character were undertaken in collaboration with the Bureau of Plant Industry, looking to the improvement of the different varieties of Indian corn by selection, based upon analytical data. In all, over 3,000 analyses were made of cereals in the prosecution of the above investigations. These investigations also include the effect of environment upon the chemical composition of barley as related to the brewing industries and co-operative work on wheats, etc., described in detail under the Cereal Section. While these investigations are not completed, they have gone far enough to show the great value of such studies in relation to practical agriculture.

An important investigation was also begun upon the economic production of alcohol from various raw materials in relation to the production of denatured alcohol for industrial purposes. The object of this investigation was to discover the value of various waste materials of factories—the use of wood, molasses, sweet potatoes, corn-stalks, etc., for the purpose mentioned. This work is certain to prove of immense value to our farmers in developing new sources of income from the increased utilization of such products and by-products. One of the most promising sources of alcohol among these appears to be the waste from corn and other canning factories. At the request of packers in Hoopston, Ill., an agent was sent from the Bureau to cooperate with them in experimental work to determine the value of these wastes. It was found that, roughly speaking, the wastes amounted to 40 per cent of the total weight of corn brought to the factory, not counting the husks as available, though they amount to about one-third of the total weight of the corn. As the result of a long series of tests on the various waste products, it was found that it was possible to produce from them from 6 to 10 per cent of alcohol, with a safe average of 8 per cent, or a yield of 3.2 per cent of alcohol calculated on the total weight of corn hauled to the factory. On account of the expensive machinery and other apparatus required in the manufacture, it is hardly possible that a small factory could engage in the alcohol business, but a large factory could do so with apparent profit, or, where several factories were located within a short radius, by shipping their wastes to a central plant they might be utilized to advantage.

Investigations are also in progress, by a special agent, to determine the causes of spoilage in canned goods, especially corn, tomatoes, and peas, in relation to the chemical changes which occur therein. In this connection the sugar content of the corn is considered, that the question of adding sugar to the canned product may be answered.

The general work of the Sugar Laboratory included the analysis of 585 samples, consisting chiefly of sugar beets, sugar-cane juices and sirups, maple products, and a variety of cereals, malts, and other materials from the various laboratories of the Bureau. The four-year experiment in the fertilization of sugar cane and the experimental work in the production of table sirup therefrom has been



completed, and the final report has been issued as Bulletin 103 of this Bureau. The work of the Sugar Laboratory, which has for several years been conducted under the direct supervision of the Chief of Bureau, will in the future be in charge of a chief of laboratory.

The work in chemical enology on the cultures of yeast for the production of superior ciders was compiled for publication, and during the current year it is expected to extend the scope of the work, the botanical phases of the same to be conducted in connection with the Bureau of Plant Industry, and to organize a laboratory for these special studies.

An important investigation has also been made in collaboration with the Bureau of Plant Industry for the determination of the quantity of hydrocyanic acid (prussic acid) and of starch in cassava. Cassava is one of the most important plants of tropical or subtropical production. The presence of this violent poison, however, in cassava unfits it, as a rule, for human food and also for stock feeding. The object of the investigation was to determine what varieties produce the smallest amounts of hydrocyanic acid and what would be the effect of selection upon their production, the purpose being to procure varieties as free as possible from this injurious substance in order that they might be utilized as food and in the production of starch and products made therefrom. A report on these points has been prepared.

A very important part of the work of the Bureau is that undertaken in the Contracts Laboratory, the object of which is the examination of materials furnished to different Departments of the Government under contract. These examinations, enumerated in detail under the report of the laboratory, were of the most rigid character, and the result of the work has been to secure a much higher quality of material than was formerly supplied under the contract system.

The work in the examination of drugs has been particularly fruitful during the year. A large part of the work has been in connection with the Post-Office Department for the purpose of suppressing traffic in fraudulent preparations transmitted through the mails. As the result of our investigations, a large number of fraud orders has been issued forbidding the use of the mails for the purposes above mentioned. Many other important investigations were also undertaken in the testing of chemical reagents, of oils and essences, and of plant drugs in connection with the Bureau of Plant Industry.

The work in the examination of waters used as beverages has been continued and also the analyses of waters used for irrigation purposes. A bulletin on the "Mineral Waters of the United States" was published during the fiscal year. Studies were made also of the lime-sulphur-salt wash and allied mixtures used as insecticides.

One hundred and fifty-four samples of cattle food were analyzed to determine the quality of the cattle foods sold upon the markets. Important studies were also made of the injurious effects of fumes from smelters upon vegetation, and testimony was given in the courts relating thereto. It is evident that the sulphurous-acid fumes produced in most smelters are of a character to injure vegetation and also animal health in a region very widely extended about the factory. It appears probable that in the near future smelters will be required to convert the sulphurous acid into sulphuric acid or some other substance which will prevent the injuries above mentioned.

Important progress has been made also in the study of tanning materials, especially of the Sicilian sumacs. Studies were made respecting the effect of different tanning materials upon the character, quality, and durability of leather. Investigations of great importance, not only to the various Departments of the Government, but to the public in general, are those relating to the character of paper which is used for preserving public records. Investigations respecting the composition of turpentine distilled from wood and its relation to the ordinary turpentine have been continued.

#### FOOD-INSPECTION WORK.

The extension of the food-inspection work at the ports of entry has been extremely beneficial. The work at all the ports has been increased, especially at New York, Boston, and Philadelphia. The San Francisco earthquake in April destroyed our laboratory at that point, rendering it necessary to temporarily suspend the inspection at that port. The work, however, is soon to be resumed at Berkeley, Cal.

The effect of the food inspection on foreign commerce has been most salutary. In many cases food products which were formerly very generally misbranded are now found to be properly labeled, and there has been a very decided improvement in the quality of imported food products due to inspection. The Division of Foods has also, in addition to the work already mentioned, conducted special investigations into the extent of domestic adulteration of food products and an investigation, in connection with the Division of Pomology of the Bureau of Plant Industry, of tropical and subtropical fruits, as well as of fruits of domestic production.

A very extensive investigation was made to determine the character of distilled liquors, both those imported into the United States and those of domestic manufacture. These investigations have been practically completed, but the results have not yet been published.

The study of the effects of colors, preservatives, and other substances added to foods has been continued during the year, and most valuable data relating thereto have been secured, which are now preparing for publication. The value of this investigation is particularly great because of the fact that the experiments are made upon human beings. The establishment of a Physiological Laboratory for the segregation of all experimental work of this nature will probably be effected during the current year.

The micro-chemical investigations during the year have been extremely fruitful. The microscope has become one of the most valuable adjuncts in the examination of food products and materials used for technical purposes. To this end micro-chemical investigations, including bacteriological examinations, have been made in connection with the other work of the Bureau of Chemistry and extended not only to foods, but also to leathers, papers, and tanning materials. The bacteriological-chemical work has been of extreme importance. This is especially true in connection with the work authorized by Congress for studying the effects of cold storage upon the wholesomeness of food products. Particularly in studying the question of the relative merits of drawn and undrawn fowls when placed in cold storage the bacteriological-chemical examination is

one of vital importance. To this end studies are making to determine whether the bacteria of the intestinal tract migrate to the flesh of the fowl during the period of cold storage; and if so, what chemical changes are produced thereby.

The bacteriological-chemical investigations have extended to a large number of subjects, but have been particularly directed to the chemical changes which take place in milk, cream, and evaporated and condensed milks, and to the general changes of a bacteriological character which foods undergo in storage.

## WORK OF DIVISIONS AND LABORATORIES.

### DIVISION OF FOODS.

The study of the influence of preservatives on nutrition was continued. The plan followed was somewhat different from that previously employed, since the work during the past year was for the purpose of extending the studies in some directions that had not been undertaken in the earlier experiments. Especial attention was given to the study of the nitrogenous bodies in the urine and the influence of the principal food preservatives upon the relative amount of these bodies; also to the various compounds of sulphur in the urine and the relation between them and the nitrogenous bodies.

The study of the composition of fruit with special reference to the changes which take place during the ripening and to the influence of different methods of storing on the composition of the fruit has been continued in collaboration with the Division of Pomology of the Bureau of Plant Industry. In the study of the ripening of fruit particular attention was given to the orange, persimmon (both Japanese and native varieties), strawberry, raspberry, and avocado.

The samples of oranges were obtained in the Department greenhouses. This fruit is peculiar in the fact that at all stages of its growth the total sugars are divided about equally between reducing sugar and sucrose. The marc of the orange is formed very early in its history and remains constant in weight during the growth and development of the fruit. The acids are also formed at an early stage, and apparently increase gradually and slowly in actual weight. The storage of the fruit at all stages of its growth results in slight loss of total sugar, a marked increase of reducing sugar, and a corresponding loss of sucrose. The loss of sugar noted above is to be explained, as in the case of apples, by the consumption of reducing sugar as a result of the respiration of the fruit. The weight of marc remains practically constant, and the weight of acid appears to decrease slowly on storage during the various stages of the development of the orange.

The persimmon was selected largely because of its relatively large content of tannin. In this fruit the sugar was found to consist almost entirely of invert sugar. It was found that the disappearance of astringency coincident with the ripening of persimmons is due not to the disappearance of tannin, but to the fact that the tannin is converted into an insoluble form within certain specialized cells.

The study of the chemical changes occurring in the manufacture of cider vinegar on a commercial scale and the composition of cider and wine vinegar of known methods of manufacture has been continued.

The division has also continued the study of the occurrence in nature of the chemical substances ordinarily used as food preservatives. A number of determinations have been made of the amount of such substances in various fruits. Search was made in the following fruits and vegetables for benzoic acid, with negative results: Malaga grapes, grape fruit, oranges, pineapples (two varieties), carrots, parsnips, cauliflower, rhubarb, and green peppers. Eighty samples of salt from different localities in the United States were examined for boric acid, which was found to be present in all cases in amounts varying from less than 1 part per million to 1 part per 3,500.

The work begun during the preceding year on distilled liquors was continued during the last fiscal year. In all 1,088 samples of whisky, brandy, and rum were examined. The purpose of this work was to secure data for the establishment of standards of composition. The samples examined were mainly of known origin. A large number of samples of whisky and brandy were obtained through the Bureau of Internal Revenue, which supplied full information regarding their manufacture. Samples of French brandy were also secured, with authoritative information regarding their manufacture. Additional samples were purchased in the open market and taken at the port of entry, in order to determine the character of liquors commonly sold and imported for sale.

Methods for the examination of flavoring extracts have been extensively studied, and a series of extracts have been prepared for the purpose of testing the methods and for use as standards. A systematic examination of the flavoring extracts sold in the retail trade is in progress.

Complaint has repeatedly been made that a considerable portion of the rice consumed in the country is so modified by manufacture as to decrease its nutritive value, and that certain substances, such as talc and similar products for coating and paraffin and oils for glazing, are commonly employed. A series of samples of unhulled rice has been obtained and prepared for examination in the laboratory. Samples of known origin from various mills have also been secured, and an extensive series of samples has been purchased in the open market and taken from shipments of imported rice. The examination of these samples is now in progress.

The Department has taken the attitude that edible oils imported from districts famous for the production of olive oil will be understood to be represented as olive oil unless otherwise designated. Certain importers have questioned the propriety of this decision, on the ground that olive oil is not the leading edible oil of the countries mentioned. In order to determine this matter, 450 samples of edible oils were secured from the retail trade by the American consular officers in the olive-oil producing countries of Europe. These samples are now under examination.

Attention has also been given to the study of methods for the examination of foods. Although much progress has been made in the last ten years in the methods employed for studying the nutritive value and the purity of foods, much yet remains to be done. Manufacturers do not fail to take advantage of their knowledge of methods employed by official chemists in judging of their products and very often only attempt to place on the market articles that will withstand examination by those methods. An important part of the

work of the food-inspection chemist, therefore, is to keep abreast of methods that have been suggested and to elaborate new methods or to modify old ones so as to make them applicable under the new conditions that constantly arise. The work in this line has been undertaken largely by the requirements of the regular work of the Division.

A study of methods for identifying and determining the relative amount of nitrogenous compounds in meat extracts and in other foods was continued and the results reported to the Association of Official Agricultural Chemists. In this field material progress was made in the method employed for the separation of peptones from the so-called meat bases. It is believed that in the data given in earlier reports the percentage of meat bases was relatively too high and the percentage of peptones correspondingly low.

A study of the methods for the detection and quantitative determination of preservatives in foods was continued. The quantitative determination of these preservatives is a subject to which careful attention has only been given very recently, but its necessity is becoming more obvious as our information in regard to the occurrence of these substances in nature, as noted above, is extended. During the last year special attention has been given to the determination of salicylic acid and fluorids, and progress has been made in both.

The greater part of the energy of the Division of Foods has been devoted during the past year to the enforcement of the imported-food law. Port laboratories have been established in Chicago, Boston, Philadelphia, and New Orleans. Much time has been occupied in equipping these laboratories, and their organization has resulted in a largely increased efficiency in the enforcement of the law. The following is a tabular statement of the shipments examined in the enforcement of the law:

*Number of imported food samples received by the Bureau of Chemistry during the year ended June 30, 1906, with results of inspection.*

Result of inspection.	Result of inspection.											
	Wine.	Meat.	Olive oil.	Vegetables.	Fruit products.	Beverages.	Spices and condiments.	Fish in oil.	Vinegar.	Egg products.	Miscellaneous.	Total.
Found contrary to law:												
Released without prejudice to future decisions in similar cases.....	31	6	3	124	59	87	62	18	16	11	114	531
Admitted after the labels were changed to harmonize with the law.....	1	2	1	81	85	86	48	40	42	....	191	577
Required to be reshipped beyond the jurisdiction of the United States or destroyed.....	6	8	....	11	23	17	15	21	13	8	16	138
Total contrary to law.....	38	16	4	216	167	190	125	79	71	19	321	1,246
Found to comply with the law.....	395	85	313	457	744	470	332	743	112	162	690	4,503
Total number of samples examined from invoices detained.....	433	101	317	678	911	660	457	822	183	181	1,011	5,749
Samples taken from invoices not detained...	....	....	....	....	....	3	3	32	2	4	5	49
Samples inspected on the floor of the examiner's room in appraiser's stores and invoices not detained.....	....	....	....	....	....	....	....	....	....	....	....	8,735
Shipments gone into consumption before receipt of our notice to relabel.....	....	....	....	....	....	....	....	....	....	....	....	10

<sup>a</sup>Beginning October 1, 1905.

It is only when it is remembered that each of the inspections made is of a shipment of goods usually of considerable magnitude that the full meaning of the work can be understood. A simple inspection of the label is often sufficient to indicate whether or not the goods are in compliance with the law. For instance, canned peas have been found to be free from extraneous matter except copper, which is added for coloring. If the presence of copper were declared on the label, it is evident that a chemical examination of the sample is not necessary. Shipments, therefore, which are inspected merely with reference to the label and from which samples are not taken to the laboratory are entered separately in the tabular statement just given. Attention should be called to the fact, however, that at the beginning of the year a record was not made of the shipments which were merely inspected for label, and that the record given in the table begins with October 1, 1905.

A beginning has been made on the study of the effect of cold storage upon the healthfulness of foods. Fresh eggs, chickens, and quails prepared according to ordinary market conditions have been placed in cold storage, and samples are examined at suitable intervals.

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 Division of Foods examined 5,798 samples of imported foods, 222 samples relating to the hygienic table, and 2,529 miscellaneous samples, making a total of 8,549 samples.

#### DAIRY LABORATORY.

During the year 818 samples were examined in this laboratory. The greater part of this number represent work done either for the Dairy Division, Bureau of Animal Industry, in the enforcement of the renovated-butter law or in cooperation with that division in an extended study of American cheese.

The total number of samples of butter, milk, and cream examined for the Dairy Division was 569, of which over 500 were samples of butter examined with reference to possible violation of the butter laws. The facts thus obtained have been used by the Bureau of Animal Industry in enforcing the law and in educating the butter renovators and creamery-butter makers to the necessity of a more strict control, especially of the water content of their product.

In the cheese investigation carried out cooperatively with the Dairy Division 146 samples, representing different ways of making, different ages, and different temperatures of ripening, were not only analyzed, but also studied in regard to their comparative digestibility by the method of artificial digestion in solutions of pepsin and pancreatin. The results of this investigation are now preparing for publication.

The remaining 103 miscellaneous samples of dairy products and dairy materials were received from various sources, and include samples of condensed milk, dried milk or milk powder, human milk, butter colors, and ice cream, in addition to 28 samples of cheese, used in studying methods for determining the comparative digestibility of different cheeses by artificial means.

Within the past year the chief of this laboratory has made his second report as referee on dairy products to the Association of Official Agricultural Chemists, a report which deals with a large amount of research work and is published in the Proceedings of that association for 1905.

#### MISCELLANEOUS LABORATORY.

During the last year the Miscellaneous Laboratory has examined 695 samples. Some of these analyses were made as part of the work in special investigations of the laboratory which will be published later, and part were performed for other Bureaus and Divisions of this Department and other Departments of the National Government.

The work of the Miscellaneous Laboratory naturally divides itself into five different sections, which will receive separate treatment. These sections are as follows: First, waters; second, insecticides and fungicides; third, miscellaneous; fourth, cattle foods; fifth, the study of the effects of trade wastes on agriculture.

#### WATERS.

The water section has during the last year examined 31 samples of irrigation waters for the office of Irrigation and Drainage Investigations, and has made various chemical studies of special subjects that were of particular interest to that office. Forty-one complete mineral-water analyses were also made. The majority of these analyses were for the purpose of continuing a study of American mineral waters from source, which has occupied the attention of this section during the last year or two. Of sanitary examinations 44 have been made, the majority of which will be published.

#### INSECTICIDES AND FUNGICIDES.

The insecticide and fungicide section has examined 39 samples of insecticides. Twenty-seven of these were made at the request of the Bureau of Entomology or the Bureau of Plant Industry. Twelve samples were examined for special investigations and the results will be published later. This section has completed, during the past year, two very important insecticide investigations which are now ready for publication, viz, chemical studies of the lime-sulphur-salt wash and closely allied mixtures, and methods of analysis of lead arsenate. A paper on the Hydrogen-Peroxid Method of Determining Formaldehyde, and the Report of the Referee on Insecticides and Fungicides for the Association of Official Agricultural Chemists, were also submitted by this section.

#### MISCELLANEOUS.

The miscellaneous section has charge of the work of a miscellaneous character that comes into the Bureau of Chemistry, and has during the last year examined 200 samples. These samples are received from nearly all the Departments of the National Government, and many of the Bureaus and Divisions of the U. S. Department of Agriculture.

## CATTLE FOODS.

The cattle-food section has examined 154 samples. Forty of these examinations were made in the interest of a study now making by this laboratory in collaboration with the Office of Farm Management, Bureau of Plant Industry, on forage crops of the arid and semiarid West; 20 were of a miscellaneous character, and 94 were more or less complete analyses of malts and barleys, the results of which will be published.

A considerable portion of the time of one member of the cattle-food section, who was appointed by the Association of Official Agricultural Chemists as referee on cattle foods, has been given up to investigations of methods of analysis of this group of substances. This section has almost completed the analytical work of a study that has been in progress for the last two or three years on the composition of cattle foods sold on the American market, and will shortly present the results of the investigation for publication.

## TRADE WASTES.

The section for the study of the effects of trade wastes on agriculture has made two very important investigations during the last year. One of these required the examination of 186 samples and was made at the request of the Bureau of Forestry. The results of the work will be published by that Bureau under the title of "Injury to Vegetation by Smelter Fumes Near Ducktown, Tenn." The results of the other investigation have been published in the *Journal of the American Chemical Society* under the title of "Copper Salts in Irrigating Waters."

## DRUG LABORATORY.

During the past fiscal year 553 samples of material were examined in this laboratory. Of this number 293 were chemical reagents, 121 proprietary medicinal remedies, 50 samples of whisky oils and essences, 37 samples of hops, 27 plant products for the Bureau of Plant Industry, 9 articles for the Bureau of Entomology, and 16 samples of a miscellaneous character.

## CHEMICAL REAGENTS.

The chemicals examined were those regularly employed in chemical analyses in the Bureau of Chemistry, delivered on contract and special purchases. The objects of the examinations during the past year were the same as recorded in last year's report—i. e., to insure the receipt of reliable chemicals for analytical work, to secure data upon which standards may be based, and to place competitors on a uniform basis. The kinds of chemicals used and purchased were the best of their respective types. It is necessary again to state that a goodly proportion of the chemicals delivered were of inferior quality, but it is also true that the proportion of rejections during the past year was smaller than in the previous years. Dealers are beginning to understand that it is necessary to label their goods in conformity with the contents of the packages, but this is not as yet generally recognized. Many chemicals are still labeled to indicate a



high grade of goods when, as a matter of fact, the chemicals are of inferior quality. The designation "Chemically pure" is markedly misleading at present, but the tendency is to deliver goods which conform more nearly to what this term should represent.

The committee on the testing of chemical reagents of the Association of Official Agricultural Chemists, of which the chief of the Drug Laboratory is the chairman, in its second report again set forth the necessity of carefully testing chemical reagents before they are employed for any accurate analytical operations. The committee is continuing its work, and the Drug Laboratory now has in its possession the analytical data for approximately 1,000 chemicals. These results and the standards required for the various chemicals will be published.

#### PROPRIETARY MEDICINAL REMEDIES.

Of the 121 proprietary medicinal remedies analyzed, 49 were examined for the purpose of gaining information of a general character, 22 were examined at the request of Members of Congress for information in connection with the food and drugs act, and 29 were examined in cooperation with the American Medical Association. The Post-Office Department also asked during the course of the year that investigations be made of 21 remedies of a questionable nature, which, through their advertising literature, were heralded as being capable of curing all forms of disease. The composition of these various remedies and the means employed for the purpose of effecting their distribution were unique in a great many cases. Some of them contained strychnine as one of the active ingredients. The virtue of one of the "consumption cures" was claimed to reside in *cannabis indica*, but an examination showed that the most active part of the medicine was morphine. Another "consumption cure" consisted of an ordinary tincture of ferric sulphate, with a very small amount of manganese sulphate. It was claimed to be a "positive and recognized cure" for this disease. Some of the results obtained at the instance of the American Medical Association have been published in the official organ of the association.

#### WHISKY OILS AND ESSENCES.

Fifty samples were analyzed for the purpose of determining approximately the composition and nature of the agents employed in preparing artificial liquors of various ages from raw spirits. The work presented many difficulties, and some of the problems are yet unsolved.

#### HOPS.

Thirty-seven samples of hops for export trade were examined for the presence of arsenic in order to ascertain whether the amount of arsenic was sufficiently low to permit entry of same into England under the rules and regulations of that country. Twelve samples were virtually free from this impurity, 9 contained an excessive amount—that is, more than 0.01 of a grain of arsenic to a pound of hops—while the remaining samples contained from a trace to less than the limit specified by the English regulation.

## PLANT DRUGS.

The plant drugs examined during the past year consisted almost entirely of those submitted by the Bureau of Plant Industry. These samples were examined as to the amount of active constituent present. The second report of the chief of the Drug Laboratory, as the referee on medicinal plants and drugs of the Association of Official Agricultural Chemists, was presented at the twenty-second annual convention. The report clearly indicated the necessity of more careful cooperative work along this line before it can be definitely stated that we are in possession of a method that will be satisfactory in the hands of the average analyst for the determination of morphine in opium. The work at present consists in the testing of the various analytical methods of recognized merit for estimating the various active constituents of opium, cinchona bark, ipecac, and nux vomica.

## APIARY PRODUCTS.

The Bureau of Entomology requested an examination to be made of several samples of honey—first, for the purpose of ascertaining whether the honeys contained any poisonous agents which could have been derived from the sources from which the honey was collected, and, second, an examination of samples of honey for the purpose of ascertaining whether any poisonous or deleterious substance has been mingled with the bee food. It was also considered advisable to examine the bees to ascertain whether or not the poisonous agent might possibly be disseminated in the tissue of the bees themselves. It was found that the honey was contaminated with an alkaloidal substance, but no trace of the poison could be found in the bees. An analysis of the plant from which it was supposed the bees collected the honey was also made, and it was found that the suspected plant contained a considerable quantity of a poisonous body similar to the one found in the honey. One sample of honey which was supposed to have been produced as the result of an unwholesome food was found to be filled with yeast plants. Another sample was found to be pure as far as could be ascertained by the ordinary chemical methods.

## MISCELLANEOUS.

The alcohol content was determined in two samples of medicinal remedies for the Treasury Department. A sample of candy was analyzed for the Department of Commerce and Labor. Two samples of sulphur were tested for the presence of arsenic for the Bureau of Plant Industry, the object being the location of the source of the arsenic found in the hops referred to above. Sulphur is used for the purpose of bleaching hops, and it is supposed that by this means the arsenic contained in the hops would contaminate this commodity. The remaining miscellaneous samples consisted of headache powders, opium, beeswax, etc.

## COD-LIVER OIL.

The investigation begun two years ago on cod-liver oils was continued during the past year. Authentic samples of cod-liver oil had been collected from various fishing ports throughout the world. The

prime object of the investigation is a comparative study of the American and Norwegian oils, both chemically, medicinally, and commercially, with a view to ascertaining whether or not any good reasons exist for the present discrimination against American oils by the medical profession, and, if so, what they are and how they can be removed. The work is done in cooperation with the Division of Foods of the Bureau of Chemistry and the United States Bureau of Fisheries. Most of the chemical work bearing on the composition of the oils has been completed. The experiments relative to the keeping qualities of the oils are in progress. Analyses to ascertain whether or not the ordinary cod-liver oil on the market contains any medicinal agents which could exert a beneficial influence in disease, excepting that of the nutritive value of the oil itself, are now in progress. It has been found that the ordinary chemical methods generally employed for the purpose of differentiating cod-liver oils from other liver oils derived from marine sources are virtually worthless. Almost all the oils possess similar reactions; in fact they approximate one another so closely that it is impossible for even an expert to differentiate between them.

#### DRUG LEGISLATION.

This subject was referred to in last year's report, and the reasons for collecting the laws into bulletin form were given. The bulletin contains all Federal and State laws (including the National food and drugs act) bearing on drug adulteration and the proper labeling of the same.

#### CONTRACTS LABORATORY.

During the past year there were examined in this laboratory 470 samples, in addition to the testing of about 500 samples of whisky for coloring matter. A very large part of the work of the laboratory has been done for other Departments, as the following summary will show:

	Number of samples.
War Department.....	69
Navy Department.....	19
Interior Department.....	65
Treasury Department.....	36
Post-Office Department.....	73
Department of Commerce and Labor.....	1
Department of Agriculture, Board of Awards.....	59
Government Printing Office.....	73

The character of samples analyzed was also quite varied, comprising lubricating oils, pigments, glues, glycerin, inking pads, inks, soap, face powders, coal, glassware, disinfectants, coffee, and numerous other miscellaneous substances. The routine work, as shown by these samples, is so varied and extensive as to consume the greater part of the time.

Several investigations of methods have been conducted and results published in scientific papers and bulletins, including work on writing inks, typewriter ribbons, reducing sugars, and artificial colors in whiskies.

## PLANT ANALYSIS LABORATORY.

The cassava investigations in collaboration with the Bureau of Plant Industry have been continued. Work was conducted at Biloxi, Miss., in which a series of about 100 plants was studied with reference to the relation of seedlings to the parent plant in the development of seedling varieties. After this the work at Miami, Fla., was continued, in which variety studies were made, about 250 plants being examined.

Experiments were conducted with reference to putting the crop in a marketable condition before leaving the farm, in order that the producer may not be dependent upon the starch mill as the only market. To this end some practical experiments were made in drying the product, which demonstrated the feasibility and economy of the process.

Upon the dried product considerable time has been spent in a study of its feeding value and the possibility of making a second grade starch by dry milling, with particular reference to its use as a material for the sizing of cotton goods and yarns. Also, experiments on cassava are conducting with reference to the manufacture of alcohol as a product to be denatured and used in the arts.

During the year complete analyses were made of 36 tobacco samples, and a series of experiments on the burning qualities of tobacco was conducted. These tests were on the raw product, in which the mechanical conditions were reduced to uniformity. For this purpose the samples were reduced to a powder and raised to a constant moisture content, then made into briquettes by means of an hydraulic press, after which they were burned under uniform conditions.

Fifty samples of crops, collected several years ago in a study of the relation of pot culture to plot culture, and 16 samples of oats grown in a series of experiments in the study of basic slag, were analyzed.

The study and tabulation of many data in hand completed the year's work.

## CEREAL SECTION.

The cereal section was organized in 1904 with the purpose of collaborating with the Bureau of Plant Industry, principally along the following lines: (1) To improve the quality of wheat grown in this country; (2) to study the effect of varying climatic conditions on newly introduced varieties of grain; and (3) to study the changes in chemical composition which our own wheats undergo when growing in different localities.

More specifically the work of the section is as follows:

(1) The study of the deterioration of wheat, or the production of white spots, thus making the grain less glutenous. This study is being carried on both in greenhouse pot experiments and in the field in connection with the Colorado Experiment Station.

(2) The influence of fertilizers, especially phosphate salts, on the gluten content of wheat. This experiment is being conducted in collaboration with the Tennessee Experiment Station.

(3) The influence of a preceding legume crop on the gluten content of wheat, conducted in collaboration with the California Experiment Station at Modesto.

(4) Several experiments (so-called "triangular experiments") have been begun, the object of which is to grow a sample of grain from the same source at three different points (South Dakota, Colorado, and Tennessee, for example) in successive years, and also to grow a portion of the crop from each point at each of the other two points. These experiments will give a check on the influence of climate and of seed.

(5) The work reported last year on the protein, phosphorus, sulphur, and lecithin content of barley and malt was continued, to determine whether these constituents exert any influence on the quality of the beer produced therefrom.

(6) Experiments are also under way in collaboration with the Tennessee, Kansas, and Nebraska experiment stations, on the influence of the date of planting and the rate of seeding on the composition of cereals.

In carrying out these experiments it is necessary to make determinations of water, ash, phosphoric acid, fat, fiber, pentosans, sugars, gluten, total protein, weight per 1,000 kernels and weight per bushel, etc., and 2,626 such determinations have been made during the past year. In addition to these, 490 samples of food and excreta were examined in connection with a metabolism experiment conducted in feeding phosphorus to rabbits and dogs. The results of this experiment will appear in the *Journal of Biological Chemistry*.

The work on the Swedish Select oat, in cooperation with the office of Grain Investigations of the Bureau of Plant Industry, has been continued. The investigation embraces a study of the feeding value of a large number of samples, mainly of introduced varieties, of grains especially characterized by drought and rust-resistant properties. In addition to the oats the study includes barley, rye, emmer, einkorn, proso, and sorghum. The individual samples number between 500 and 600, and the usual analyses for feeding stuffs are made.

Special research work has also been conducted, including a study of the protein constituents of wheat and flour and other constituents considered in their relation to the keeping properties and aging of flours and the quality and value of bread.

#### LEATHER AND PAPER LABORATORY.

##### TANNING MATERIALS.

The analytical work on Sicilian sumacs was completed about the end of the last calendar year, and as all the calculations have now been made the results are being prepared for publication as rapidly as possible. The results show conclusively that somewhat less than one-half of the samples were more or less adulterated, chiefly with lentiscus, while some were adulterated with sumac stems and other foreign materials. The investigation shows that adulterations may be detected both from the chemical analysis and from microscopic examination. The percentage of tannin and the color of the liquor made from the sumac are essential features of sumac examination from the tanner's point of view.

## LEATHER.

There has been much complaint abroad that our leathers are heavily adulterated and weighted with worthless materials. Publication of these facts has considerably injured our export trade in certain leathers, and samples of these leathers are being collected to determine the truth of the statement as well as to determine whether our leathers are inferior to foreign leathers in this respect.

## PAPERS.

Investigations on book and envelope papers, with particular reference to the needs of the public service, have been conducted during the past year, and it is hoped to complete this work during the current calendar year. A large number of envelopes, postal cards, stamped envelopes, and stamp papers have been examined and analyzed during the year for the Post-Office Department, and assistance has been given in revising the specifications for these classes of paper, so that they are more definite than before and will better secure the interests of the Government—in fact, a marked saving has already resulted from the work along this line.

## WOOD TURPENTINE.

A large number of the wood turpentine plants of the South were inspected and data collected with regard to the yields of the various processes, cost of materials and of operation, availability of raw material, etc. At the same time large samples of turpentine, prepared by the typical processes, were collected, and with the cooperation of two varnish makers varnishes were prepared from these in order to determine the value of wood turpentine for the manufacture of high-grade varnishes. As soon as sufficiently aged these varnishes will be tested practically and in the laboratory and a report of the results prepared. Samples of wood turpentine produced by various processes have also been collected for analysis. A small retort has been installed and different methods of recovering turpentine from wood are studied.

## DESTRUCTIVE DISTILLATION OF WOOD.

The wood-distillation centers of New York and Pennsylvania were visited and information collected with regard to the status and needs of this chemical industry and cooperative experiments arranged to show the yield of valuable products and the quantity of each produced at different periods of the distillation. These experiments are planned to form the foundation for research work looking to the material increase of valuable products now obtained.

## MISCELLANEOUS WORK.

This character of work has occupied a great deal of time during the past year. A number of fertilizers, soils, and other materials were referred to this laboratory from various sources. In addition to this a considerable amount of preliminary work was done in cooperation with other laboratories of the Bureau in making the beers to be used

in experimental work and in organizing the cold-storage investigation under the direct supervision of the Chief of Bureau. The work of the Association of Official Agricultural Chemists and of the American Leather Trade Chemists on tanning materials and fertilizers has been participated in by this laboratory, and much time devoted to the study of methods.

The number and character of samples received in the laboratory during the year are shown in the following table:

Papers .....	450
Tanning materials and leathers.....	50
Turpentine and woods.....	14
Beers .....	83
Miscellaneous .....	47
Total number of samples indexed .....	644

#### MICROCHEMICAL LABORATORY.

As in previous years the work of this laboratory has been conducted chiefly in cooperation with the other laboratories, a total of 1,067 examinations having been made.

In connection with the imported-food work there have been examined in collaboration with the Division of Foods samples of cocoas, mustards, and other spices, as well as a few confections. For the investigations upon fruit, microscopical examinations were made of persimmons and the alligator pear, making a total of 173 examinations.

The microscopical work upon cattle foods begun during the previous year has been completed, 404 examinations having been made for the Miscellaneous Laboratory, and the results will be prepared for publication during the coming year.

In collaboration with the Contracts Laboratory there have been examined carbon papers and typewriter ribbons. In connection with the work of that laboratory for other branches of the Government service, microscopic examinations have been made of a few talcum powders and dextrins, giving a total of 79 examinations.

A large number of imported sumac samples have been examined for the Leather and Paper Laboratory to determine the extent and nature of adulteration. There was also examined a number of paper samples for the Post-Office Department and the Government Printing Office. In fact, the larger part of the work upon papers during the past year has been on samples submitted by the Post-Office Department, and that the work is recognized to be of importance is shown by the fact that the number of samples submitted during this period has greatly increased over that of previous years. In connection with the work upon papers there have been carried on some investigations upon a method for the estimation of the percentages of pulp entering into papers. This involved the making up of a large number of composite pulps which were made the basis of the work. Altogether 248 examinations were made for this laboratory.

In connection with the work of the Drug Laboratory on fraudulent medicinal preparations for the Post-Office Department, 44 samples were examined to determine, by their structural nature, the kinds of material used, especially starches and powdered plant and glandular tissues.

In connection with the investigations of the cereal section the biological analysis of 130 barleys has been made.

The miscellaneous work of the laboratory includes the examination of certain rices, starches, fibers, buckwheat flours, and similar substances. An investigation concerning the identification of cocoa starch in the presence of common adulterants was carried out during the first part of the year. The results are published in the report of the Association of Official Agricultural Chemists for the meeting of 1905.

During the year the chief of the laboratory collaborated in the preparation of the manuscript for Bulletin 100, entitled, "Some Forms of Food Adulteration and Simple Methods for their Detection," which was published in the latter part of the year. The preparation of sets of samples illustrating pure and adulterated food materials, which was begun last year, was completed, and the sets were distributed or loaned to persons and teachers interested in foods and their composition.

There have been prepared during the year 100 photographic negatives, the most of which were photomicrographs, and included additions to the collection of photographs of starch, persimmon tannin cells, plant crystals, and diatoms from agar-agar, besides certain spice photographs.

In October, 1905, a bacteriological chemist was appointed and assigned to the Microchemical Laboratory. The following is a synopsis of the work accomplished since that time, the collection of the apparatus and other equipment for bacteriological work having consumed much time: The laboratory work included the bacteriological examination of 17 samples of water; 31 cans of condensed milk and infant foods; 10 petri plates containing colonies from milk to be identified; testing germicidal value of 17 disinfectants; one-half dozen fresh eggs; 2 cold-storage quail; 1 fresh chicken; 1 specimen watercress; 2 samples imported egg yolk; 1 prickly pear; 2 specimens cold-storage beef; 2 samples ice; 2 samples milk; 1 sample sugar cane; 1 analysis of air; 2 samples beer; 1 liquid peptonized food, and 1 cream puff. Some idea of the amount of work required in making these examinations can be obtained from the fact that more than 200 species of organisms were isolated and identified.

#### CLERICAL WORK.

The amount of clerical work performed in the Bureau during the fiscal year ended June 30, 1906, is summarized as follows:

Approximate number of typewritten letters.....	16, 600
Approximate number of typewritten pages other than letters.....	4, 000
Requisitions .....	1, 226
Accounts audited.....	1, 600

The above tabulation does not include a large number of circular letters, a vast amount of work on the various card catalogues of the Bureau, or the work of receiving and disbursing supplies.



## PUBLICATIONS.

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

## NEW PUBLICATIONS.

Bulletins: No. 91, Mineral Waters of the United States, 100 pages; No. 97, Studies on Peaches, 32 pages; No. 98, Drug Legislation in the United States, 217 pages (in press); No. 99, Proceedings of the Twenty-second Annual Convention of the Association of Official Agricultural Chemists, held at Washington, D. C., November 16, 17, and 18, 1905, 211 pages; No. 100, Some Forms of Food Adulteration and Simple Methods for their Detection, 59 pages; No. 69, Parts I-IX, Foods and Food Control, revised to July 1, 1905, 785 pages. Total, 1,408 pages.

Circulars: No. 10, revised, Methods of Analysis of Insecticides and Fungicides, 11 pages; No. 14, revised, Organization of the Bureau of Chemistry, 16 pages; No. 16, revised, Officials Charged with the Enforcement of Food Laws in the United States and Canada (April 1, 1906), 29 pages; No. 19, revised, Methods for the Detection of Renovated Butter, 3 pages; No. 24, Analysis of the Mexican Plant *Tecoma mollis* H. B. K., 6 pages; No. 25, Coloring Matters for Foodstuffs and Methods for their Detection, 40 pages; No. 26, Extracts from the Proceedings of the Association of Official Agricultural Chemists, 1905, 16 pages; No. 27, Cooperative Work on Fats and Oils, A. O. A. C., 1906, 6 pages; No. 28, Provisional Methods for the Determination of Food Preservatives as authorized by the Association of Official Agricultural Chemists, 1905, 13 pages; No. 29, Changes in Provisional Methods for the Analysis of Foods and additions thereto, from 1902 to 1905, 20 pages; No. 30, Changes in Official Methods of Analysis and Additions thereto, 1899 to 1905, 28 pages; No. 17 of the Secretary's Office, Standards of Purity for Food Products, 7 pages. Total, 195 pages.

Food Inspection Decisions: Nos. 26-39, 15 pages.

Articles in 1905 Yearbook: Table Sirups, 10 pages; Formaldehyde, Its Composition and Uses, 6 pages. Total, 16 pages.

Unnumbered circulars: Standard for Honey, 1 page; Outline of A. O. A. C. Work on Drugs, 1905, 3 pages; Tables for Calculating Reduction of Cuprous Oxid to Copper, etc., 2 pages; Tables for Calculating Percentage of Alcohol, 2 pages; Preliminary Report on the Unification of Terms for Reporting Analytical Results, 16 pages; Cooperative Work on the Unification of Terms for the Reporting of Analytical Results, A. O. A. C., 1906, 2 pages; Suggestions to Importers, March 10, 1906, 1 page; Standards of Purity for Food Products, Tentative Draft, May 29, 1906, 4 pages; Outline of Cooperative Work on Drugs, A. O. A. C., 1906, 4 pages. Total, 35 pages.

Total number of pages of original matter prepared for publication, 1,669.

## PUBLICATIONS REPRINTED.

Bulletins: No. 13, Part 10, Preserved Meats; No. 46, revised, Methods of Analysis, etc.; No. 62, Proceedings of the Seventeenth Annual Convention, A. O. A. C., 1900; No. 64, The Influence of Environment upon the Composition of the Sugar Beet, 1900; No. 65,

Provisional Methods for the Analysis of Food (2); No. 66, Fruits and Fruit Products. Chemical and Microscopical Examination; No. 69, Parts I to VIII, Foods and Food Control; No. 71, A Study of Cider Making in France, Germany, and England, etc.; No. 73, Proceedings of the Nineteenth Annual Convention, A. O. A. C., 1902; No. 74, The Influence of Soil and Climate upon the Composition of the Sugar Beet, 1901; No. 78, The Influence of Environment upon the Composition of the Sugar Beet, Including a Study of Irrigated Sections, 1902; No. 80, Adulterated Drugs and Chemicals; No. 81, Proceedings of the Twentieth Annual Convention, A. O. A. C., 1903; No. 82, Paris Green Spraying Experiments; No. 84, Part I, Influence of Food Preservatives and Artificial Colors on Digestion and Health: I, Boric Acid and Borax; No. 88, The Chemical Composition of Apples and Cider; No. 90, Proceedings of the Twenty-first Annual Convention, A. O. A. C., 1904; No. 92, The Effect of Water on Rock Powders; No. 93, Experiments in the Culture of Sugar Cane and Its Manufacture into Table Sirup (2); No. 95, The Influence of Environment upon the Composition of the Sugar Beet, 1903; No. 96, The Influence of Environment upon the Composition of the Sugar Beet, 1904, etc. Total number of pages in bulletins reprinted, 3,376.

Circulars: No. 15, Results of Borax Experiment (2); No. 22, Cooperative Work on the Titer Test, etc.; No. 23, Methods for the Examination of Maple Products. Total number of pages, 78.

Food Inspection Decisions: Nos. 1-25; No. 26 (2); Nos. 27-32. Total number of pages, 39.

Miscellaneous: Detection of Cottonseed Oil in Lard (Yearbook, 1904); Table Sirups (Yearbook, 1905); Formaldehyde, Its Composition and Uses (Yearbook, 1905); Report on Soils, from Bulletin 90; Testimony before the Interstate Commerce Committee of the House of Representatives; Report on Insecticides, etc., from Bulletin 99; Report of the Chemist, 1905. Total, 478 pages.

Total number of pages reprinted, 3,971.

#### JOB PRINTING.

A total of 216 requisitions, distributed approximately as follows:

Miscellaneous (forms for time clerk, property clerk, and librarian, notices, etc.), 46; drawings and blueprints, 32; index cards, 17; labels, 19; books of food-inspection forms, 5; circular letters, 43; stationery (envelopes and franks), 22; letter heads, 32.

#### WORK OUTLINED FOR THE FISCAL YEAR ENDING JUNE 30, 1907.

##### DIVISION OF FOODS.

The study of the influence of preservatives and coloring matters on nutrition and health will be continued. If this work is conducted on the same scale as in the past it will require the entire time of seven men in addition to those engaged on the determination of nitrogen. The study of the effect of cold storage upon the healthfulness of foods will be continued.

A study of the ripening of fruit will be continued, special attention being given during the early part of the year to the manufacture of cider. During the latter part of the year it is hoped to work entirely on several varieties of tropical and subtropical fruits.

A study of the manufacture of vinegar will be continued, special attention being given to the manufacture of malt vinegar. Some attention will also be given to the standards of composition for vinegar, a number of samples of known origin being examined for that purpose.

A large amount of analytical work for the purpose of determining the standards of composition of other foods will be necessary. A comparative study of methods for the investigation of foods and the elaboration of new methods will be continued.

A large part of the attention of the division will be given to the enforcement of the imported-food law. The laboratories at the ports of New York and Philadelphia will be greatly enlarged during the year, and the number of employees in those laboratories will be correspondingly increased. The efficiency of the inspection will therefore be improved, and the number of samples examined will be greater than it has been in the past.

A most important part of the work of the Division of Foods during the fiscal year ending June 30, 1907, will be in connection with the enforcement of the food and drugs act, passed June 30, 1906, and taking effect on January 1, 1907. The laboratories now engaged in the inspection of imported foods will also give attention to the examination of foods inspected under the food and drugs act. In addition to this, as far as possible, arrangements will be made with the dairy and food departments of the respective States for collaboration in the enforcement of the act.

#### SUGAR LABORATORY.

The following lines of work are contemplated for the current year:

1. A continuation of the cooperative work with the Association of Official Agricultural Chemists along the following lines, the chief of laboratory acting as the referee on sugar.

(a) A study of commercial methods for sugar and molasses analysis; also an investigation of bleaching agents for molasses.

(b) A study of methods for the determination of caramel, organic acids, and other nonsugar constituents of cane and beet products.

(c) A study of special methods used for the investigation of carbohydrates in general.

2. An investigation of malts and malt products. This investigation is to embrace a study of the nature and composition of the various malted products found in the market, including such preparations as the various malt extracts used for brewing or for medicinal purposes, malted breakfast foods (as malta vita, malted rice, etc.), malted milks, malted cocoas and chocolates, etc. This research will necessitate considerable investigation not only of methods of analysis, but also as to the character of the hydrolytic effect produced by malts upon different starches under the varying conditions of temperature, restriction, and concentration.

3. An investigation of the economic production of alcohol from various raw materials, such as cornstalks, wood refuse, molasses, sweet potatoes, etc. This research will not only take up the composition of the various products mentioned, but will also include a study of the methods of hydrolysis, fermentation, and distillation.

4. An investigation of the various denaturants of alcohol and their special application in denaturing.

5. It is also hoped that a somewhat extensive investigation may be made regarding the character of the various carbohydrate bodies, classified under the head of nitrogen-free extract, in a variety of less commonly studied plant products, this investigation to be carried on as the more urgent work of the laboratory permits. Among the materials to be investigated in connection with this investigation might be mentioned certain mushrooms, kelp, and other human foods of similar nature; mesquite pods, carob beans, and other less commonly studied cattle foods; the different plant gums, and commercial products of a similar nature.

6. In addition there will be a varying amount of miscellaneous work to be done in connection with the work of the food, drug, and other laboratories of the Bureau.

The study of the influence of environment on the sugar content of sweet corn in cooperation with various experiment stations will be continued.

#### DAIRY LABORATORY.

The work of the Dairy Laboratory during the current year will be as follows:

1. Continuation of work for the Dairy Division, Bureau of Animal Industry, in the examination of samples collected by that Bureau in its work of enforcing the renovated-butter law and of investigating the composition of American butters.

2. Analysis of dairy products and dairy materials in connection with the food investigations of this Bureau as heretofore.

3. Miscellaneous analyses of dairy products for other Departments of the Government as heretofore.

4. Practical trial in creameries and renovating factories of the rapid method of determining water in butters, mentioned above, to test its applicability and usefulness as an aid in controlling the water content of the butters produced.

5. Continuation of cooperative work with the Dairy Division, Bureau of Animal Industry, upon the composition and digestibility of Cheddar cheese, made in different ways and ripened at different temperatures.

#### MISCELLANEOUS LABORATORY.

During the year ending June 30, 1907, the examination of irrigation waters for the Office of Irrigation and Drainage Investigations will be continued, and according to present indications the work will be greatly increased.

The composition of American mineral waters will be further studied, giving special attention to these waters as they come from the ground, rather than as they appear on the market. This investigation will be carried on in collaboration with the Hydrographic Office of the United States Geological Survey.

Work on sanitary water analysis will be continued, and in special cases studies of the water supply of towns too small to employ a chemist will be undertaken.

The work on insecticides in collaboration with the Bureau of Entomology will be continued and a study will be made of the composition of samples of lead arsenate and the ingredients for making it, as they are sold on the American market. This last investigation will also

include field studies in collaboration with the Bureau of Entomology to determine the cause of injury to fruit and foliage by certain samples of lead arsenate. The results obtained in the studies of the lime-sulphur-salt wash and methods of analysis of lead arsenate will be published.

A study of the methods of determining various constituents in the common disinfectants will be undertaken in the hope of improving the same.

The work on the composition of American cattle foods already completed will be collated and published, and further work on this subject will be undertaken. Considerable time will be spent in studying the composition of forage crops of the arid and semiarid West in collaboration with the office of Farm Management. The analysis of malts and barleys will be continued.

Work on the effects of trade wastes on agriculture will be continued and an investigation of the effect of the constituents of the dump heap from copper smelters on various farm crops will be undertaken. In connection with this study an investigation will also be made of the amount of toxic elements absorbed by various crops which are irrigated with waters containing such toxic elements.

If time allows, certain hygienic studies will be undertaken similar to those previously published from this laboratory on arsenic in papers and fabrics. It is also hoped that an investigation will be started during the year on the analysis and adulteration of paints.

#### DRUG LABORATORY.

The work planned for the current year is a continuation of the investigations instituted in this laboratory and given in detail in the report of work for the fiscal year ended June 30, 1906. To this must now be added the work which devolves upon this laboratory when the food and drugs act goes into effect January 1, 1907, which will include examinations of all substances intended to be used for the cure, mitigation, and prevention of diseases, both internally and externally. The work can be briefly summarized as follows:

**CHEMICAL REAGENTS.**—Examination of chemical reagents in the Bureau of Chemistry for the purpose of collecting data for standards and insuring the securing of reliable chemicals for analytical work.

**PLANT DRUGS.**—Study of quality, purity, and keeping qualities, and an examination of the analytical methods at present in use.

**COD-LIVER-OIL INVESTIGATION.**—Investigation of cod-liver oils with a view of determining in what manner the American oils differ from the Norwegian, and, if they differ, what the causes of such differences are and how they may be eliminated.

**PROPRIETARY MEDICINAL REMEDIES.**—Examination of these remedies so as to supply the Post-Office Department with the desired information relative to fraudulent medicines; to cooperate with the American Medical Association, and to supply recognized officials with proper data.

The examination of these remedies, in view of the recent Federal pure-drug legislation, must include not only those referred to above, but also medicinal compounds which must comply with the law recently enacted.

**PLANT ANALYSIS.**—This line of work has for its object the determination of the medicinal value of indigenous plants which are represented as having great curative properties.

**DRUGS.**—The food and drugs act specifies that the Bureau of Chemistry shall make examinations of drugs, which term includes all those not of a proprietary nature referred to above.

#### CONTRACTS LABORATORY.

The work for the fiscal year ending June 30, 1907, will be along the same general lines as that for the past year. It has been the policy of this laboratory to take up as far as possible work desired by the various Executive Departments. It was in this way that the work on inks and typewriter ribbons was undertaken. While these investigations have been published, it is probable that more work will be required on these subjects. An investigation of carbon papers is now in progress, and it is proposed to continue this. Also, at the request of the Treasury Department, a study of methods of determining zinc silicate and carbonate in ores has been begun, which will probably occupy some time. The work on determination of reducing sugars will also be continued. It is proposed to take up the examination of other supplies purchased by the Government, and, while the selection of subjects may be largely influenced by the demands of other Departments, a study of paints and varnishes is contemplated.

#### PLANT ANALYSIS LABORATORY.

It is planned to continue the studies in cassava, with special reference to fertilization tests, cultural methods, and the practical utilization of the product in a study of sizing material, cattle food, and alcohol manufacture. To this end a series of field tests on the fertilization of different varieties has been planned, the work to be done in collaboration with the Bureau of Plant Industry.

A second study in collaboration with the Bureau of Plant Industry will be undertaken in the investigation of the cotton plant. This will comprise the examination of several hundred samples, which constitute a series of plant-breeding experiments. The chemical investigation is to be made upon the seed with regard to the variation in composition between different varieties and the same variations in their successive offspring grown under different conditions of climatic environment.

In collaboration with the same Bureau a similar study of forage plants has been arranged. For this experiment 74 samples of different varieties of grasses and their offspring will be studied with reference to alkali-resisting qualities.

#### CEREAL SECTION.

The following investigations will be continued in cooperation with the Bureau of Plant Industry:

1. The effect of various fertilizers on the quality of grains; plant experiments conducted at various experiment stations.
2. The effect of environment on the gluten content of durum wheats.

3. The feeding value of the Swedish Select oat and other grains.
4. The study of the protein and other constituents of wheat and flour with relation to the aging of flour and the quality of bread.

It is also planned to inaugurate other experiments in connection with the Bureau of Plant Industry and the experiment stations for the purpose of studying the influence of climate and soils on the composition of grains and the changes in protein and other constituents during the growing period.

#### LEATHER AND PAPER LABORATORY.

The following lines of work are planned for the Leather and Paper Laboratory:

A continuation of the investigation of tanning materials with reference to the suitability of such products as are quick-growing or which have been hitherto but little used, with a view to supplementing the rapidly decreasing supply of material now generally used.

The investigation and valuation of degrass, or wool grease, and of various methods for the detection of its adulterants.

The investigation of the physical and chemical qualities of various leathers.

The investigation of the principles of rapid tanning.

A continuation of the investigation of papers for various uses, and the preparation of standard specifications for such papers.

The investigation of new raw material for pulp and paper making and the demonstration of the value of such material.

The continuation of the investigation of the production and industrial application of wood turpentine.

The investigation of the adulterants of turpentine.

A continuation of the study of the destructive distillation of woods, with particular reference to increasing the yields of products.

This laboratory will also cooperate, so far as its facilities will permit, with other bureaus and divisions of this and other Departments in work which comes within its province.

#### MICROCHEMICAL LABORATORY.

Arrangements are being made to extend the work on foods and drugs in order to meet the increased demands entailed by the food and drugs act, June 30, 1906. Especial attention will be paid to the microscopic examination of drug materials.

The work on bacteriological problems, especially those relating to the storage and preservation of foods, will be continued under the direct supervision of the Chief of Bureau.

The work begun last year upon barleys and malts will be continued and probably completed.

These special lines of investigation, together with the routine work incident to the examination of miscellaneous samples and the experiments conducted by other laboratories, will complete the work of this laboratory.







