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U. S. DEPARTMENT OF AGRICULTURE

REPORT OF
THE ACTING CHEMIST

FOR

1911/12 1912.

By R. E. DOOLITTLE.

[From Annual Reports of the Department of Agriculture.]



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REPORT OF THE ACTING CHEMIST.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY,
Washington, D. C., September 2, 1912.

SIR: I have the honor to transmit herewith the annual report of the Bureau of Chemistry for the year ending June 30, 1912, together with the plans for the work proposed for the next fiscal year.

Respectfully,

R. E. DOOLITTLE,
Acting Chief of Bureau.

HON. JAMES WILSON,
Secretary of Agriculture.

FOOD INVESTIGATIONS.

SPECIAL INVESTIGATIONS OF THE DIVISION OF FOODS.

CANNED FOODS.

The study of the canning of food products for the purpose of improvement in quality and processes of manufacture, as well as the securing of information for the enforcement of the food and drugs act, has been continued during the past year. The results of the investigations as far as completed have been assembled in popular form in Chemistry Bulletin No. 151, which gives a description of the conditions and the methods followed in the better type of factories. The study of the quantity of material in each can and the degree of temperature and length of time for proper processing makes this work of especial interest to the canners.

The work now in progress involves a detailed study of the canning and preserving of fruits, especially in California. The number of questions involved are so numerous and some of them so complicated that a special laboratory has been equipped for this work. It is in fact a miniature canning and preserving factory, duplicating on a small scale the equipment used in the best commercial plants; it is provided with its own steam plant, sterilizers, retorts, exhauster can-capping machines, various styles of jacketed kettles, two vacuum pans, cooking coils, vacuum and pressure pump, vacuum glass sealer, hydraulic press, clarifier, and various testing apparatus. A bacteriological laboratory is attached to study the organisms normally present on the fresh products and those present in decay. The chemical work is carried on in the San Francisco food and drug inspection laboratory.

SLACK FILL.—For the purpose of competition there has sprung up among certain canners the practice of filling their cans partially with food and adding a sufficient amount of water to fill to the required content. The water has been added especially to products where its addition was not apparent to the observer, as in canned tomatoes, and to other foods where its addition was apparent, but where the average consumer would not recognize it as added water, as in cove oysters, in which only $1\frac{1}{2}$ ounces of oysters were sometimes placed in a can which would hold nearly 6 ounces and the can then filled with a weak brine. While these practices were not general in the canning industry they were sufficiently prevalent to be regarded seriously, and a study was made of the problem, including necessarily a considerable amount of analytical work. The study was conducted in a number of commercial canneries as well as in the laboratory, and as a result food inspection decision 144 was issued, requiring cans to be as full as practicable of the food supposed to be present and forbidding the addition of unnecessary water.

TIN CONTENT.—The study of the corrosive action of various canned foods upon the tin of the receptacles and the consequent tin content of the food preserved has been continued. About 30 varieties of food in tin receptacles have been reexamined after an interval of one year and the increased solvent action noted. The results are of value in determining the character of container which should be employed with the different varieties of food.

The division has also collaborated with the research committee of the National Canners' Association in a much more exhaustive investigation of the same general nature. This work involved the determination of tin in about 250 samples of canned food, with the result that the corrosive action of the foods on the container seems to be due not only to the chemical action of the acids of the strongly acid foods and of the volatile alkalies of some of the nonacid foods on the uncoated plate, but also to the amount of oxygen included in the can. A study of the action on tin plate of some of the nonacid foods reported a year ago has been extended and Circular 79 has been published, giving the results of the work. Food inspection decisions 142 and 148, issued by the Board of Food and Drug Inspection, forbidding the use of saccharin and copper sulphate in food products, will probably affect some canning methods.

SANITARY CONDITION OF FOOD MANUFACTURING ESTABLISHMENTS.

One of the most important problems in connection with the manufacture of food is the bettering of the sanitary conditions under which the processes of manufacture are conducted. Several States have enacted laws regulating the maintenance of food-manufacturing establishments in a sanitary manner. This is not required directly by the food and drugs act, but the question is important to its enforcement, since the use of insanitary establishments sometimes results in the production of foods which are regarded as in violation of the Federal food and drugs act because of their content of filthy, decomposed, or putrid material. The question of sanitary conditions of a factory, therefore, is inseparably connected with the question of spoilage in food.

The studies regarding tomato spoilage have been extended in collaboration with the branch laboratories and additional data secured which is of value in the interpretation of the results obtained in the examination of tomato ketchup. Analysis was made of many of the common brands of ketchup sold on the American market. As would be expected, the decomposition of tomatoes in various localities does not proceed uniformly because of the lack of uniformity in the organisms which have led to the decomposition. The work has been extended, therefore, in collaboration with the microchemical and bacteriological laboratories by the application of pure cultures isolated from spoiling tomatoes in varying localities. This work was begun in April, since which time 16 samples subjected to the action of definite organisms have been examined from time to time.

The same general methods have been applied to the study of the common berries on the market, but have not been found to be so generally applicable.

Some attention has also been given to methods for the detection of spoilage in other products, as frozen and desiccated eggs, gelatin, and coffee containing a large number of imperfect or decayed berries, ordinarily known as quakers and black jacks, and also of coffee that has been damaged by various causes during shipment.

FRUIT PRODUCTS.

ECONOMIC STUDIES.—The studies on fruits and fruit products in collaboration with pomologists in charge of the field investigations of the Bureau of Plant Industry have been continued. A field study on the processing of Japanese persimmons to render them nonastringent was made during the past season and the results published. It was found that all varieties of Japanese persimmons tried could be satisfactorily processed on the large scale by keeping them in carbon dioxide for a time varying with the variety and the temperature.

The methods previously applied to the preparation of grape juice and apple juice have been studied with reference to the modifications necessary for their application to juices of other fruits, and the juice-yielding properties of many varieties of grapes grown in the eastern part of the United States have been studied in collaboration with the viticulturist of the Bureau of Plant Industry. A study has also been made of methods for the preparation and preservation of orange and lemon juices to make them hold their color and flavor. In the last year it has been found possible to prepare juices which hold their color for several months and whose flavor deteriorates much less than in juices heretofore prepared. Recent studies indicate the possible value of concentration of such juices by means of freezing. This method appears promising, from the experimental study that has been made, and it is proposed later to conduct a small commercial experiment to determine its cost.

A study on a small laboratory scale has been made of the drying of fruits in vacuum, together with an absorbent for water vapor, such as unslaked lime. The quality of the article prepared in this manner is so satisfactory as to make it appear advisable to conduct experiments on a small manufacturing scale for the purpose of determining the cost, and also in order that a sufficient amount of the product may be prepared for a study of its maintenance of color and flavor during storage.

During the year some of the orange districts suffered from frost and many of the oranges were frozen on the trees. This resulted in the placing on the market of a large number of shipments of oranges containing a varying percentage of frozen fruit. A preliminary study of possible methods for the detection of frozen fruit was made in the Division of Foods, and the matter was then transferred to the San Francisco laboratory for field investigation.

CHARACTERISTIC ACIDS.—Much attention has been given to the identification of the acids occurring naturally in various fruits and to the determination of the amounts of these acids. This information is of value in the examination of samples taken under the food and drugs act and also in connection with the constructive work of the bureau. The character of the acid present in a prepared fruit product may be used for the identification in a general way of the variety of fruit employed in its preparation, or at least it may often afford evidence of the absence of a fruit claimed to have been employed. It also affords means of determining the changes of composition during the manufacture of some foods, as, for instance, wine, and of determining to a certain extent the method of manufacture that has been employed. The fruits examined included many varieties of apples, pears, strawberries, raspberries, blackberries, cherries, currants, gooseberries, quinces, huckleberries, apricots, and peaches.

SUGAR-ACID RATIO.—It is the practice in the preparation of the highest grade of canned fruits to vary the strength of the sirup added according to the flavor desired. This seems to depend mainly on the acidity of the fruit; for instance, a 60 per cent sirup is employed with some strongly acid fruits, whereas with certain fruits of medium or low acidity the maximum sugar content is 40 per cent. It is believed that more satisfactory results can be obtained by determining the acidity of the fruit in the cannery and giving closer attention to the sugar-acid ratio in the finished product. This matter is being studied in the canning laboratory of the bureau located at San Francisco, Cal., and in collaboration with this work the Division of Foods has determined the sugar and acids and the ratio of the two in about 200 samples of fresh apples and peaches and a somewhat larger number of samples of canned fruits of various varieties.

CITRUS BY-PRODUCTS.

The field work of this laboratory has made splendid progress during the year. The experimental plant has been installed at Los Angeles, Cal., for making practical commercial tests upon the production of citrus by-products early in the coming winter. Experiments have been tried both in the field and at the laboratory in Washington, and many practical experiments now await only the practical field test as a final proof of their efficiency. The chief of the laboratory has visited several commercial plants and made practical tests as to the availability of the manufacturers' machines for use in this work, and no little benefit has been derived from the experience gained.

ESSENTIAL OILS USED FOR FLAVORING FOOD PRODUCTS.

Much time has been devoted to research work on the methods for the determination of the active constituents of essential oils and to general methods for the detection of their adulteration. It was found that many of the methods of analysis, as well as physical constants, given in the current edition of the Pharmacopœia were not up to date, so that the work on each individual class of oil has had to be done simultaneously with a special investigation upon samples of known origin. It is hoped that the results of these investigations will shortly be published as a circular.

The work included a general investigation upon oil of bitter almond, with special reference to methods for determining the amount of benzaldehyde therein, but was also extended to include the determination of hydrocyanic acid, benzoic acid, and of chlorin; the determination of cinnamic aldehyde in cinnamon and cassia oils, together with the detection of added rosin; and the detection of glycerin in lavender oils.

EDIBLE OILS.

The work on the commercial production of peanut oil taken up last year has been continued. Sixteen lots of material (supplied in part by the Bureau of Plant Industry) have been expressed in the oil expeller under varying conditions of moisture content and temperature and the most economical method of treatment for Spanish and Virginia peanuts determined.

The preparation of samples of oils of known origin and purity has been continued this year, and there have been added to the stock sunflower oil pressed from the seeds of the Mammoth Russian variety, coconut oil made from fresh nuts dried in an evaporator and pressed in an expeller, and several samples of pecan oil, which were pressed out in a hydraulic press from material supplied by the Bureau of Plant Industry.

The chief of the oil, fat, and wax laboratory, as an associate referee of the Association of Official Agricultural Chemists, has conducted investigations on several methods proposed for the analysis of fats and oils, some of which will be adopted officially.

In collaboration with the Interstate Cottonseed Crushers' Association's committee on uniform methods, a series of analyses have been made on cottonseed products and recommendations as to the best methods for adoption as official by that association transmitted to them.

The study begun last year on the chemical composition of soft-shell pecans and their oil, with a view to determining whether the composition would shed any light on the distinguishing features of various varieties and the effect of different climatic conditions upon this chemical composition, has been continued in collaboration with the Bureau of Plant Industry and will shortly appear as part of a bulletin of the Division of Pomology.

MISCELLANEOUS.

A number of investigations have been undertaken to which a varying amount of attention has been paid. Some additional study has

been given to bleached flour with a view to determining methods for the detection of bleaching agents other than nitrogen peroxid. The salt content has been determined in a number of samples of water in oyster beds. A study has been begun of the various lac preparations and the question of the application of lac to the glazing of candy. Attention has been given to the manufacture of calcium acid phosphate intended for bakers' use, especially with a view to determining the effect of added calcium sulphate in the process of baking, and it has been determined that the presence of calcium sulphate increases the amount of carbon dioxide evolved, hastens its evolution, and increases the amount of insoluble residue by reason of the product closely approaching tricalcium phosphate.

EXAMINATION OF SAMPLES FOR OTHER DEPARTMENTS.

Several hundred samples of miscellaneous food products were examined during the year for the Army, Navy, Panama Canal Commission, the Insane Asylum of the District of Columbia, and especially for the General Supply Committee.

WORK OF THE FOOD RESEARCH LABORATORY.

The food research laboratory has continued its study of the handling of perishable products, using poultry and eggs as the objects on which to work out the fundamental principles of good handling. The phases of the problem and the field of operations have been broader than in preceding years. The main lines of investigation have been (1) the study of the rate of deterioration in "wet-packed" as compared with "dry-packed" poultry; (2) the effect of temperature during long railroad hauls on dressed poultry; (3) the effect of the present methods of routine marketing in large cities on the rate of deterioration in dressed poultry; (4) the effect of temperature on the rate of deterioration in eggs during transportation and storage; (5) the study of the changes in eggs produced by their environment; and (6) the methods of handling eggs when removed from the shell to be frozen or dried for preservation. All of these topics have been approached from the practical as well as the scientific side, the field work having been centered in New York City, Nashville, Tenn., and Omaha, Nebr.

FIELD STATION.

The field station, which includes an excellently equipped laboratory located in a poultry-packing house in Nashville, Tenn., for a little more than the past fiscal year, has prepared, examined (bacteriologically and chemically), and shipped to the receiving station in New York experimental packs on a commercial scale, to study the relative keeping time of "wet-packed" and "dry-packed" and "well-bled" and "badly-bled" poultry. The conditions maintained during the haul in refrigerated carriers were followed by thermograph records, and in a number of shipments by means of resistance thermometers read at frequent intervals.

Visits were made to 128 poultry-handling establishments in Ohio, Indiana, Kentucky, and Tennessee, where the general conditions of the trade were discussed with the shippers with the object of improving their methods. As a result of the actual work performed in

these establishments, and of the advice given to shippers to use mechanical refrigeration for the handling of eggs and the cooling and packing of poultry, the number of plants using mechanical refrigeration in Kentucky and Tennessee has increased during the last fiscal year from 2 to 6 and the tonnage of refrigeration has increased from 48 to 160 tons.

At the request of the management of the Tennessee State Fair, a commercial poultry exhibit and demonstration was held in connection with the fair in the latter part of August, 1911, consisting of charts giving brief directions for the better handling of market poultry and eggs, cases containing commercial grades of eggs, showing the monetary loss to the farmer and consumer due to the production of inferior eggs, dressed poultry showing best and poorest types, milk-feeding batteries with chickens actually being milk fed, and killing demonstrations by professional poultry dressers. Daily talks were given on the handling of poultry and eggs.

The laboratory has been visited by approximately 100 people, including shippers desiring information regarding the handling of poultry and eggs, railroad men wanting information regarding refrigerative cars, temperatures, and insulation; Government meat inspectors, cold-storage men, agricultural extension college professors, poultry raisers, editors of poultry and trade papers, veterinarians, chemists, housewives, etc.

During the past year an all-metal cooling truck for the cooling of poultry was perfected and is being rapidly adopted by the poultry packers of the country. This truck is covered by patent No. 1020575. A killing frame for the better killing of poultry has been devised, and a picker's ticket for use to determine the numbers of chickens picked by each picker has been designed.

Two phases of the field work at the Nashville station have excited an unusual amount of interest, (1) buying eggs and poultry on a "quality basis," and (2) the improved results obtained in the shipping of eggs by cooling before loading and transportation under refrigeration. The old custom of buying eggs in 30-dozen lots, paying a definite sum, regardless of the percentage of loss, is changing slowly but surely to the quality basis, where the shipper usually separates the eggs into three grades, paying a different price for each, according to the quality, and paying nothing for rotten or moldy eggs.

The precooling of eggs has been accomplished for the education of the shippers far from mechanical refrigeration by means of a portable refrigerating plant installed in a refrigerator car. The principles were devised by the Division of Field Investigations in Pomology, Bureau of Plant Industry, for use in their fruit-marketing work in the far West. They cooperated with this bureau in adapting and modifying those principles to render them applicable to the work of this bureau. The result is a well-insulated portable room, divided by a partition, in which a temperature at or near 0° C. can be maintained. The space is sufficient to permit of handling eggs or poultry in 10,000-pound lots. Eggs precooled in this car were shipped during May and June from Winchester, Ky., to New York. The results indicate a remarkable saving in quality as compared with eggs not precooled.

The relative rate of deterioration in fertile and unfertile eggs has been studied in the laboratory in more than a hundred samples, using the candle as a means of grading.

MARKETING OF POULTRY AND EGGS IN NEW YORK.

A member of the staff of the Food Research Laboratory has been almost constantly in New York City during the past year to receive experimental shipments of poultry and eggs and to study transportation and the whole complex marketing system in New York City as applied to perishable products.

During the year 8 cold-storage warehouses, 33 commission houses, and 15 retailers have been in close touch with the work, in most cases cooperating with this laboratory. The New York City commissioner of docks and other public officials in connection with the establishment of a new municipal market have called for information concerning the handling of perishables, that the losses to the people in both quality and quantity may be reduced as far as possible.

INVESTIGATION OF FROZEN AND DRIED EGGS IN OMAHA.

The investigation at the Omaha food and drug inspection laboratory, begun in June, 1911, and continued until early in September, was outlined in the report of this laboratory for 1911. From July until September active work was conducted in six plants which were preparing frozen or dried eggs. The prevailing conditions, as well as the various grades of eggs which went into the commercial product, were studied carefully. The eggs used by the industry were taken to the laboratory and there handled as the industry handled them; the improved methods worked out in the laboratory were transferred to the commercial breaking rooms and applied to the eggs used there. The results showed that good eggs, unless handled properly, would not give a bacterially clean product and that many eggs which would not be good at the market center, generally a six-day haul away, were good food if broken and frozen or dried immediately. Such studies also served to locate the sources of contamination, and, having located them, the problem shifted to the study of means for their elimination. The practical application of the principles of bacteriological cleanliness to commercial procedures must be the basis for the handling of eggs out of the shell, just as it must be in dairying for the handling of milk out of the cow. The fundamentals gathered from the work of the summer of 1911 have been published as Bureau of Chemistry Circular No. 98, Practical Suggestions for the Preparation of Frozen and Dried Eggs. During the winter some work was done cooperatively with a bakery which used the frozen eggs prepared by one of the plants which had been studied during the previous season, thus following the product to the consumer.

The egg season of 1912 opened with three egg-breaking plants equipped with facilities for handling eggs in accordance with the knowledge gained during 1911 and in May a fourth plant was added. A member of the staff of the food research laboratory has spent the summer in these newly equipped houses, watching methods, experimenting, noting the variation of the eggs with the season and the

weather, and collecting samples of all sorts to be examined by the chemists and bacteriologists located in the Omaha food inspection laboratory, which, for the summers of 1911 and 1912, was turned over to this egg investigation exclusively.

The scientific and practical results obtained on the handling of this perishable product, the mechanical devices used to wash and sterilize utensils, and the gain in efficiency of work and in quality of product by the application of what may truly be called "scientific management," furnish a broad field for further endeavor in the evolution of a pure, clean food supply. It is planned to publish a full account of this work as soon as the data are sufficiently complete.

WORK IN PHILADELPHIA.

The headquarters in Philadelphia maintain a close relationship with all the branches of the field work, that information gained in one place may be quickly transmitted and utilized in another and that the widely diversified phases of study and fields of operations may be correlated and the logical progress of the work as a whole ensured. The more elaborate scientific studies are worked out, methods to be used in the field work devised, and all of the routine chemical and bacteriological examinations in connection with the study of experimental shipments and marketing are made in the main laboratory.

POULTRY.

During the past year, in connection with the field work and shipments of wet-packed and dry-packed chickens, a study has been made of the amount of water absorbed by the chicken and the amount of nutrient material dissolved out of the chicken when the wet-packed system is practiced commercially. Calculating on the 20,000-pound car-lot basis, wet packing for each car of poultry would cause the consumer to pay chicken prices for about 1,300 pounds of water and to lose down the drains about 300 pounds of the best food material that chicken flesh contains. Such economic losses are too great to pass unnoticed.

A study has also been made of the comparative keeping quality of wet and dry packed birds when hard frozen, carrying them through the whole routine of marketing as usual. Other investigations are indicated by the following titles of circulars published during the year: "The Occurrence and Permanence of Lipase in the Fat of the Common Fowl" and "The Oxidation of Chicken Fat by Means of Hydrogen Peroxid" (Circular 75), as well as by titles to publications now in press, namely, "The Influence of Temperature on the Lipolysis of Esters," "The Hydrolysis of Chicken Fat by Means of Lipase," and "The Occurrence of Catalase, Oxidase, and Reductases in the Fat of the Common Fowl."

EGGS.

Shipments of eggs have been studied along lines paralleling the study of poultry, using generally the "southern" egg as the subject of experimentation. The enzymes occurring in fertile and unfertile eggs, fresh and stale eggs, kept at low and high tempera-

tures, were also examined and the results submitted for publication under the title "A Study of the Enzymes of the Egg of the Common Fowl."

Eggs have also been studied for the rate of loss of water from the white at varying temperatures and the diffusion of water into the yolk, the results having been given in Circular 83, "Deterioration of Eggs as shown by Moisture Content."

A special study of moldy eggs has been made, looking toward a knowledge of this condition in eggs and their consequent unfitness for food. The penetration of egg shells by molds and bacteria has also been under investigation.

CONCLUSIONS.

The need for personal contact with the industries handling poultry and eggs has been more forcibly emphasized during the past year than before. It is not possible, with the small field force, to extend the application of better methods by individual visits; hence an effort is made to meet the men at their own industrial gatherings or at special meetings arranged by the industry forces. Accordingly, the members of the staff of the food research laboratory have addressed 19 different meetings of about 7,500 people in various parts of the country. These gatherings included meetings of shippers of perishables, railroad men, warehousemen, middlemen, producers, consumers, and educators.

Number of samples examined and analyses made.

	Philadel- phia food research laboratory.	Nashville station.	Omaha food inspec- tion labo- ratory.	Total.
Samples of eggs for chemical analysis.....	160	14	567	741
Samples of poultry for chemical analysis.....	347	58	.....	405
Samples of eggs for bacteriological examination.....	77	240	832	1,149
Samples of poultry for bacteriological examination.....	333	232	.....	565

BACTERIOCHEMICAL INVESTIGATIONS.

The principal bacteriochemical investigations conducted at Washington during the past year concern the conditions surrounding the oyster, clam, frozen and desiccated egg, and gelatin industries. A study of the influence of frozen and desiccated egg products on laboratory animals was made. Numerous examinations were made of shell eggs of known history, making separate determinations from the albumen and yolk.

Several State health authorities have cooperated in the examination of the waters, oysters, and clams from various localities. As a result, many oyster sections which have shown pollution have been closed as a source of edible oysters.

In connection with other laboratories, many examinations have been made of gelatin (see p. 27), dairy products, infant foods, cattle feeds, tomato products, and water.

The following tabulations show the nature and number of bacteriochemical examinations made during the past year of interstate and research samples:

Interstate samples:

Antiseptics and disinfectants	5
Butter.....	6
Canned goods.....	14
Clams (shell).....	15
Corn meal.....	5
Cream (raw and pasteurized).....	26
Eggs (desiccated).....	36
Eggs (frozen).....	39
Eggs (liquid).....	36
Eggs (shell).....	12
Gelatin.....	6
Hay.....	20
Infant foods and milk powders.....	14
Jam and preserves.....	24
Milk (raw and pasteurized).....	542
Mincemeat.....	31
Miscellaneous.....	25
Oysters (shell and shucked).....	146
Tomato products.....	324
Water.....	47
Total.....	<u>1,373</u>

Research samples:

Air analyses.....	25
Canned goods.....	18
Cheese.....	10
Clams (shell).....	10
Disinfectants.....	21
Eggs (frozen and desiccated).....	73
Eggs (shell), yolk and albumen.....	1,440
Gelatin.....	659
Milk (raw and pasteurized).....	12
Miscellaneous.....	36
Oysters (shell and shucked).....	132
Water.....	326
Total.....	<u>2,762</u>

The total number of samples examined bacteriochemically, both interstate and research, was 4,135.

SUGAR AND SUGAR PRODUCTS.

MAPLE PRODUCTS.

The investigation of the maple products industry of the United States, undertaken three years ago, has been continued. The report covering the work on maple sap sirup has been published, while that on maple sugar and maple-sugar sirup has been written and held awaiting further investigations on special features of the industry. The work during the past sugar season showed the necessity of more extended experimental study of the effect of metals on the appearance and composition of the sirup, the changes in composition of maple sugar and sirup in storage, and the effect of manufacture from sour sap. As the maple season is so short, lasting not more than two weeks to a month, the manufacturer of the samples must be done during that time and analysis made later, so that but little apparent progress can be made in one season.

CANE SIRUP AND MOLASSES.

The samples collected some two years ago for an investigation of the moisture content of these products received a rather complete analysis. During the past sugar-making season another lot of samples was collected and analyzed. The results of these tests are being tabulated to form a nucleus for a knowledge of the composition of cane sirup and various grades of cane molasses. Samples of imported molasses are being studied chemically to see if they differ from the products of the United States. This whole subject, together with that of sorghum sirup, must receive much original work, as the differentiating reactions and bodies are little known and the chemical means of distinguishing them are very meager at present.

SORGHUM SIRUP.

During the past season, samples of sorghum sirup from two manufacturing districts of the United States were collected and the study of chemical means of differentiating this sirup from the sirup made from sugar cane has been receiving attention.

EFFECT OF ENVIRONMENT ON SUGAR CONTENT OF MUSKMELONS.

In continuation of the study of the effect of environment on the composition of food products where sugars play an important part, the work for the past two years has been on muskmelons. Analyses of the melons grown at the stations in Florida, Arizona, Colorado, Kansas, Indiana, Maryland, New Jersey, and Connecticut tend to corroborate in a general way the inference drawn from the first year's work, namely, that climatic conditions induced by relatively lower temperature and higher altitude interact on each other to produce a sweeter melon. Some attention has been devoted to the chemical changes involved in growth and ripening of this melon. In cooperation with the Vermont Agricultural Experiment Station, many analyses were made of the "Montreal Market Melon" grown in New York, Vermont, and Canada, and the results are forthcoming in a bulletin of that station. The Bureau of Plant Industry cooperated by supervising the growing of the crop and furnishing the seed.

MISCELLANEOUS INVESTIGATIONS.

POWDERED SUGAR.—The question of the use of starch in powdered sugar is receiving attention. Numerous samples have been collected from the grinders of granulated sugar by the official inspectors.

ANALYTICAL METHODS.—Much time has been devoted to the preparation of the sugars, lactose, maltose, levulose, and sucrose, in as pure form as possible to be used in standardizing reducing sugar methods. Some work has been done on the Clerget method for determining sucrose in cane sugar and beet sugar products and on the changes produced on storage of sugars. About 50 varieties of grape juices have been tested for sucrose and for total sugars. A new method for the determination of total carbon by permanganate in sugar products, and its application in determining sucrose has been tried out.

VOLUME OF WORK.

During the year 1,120 samples were received for analysis, some requiring only a single determination, but many a complete examination. Besides these, about 500 samples were analyzed in the field in the environment work on the muskmelon.

DRUG INVESTIGATIONS.

OUTLINE OF WORK.

The drug division has been engaged in studying the composition, adulteration, and misbranding of drugs and chemicals, including those products imported into the United States or shipped into interstate commerce and found on our markets.

This work requires a careful study of the methods of analysis, the character and quality of normal material, and the standards at present official for certain commodities, with a view to either confirming existing standards or providing the necessary data for future effective work. For example, in order to determine the reliability of existing methods for testing the quality of hydrogen peroxid and the characterized purity of the articles supplied to the trade, an extended investigation was made upon the various brands available on the market. The results were published in Bulletin 150, entitled "Technical Drug Studies." A similar study was made of U. S. P. tincture of ginger, prepared according to a prescribed formula. No data are given as to the amount of alcohol, nonvolatile matter, etc., the finished product should contain. The results will be found in Bulletin 152 of this bureau. Similar studies are now in progress on tincture of iodine, nitroglycerin tablets, tablets in general, alkaloidal mixtures, etc.

The total number of samples examined during the year is 1,544.

Cooperation with the Post Office Department has been rather restricted during the past year. Several samples containing poisons shipped through the mails were examined, resulting in drastic action by the courts. An interesting brief review of the "Habitina" case will be found on pages 203-312 of the Hearings on Amendments to the Pure Food and Drugs Act.

SYNTHETIC PRODUCTS.

During the past fiscal year the synthetic products laboratory examined 294 samples, of which 249 were interstate, 8 import, and the remainder either unofficial or for other departments. As the result of such examination 58 cases were recommended to the chief of the bureau for prosecution. Nearly two-thirds of the samples investigated were representative tablet and pill preparations as ordinarily supplied to the jobbing and retail trade or the physicians direct. In addition to the excipients, lubricants, and more or less indeterminate plant extractives and tissues, each tablet or pill contained one or several such active principles as caffeine, acetanilid, acetphenetidin, antipyrin, sodium salicylate, aspirin, salol, sulfonal, trional, veronal, hexamethyleneamin, quinin, strychnin, morphin, codein, heroin, etc. In addition to the work performed for other departments, numerous

check analyses have been made for other bureau and branch laboratories.

Some 15 manufacturing plants were visited in the East and Middle West and the various methods of manufacture and control carefully observed. The information gathered in this way, taken with the evidence and data offered at various hearings held at Washington and at branch laboratories, indicated, as a rule, that the shortages or discrepancies observed in the case of certain preparations were seldom, if ever, due to willful intent on the part of the manufacturer, but rather to a lax or faulty control, either in weighing and checking the ingredients, in accounting for eventual wastage in granulation and compression, or, finally, in handling the problem of lubrication.

The investigation of various gums, as acacia, tragacanth, and Indian gum, was continued from the preceding year. A method was evolved, thoroughly tested out, and published as Circular 94, on The Volatile Acidity of Gum Tragacanth Compared with that of Indian Gum, enabling one, in conjunction with the recognized qualitative tests, to clearly differentiate between the two products, whether alone or in admixture. Methods have been perfected for the exact separation and estimation of the following combinations: Antipyrin, acetphenetidin, and codein; acetanilid, sodium salicylate, and codein; antipyrin, caffen, and acetanilid; caffen, acetanilid, quinin, and morphin.

Cooperative work on headache and similar mixtures has been continued, as in the past, with the gratifying result that methods suggested by this laboratory and submitted to outside workers for criticism have invariably met with favorable reception.

ESSENTIAL OILS.

Forty-nine samples of essential oils have been examined, of which 46 were samples from interstate shipments. Nine cases of adulteration and misbranding were reported. A number of samples for check analysis were referred to this laboratory, as well as several products of a miscellaneous character, including nitroglycerin tablets, castor oil, glycerin, etc. A research on the composition of American spearmint oil has been conducted and the results published in Circular 96 of the Bureau of Chemistry. The study of oil of chenopodium, designed to clear up the constitution of ascaridole, the medicinal constituent of that oil, is yet in progress, and it is expected that the results will soon be ready for publication. The study of methods for the determination of various essential oil constituents, particularly ketones, such as camphor, is being continued.

The analysis of authentic samples of oil of wormwood has been taken up with the purpose of establishing a standard of purity.

PHARMACOLOGICAL INVESTIGATIONS AND BIOLOGICAL TESTING OF DRUGS.

An exhaustive critical review of the literature on the action of drugs under pathological conditions, with some experiments performed in this laboratory, was published in Circular 81.

The caffen investigations of the previous years have been continued. Two reports were made, one on the toxicity of caffen, Bulletin 148, the other on the elimination of caffen, Bulletin 157. Further

studies have been made on the toxicity of caffeine with special reference to certain factors modifying toxicity, such as starvation, variation of temperature, and fatigue. This research is nearing completion. The toxicity and elimination of caffeine under some pathological conditions, as after removal of the kidneys, were studied in rabbits. The results show increased excretion of caffeine by the gastro-intestinal epithelium under this condition, but the toxicity of caffeine is not markedly affected and is not cumulative. The action of caffeine on the circulation, with special reference to drugs modifying its effect, has been studied extensively.

The pharmacological action of tin was begun, but little progress has been made.

Physiological tests were made with samples of spoiled cheese as to the presence or absence of a toxic substance, but the results were negative. Tests were also made upon "Ricin Preparat" which was being used in an assay method for the determination of pepsin, with a view of ascertaining its degree of toxicity.

Samples of digitalis leaves, as well as medicinal preparations, were tested; some of the latter were found to be of only fair quality and others were fully up to the standard.

CHEMICAL REAGENTS.

During the year 392 samples of chemical reagents supplied to the Bureau of Chemistry and branch laboratories on contract have been examined. Improvement is noted in the quality of chemicals supplied this year over that of those supplied the previous year. In a few instances, however, the bureau has had some difficulty in obtaining "special reagents" that will comply with their specifications and that will be of a degree of purity necessary for the special analytical work, although the manufacturers have worked in hearty cooperation with the bureau in its efforts to obtain the desired chemicals. Among these can be mentioned "special" acetic acid, 99.9 per cent pure, of which frequent rejections were made, either because the product did not comply with the sulphuric acid-bichromate test or because it was low in strength. Hydrochloric and nitric acid were also found to be unsatisfactory because of the presence of arsenic.

There has been urgent demand recently from various laboratories for mineral acids and zinc that are more nearly free from arsenic than those supplied up to this time for special investigations where exceedingly delicate tests were being employed. The bureau has had no difficulty in obtaining sulphuric acid which is practically free from arsenic, but it has experienced great difficulty in obtaining hydrochloric acid and nitric acid free from arsenic. The bureau is now experimenting with ceresin bottles to note the arsenic content of nitric acid delivered in such bottles. It has been practically impossible to obtain zinc absolutely free from arsenic. The reagent laboratory is investigating a method of testing for arsenic in its reagents by a modification of the Gutzeit test, in which electrolytic reduction is employed, thus eliminating the use of zinc and using as the electrolyte sulphuric acid, which is itself relatively free from arsenic.

Among the rejections made during the year may be mentioned the following:

Ether, specified chemically pure, contained nonvolatile matter and peroxids.

Hydrogen peroxid, U. S. P., found low in strength.

Uranium acetate, chemically pure, free from sodium, contained sodium and potassium salts.

Alcohol, chemically pure, absolute, contained nonvolatile matter and was low in alcohol content.

Benzol, chemically pure, free from thiophin, contained thiophin and other impurities.

Amyl alcohol, chemically pure, water white, contained impurities and was of high-boiling point.

Acetic acid, chemically pure, special, 99.9 per cent, some low in acetic acid content, others did not comply with the sulphuric acid-bichromate test.

Sodium bicarbonate, chemically pure, contained monocarbonate.

Sodium carbonate, chemically pure, anhydrous, low in sodium carbonate content.

Methyl alcohol, chemically pure, free from acetone, contained nonvolatile matter and acetone.

Lead peroxid, chemically pure, was low in lead peroxid content.

NOSTRUMS AND PROPRIETARY REMEDIES.

Some attention has been given to the various commodities placed on the market and exploited for the treatment of consumption, cancer, drug addiction, obesity, etc., and to the so-called proprietary remedies of secret composition. The therapeutic and medical claims used with these are often false or fraudulent or misleading. A large amount of printed matter and other data were collected and submitted at the hearing of the Richardson bill before the Committee on Interstate and Foreign Commerce. This information was published as the "Pure Food and Drug Act, Hearings before the Committee on Interstate and Foreign Commerce, House of Representatives, Sixty-second Congress, Second Session, Part II."

FOOD AND DRUG INSPECTION.

INSPECTION FORCE.

During the fiscal year ended June 30, 1912, there were collected more than 10,000 official samples of foods and drugs. With the exception of a limited number, which indicate samples obtained in the course of milk campaigns or from mail-order houses, these samples represent visits by inspectors to mercantile establishments and are indicative of the number of inspections of wholesale and retail stocks. There were approximately 1,500 factory inspections reported which were made with a view of noting particularly the sanitary conditions obtaining both in the establishment proper and on the premises, the propriety of labeling, and general practices which might be contrary to the provisions of the law. There were 446 recommendations submitted to the Board of Food and Drug Inspection which recounted the sale and interstate delivery in confiscable quantities of adulterated or misbranded food and drug products which were sub-

ject to seizure under the provisions of section 10 of the act. Besides the interruptions due to attendance as witnesses in prosecutions of cases based upon food and drug samples, the inspectors, in connection with the field forces of various other bureaus in the department, undertook the collection of samples and the consequent work involved in the performance of inspection duties in the enforcement of the insecticide and fungicide act of 1910.

CONTINUATION OF WORK FROM THE PREVIOUS YEAR.

MILK AND CREAM.—Campaigns were conducted to determine the character of milk and cream shipped by producers to St. Louis, Mo.; Providence, R. I.; and Philadelphia, Pa. While a great many of the samples of milk and cream examined were found to be adulterated from either a chemical or bacteriological standpoint, the majority obtained showed a steady improvement in the quality of interstate milk and cream since the initiation of these campaigns in 1907.

CITRUS FRUITS.—The investigation continued from last year of the practices of growers and shippers of citrus fruit showed that there had been almost a total abandonment of "sweating" resorted to by subjecting green and unripe oranges to moist and artificially heated atmosphere in order to hasten the yellow tint of the peel. There still exists, however, such a practice on the part of certain fruit commission merchants in several of the large cities, but, so far as we are able to determine, this treated fruit is sold locally and no offense committed under the Federal law. The State of Florida has passed a strict State law controlling the traffic in this product. In connection with the general work on citrus fruits, some attention was given to the shipment of frozen oranges, which were packed and offered for sale in some of the orange sections.

NEW WORK.

CANNED FOODS.—Attention was given in the fall of 1911 to the inspection of canning establishments, particularly with a view of reporting the practices of packing tomatoes and other products with what is technically known as "slops" or added water. A comparison of the reports submitted on the conditions existing last fall, particularly from the standpoint of sanitation, shows a marked improvement over the conditions that existed at the time previous inspections were made. This rigid inspection in the case of tomato products, noting the disposition of the pulp manufactured from skins and cores, was carried from the canning establishments to tomato-ketchup factories. Such observation, together with the prosecutions that followed against shipments of inferior grades, resulted in the marketing of ketchup which, from a standpoint of sound and clean material used and sanitary methods of handling, is decidedly superior to that placed on the market two or three years ago. Continued attention was given to the inspection of canning establishments engaged in the packing of salmon.

CHEESE.—Special attention was given to the interstate shipment of short-weight cheese. As a result of this investigation in certain sections of the South, more than 30 shipments, each of considerable quantity, were confiscated.

STOCK FEEDS.—In the early part of the year attention was given to the shipment of damaged grains sold for stock-food purposes. After confiscation of one or two shipments of such goods, however, further attention by inspectors was arrested pending an extensive investigation by another bureau of this department to determine the wholesomeness or unwholesomeness of water-damaged grains.

MISCELLANEOUS.—An investigation was made of the character of foods dispensed by railroad companies on the dining cars which plied between interstate points. Samples of manufactured drugs and other pharmaceutical products were collected for the drug division. In cooperation with the bacteriological laboratory an examination was made in several States of the various propagating grounds used by oyster and clam growers. Several seizures of shipments of both oysters and clams and a great many criminal prosecutions were instituted as a result of the apprehension of shipments and the collection of samples found to be polluted and grown in polluted waters.

Upon complaint from citizens residing along the Mexican border in the States of Texas, New Mexico, and Arizona, an investigation was made of the character of meat and meat-food products imported from Mexico, which, because of certain laws governing importations, were exempt from inspection by the Bureau of Animal Industry.

The inspection of food and drug supplies shipped to and offered for sale in Alaska, begun during the summer months of 1911, was concluded before navigation closed late in the same season, and the results indicate the wisdom and necessity of regular inspection in that Territory.

One of the special assignments of interest to the inspection force was an investigation of the preparation and exportation of horse meat by an eastern firm. This product was offered for sale in Holland, where there is an extensive traffic in such meat. The firm processing and packing the meat was one engaged in the purchase of carcasses of dead horses and cattle, as well as fat from various sources, which was rendered into tallow. As far as known this was the only business of the establishment. It was soon determined that in the course of their legitimate work certain cuts or sections from the carcasses of horses brought for consignment to the rendering vats were transported to a near-by building and pickled for exportation for human consumption, directly contrary to the provisions of the law, which deems a meat adulterated if it be from an animal killed otherwise than by slaughter. In the course of this investigation it was necessary to assign several inspectors to the collection of the different phases of evidence necessary to establish a violation of the law. After the required testimony had been obtained, but before the exportation of the shipment under surveillance, the packers were informed of the operations of our inspectors through the treachery of a local health inspector with whom our men had cooperated. All of the facts in the department's possession were submitted to the State authorities and an action was instituted under the State law.

Another class of trade which tested the ingenuity of the inspectors giving attention to the matter was locating and stopping interstate shipments of rotten eggs which were labeled for technical purposes only, but which after arrival at destination were broken, frozen, and subsequently sold to baking establishments for use in food products.

While undertakings of this character are important, they require the exercise of patience and caution and the exclusive time of several inspectors; in fact, more than can at present be spared from the regular routine inspection work, which involves the attendance as witnesses at trials. It is believed, however, that it will be practicable to give more attention in the future to this line of work, particularly if whatever increase there may be to the present small inspection force approaches the number adequate to supervise the tariff in food and drug products with that degree of thoroughness necessary for the efficient enforcement of the law.

INSPECTION LABORATORIES.

WASHINGTON DRUG INSPECTION LABORATORY.

During the past year the Washington drug inspection laboratory has examined 809 samples, as follows: One hundred and sixty-five check analyses of imported drugs, 40 import products coming directly under this laboratory, and 604 samples of domestic products. Of the last class, 132 (22 per cent) were found to be either adulterated or misbranded, or both. Two hundred and nine cases of interstate drugs adjudged to be adulterated or misbranded were prepared in this laboratory and reported to the chief of the bureau for transmission to the Board of Food and Drug Inspection. Import drug cases, representing detained shipments not reported directly to the collectors of customs upon precedents, were referred to this laboratory. Two hundred and eight import drug cases were prepared for the board, of which 196 were found to be in violation of the law and 12 were released without prejudice.

DOMESTIC DRUGS.

The scope of the work during the past year has been more extensive than in previous years. Much time has been devoted to pharmaceutical preparations, as tablets and pills having a declared standard and intended principally for physicians' prescriptions. Many of these preparations contained one or more such active constituents as opium, morphin, codein, cocain, nux vomica, strychnin, hydrastin, atropin, aconotin, caffenin, nitroglycerin, and inorganic medicinal agents. An investigation of these medicinal mixtures has in a number of instances revealed wide variation in the quantity of active medicinal agents represented to be present and that actually found.

A study has been made in detail of the conditions under which these products are manufactured and the difficulties presented in the production of this class of pharmaceuticals.

The examination of a number of samples of crude drugs, fluid extracts, and tinctures shows that the quality of these products are superior to those of previous years. This is no doubt due largely to more efficient and rigid inspection at the ports of entry than heretofore.

An investigation of bitters of the Fernet type has been continued and a number have been found to be of domestic origin, some containing methyl alcohol labeled in a manner to imitate imported products.

As in previous years, a number of proprietary medicines have been found in violation of the law in that drugs required to be declared were either not declared or else improperly stated. In some instances products intended for external use and represented to be harmless contained poisonous mercury compounds. The quality of the hydrogen dioxid upon the market has materially improved, but in many instances the retail packages were found to be below the strength specified in the United States Pharmacopœia. Care in manufacturing, bottling, shipping, and storing no doubt has a marked influence upon the quality of this commodity. A number of pepsin preparations were essentially without proteolytic activity.

IMPORTED DRUGS.

The inspection at the ports of entry during the past year has been more efficient, and the quality of crude drugs permitted entry has been superior to that of previous years.

The importations of ergot, as a whole, offered for entry during the last year were of inferior grade. Many shipments have been found to contain small, shriveled, worm-eaten, and deteriorated ergot. Portions of these shipments were rendered satisfactory by cleaning. A number of shipments of senna siftings were found to contain excessive quantities of sand, dirt, and other foreign material. In some instances it has been found practicable to reduce the ash from about 18 to 9 per cent by subjecting the drug to a process of cleaning. It is of interest to note that the market price of senna siftings is $7\frac{1}{2}$ to $8\frac{1}{2}$ cents per pound, whereas the whole senna leaf (Alexandrian senna) is quoted at 21 to 25 cents a pound.

A number of importations of anise, cardamom, fennel, and coriander have been detained owing to the excess of small gravel, sand, dirt, or foreign seed contained in such products, and a special investigation of the methods of analysis of these products is being conducted in connection with the branch laboratories and the microchemical laboratory. Consignments of uva ursi, buchu, and cubebs containing an excess of stems have been less frequent during the last fiscal year than previously. A number of importations of asafetida have been found adulterated with comparatively cheap foreign gums. As a whole, however, the quality of asafetida has improved materially. Many importations have been found to contain alcohol, soluble matter in excess of the requirements of the United States Pharmacopœia.

Many importations of proprietary medicines have been detained because of the lack of declaration or the incorrect declaration of drugs required to be declared, or misrepresentations regarding constituents and properties of the preparations. Importations of products containing opium, morphin, or codein prepared in the form of confections have been denied entry. The basis for this action is that there is nothing to prevent these attractively flavored products being used as confectionery, and the presence of such drugs as opium, morphin, and codein would render them dangerous to health and in violation of section 11 of the law.

SPECIAL INVESTIGATIONS.

MORPHIN.—Considerable work has been done with a view of devising methods for the determination of morphin generally. The results of this investigation have been encouraging. Some new facts have been brought to light which have led to the development of simple, rapid, and accurate methods for opium, opium preparations, morphin tablets, and the simpler liquid mixtures containing morphin. Further work is being pursued looking toward the application of these methods to sirups and the more complex liquid mixtures. In case of liquids containing glycerin promising results have already been obtained.

In this connection the United States Pharmacopœia method has been studied, with the result that its chief source of error has been definitely traced and a good idea obtained of the magnitude of the error.

CHLOROFORM.—In order to obtain methods for the determination of small amounts of chloroform in medicinal products, a broad study has been made of the reaction velocity between alcoholic potassium hydroxid and chloroform. The information thus gathered has been made use of in routine analyses.

During the last fiscal year investigation has been made for the purpose of securing a method for the determination of nitroglycerin in medicinal tablets. Two methods found in the literature have been successfully adapted to the purpose. Much work based on these methods has been done by various analysts in the division of drugs and the methods have now been made the subject of cooperative work by the Association of Official Agricultural Chemists for the purpose of further testing and, if possible, improving them.

Investigations have been continued upon the keeping qualities of liquid pepsin preparations and to the ricin method of assaying pepsin and testing for small quantities of it in the presence of other substances. Some commercial preparations while retaining nearly their full activity in cold storage lose much of their proteolytic power when stored at room temperature; others are fairly stable even at room temperature. The Jacoby-Solm modification of the ricin assay has been specially studied, and as further modified in this bureau it has been satisfactorily used for the detection of pepsin in chewing gum and in assaying galenicals for pepsin. The method is now being tried out by cooperating chemists throughout the United States, and it will later be submitted to the Association of Official Agricultural Chemists for their consideration.

WASHINGTON FOOD INSPECTION LABORATORY.

The work of the Washington food inspection laboratory during the past year has changed to a certain extent, more than ever turning toward the executive work in connection with the enforcement of the food and drugs act. In fact, at the present time the chief work of this laboratory is the consideration of reports made by the branch laboratories on food products. This work is divided into two parts:

First, interstate cases: All of the analytical reports made by the branch laboratories on food products, with the exception of those

reports having to do with flavoring extracts and dairy products. This work requires a study of every analytical report submitted, of which approximately 5,000 were handled during the year. Where the report shows a violation of the law, as in 2,034 instances, a case was prepared for the consideration of the Board of Food and Drug Inspection, hearings were held, testimony considered, and a recommendation was made to the board, with the submission of the evidence available to maintain the action.

Second, the import food cases: About 7,800 analytical reports from the branch laboratories were considered to see whether or not the conclusions reached by the branch laboratories were confirmed. Attention was also given to 741 special cases, representing all of the new points raised under the law and all cases upon which the laboratories are not instructed to act directly with the collector of customs under established precedent. Of these 741 cases, 558 were reported to the Treasury Department as representing adulteration or misbranding under the act and 183 were recommended to the Secretary of Agriculture for release. In each of these 741 cases samples were submitted by the branch laboratories with their reports, and check analyses had to be made before the final action.

Another part of the executive work in connection with the food and drugs act is the distribution of check samples, the receiving and recording of food samples sent to Washington, and the care of seeing that the proper exhibits are sent to the United States attorney concerned in each of the cases reported for prosecution.

MISCELLANEOUS INVESTIGATIONS.

CIDER VINEGAR.—In order to meet certain questions which were raised in a number of vinegar trials during the past year, the work on cider vinegar was extended to the study of the manufacture from the raw material through to the finished product. A field laboratory was established in Lyons, N. Y., in the early fall, and samples of the fresh apple juice made each day through the pressing season were taken and examined. About 250 samples of the fermented cider at various stages and the vinegar made from this cider were also examined, so that now there are complete data upon the changes taking place in fermentation of the fresh apple juice to the final acetification in the generator, on about 1,500,000 gallons of cider made during the past year, and the laboratory is in a better position than ever before to maintain the actions which have been begun under the food and drugs act for the adulteration of cider vinegar.

MALT LIQUORS.—A special study of the composition of malt liquors made on a factory scale from various materials was carried on during the past year to show the effects of the various raw materials used in the manufacture of beer, ales, etc., upon the finished product. Six large breweries cooperated, so that the investigation included seeing the raw materials weighed out and following them through the various steps. Analyses were made of samples taken at various stages, including the fresh wort, the new fermented products, and the finished, matured products as they go on the market. One hundred and thirty-one samples of beers, ales, and worts were analyzed, and as a result the composition of various samples taken on the market can be known with certainty; this information has already proved correct in a number of cases brought under the enforcement of the act.

An investigation has also been made of the methods of manufacture in a large number of such establishments and a study made of the various raw materials used.

GELATIN.—For the investigation of the manufacture of gelatin during the past year arrangements were made with a number of manufacturers of gelatin to allow their methods of manufacture and the effects of various forms of treatment upon the finished product to be studied. The bacteriological laboratory cooperated, giving special attention to the source of bacterial infection during the process of manufacture. A field laboratory was established in first one, then another, large factory where various forms of raw material were used. A careful study has been made regarding the effect of the use of sulphurous acid on the content of bacteria in the finished product and also on the occurrence of harmful metals in the product.

During the last year attention has been given to the addition of arsenic and lead to food incidentally in the method of manufacture and without intention or knowledge of the makers. Arsenic has been found to be added from its presence in coloring matter, shellac, and such products as phosphates by reason of the material from which prepared. Lead is almost universally contained in the tartaric acid on the market, and a study was made of the manufacture of tartaric acid and cream of tartar. The presence of lead was found to be due to the use of lead receptacles and pipes and lead-lined vacuum pans, and to the fact that in the attempt to remove it in the manufacturing establishments the solution to which hydrogen sulphid is added is too concentrated and at too high a temperature.

FOOD COLORS.—A special feature of the work of the food-inspection laboratory has been the examination of colors, especially work on samples where disputes have arisen as to the identity of the coloring matter present. Further, the study of the methods of detection of colors has been continued, and a large number of fruit samples prepared for comparison with samples which are brought in for examination. During the year a set of the coal-tar dyes, which have been used in food products, was prepared and furnished to all the branch laboratories. Much of the time was given up to the study of the identification of the coloring and facing materials used on teas, for the information of the Treasury Department.

The question as to the normal ash content of certain samples of imported red pepper, notably the Spanish pimenton, was raised, and in order to decide whether or not the standard used by the department in judging these products was correct 161 samples were examined, with the result that it was found that the limit on ash was decidedly too low for certain Spanish products which were perfectly normal in their composition; as a result it has been necessary to raise the standard of ash.

BRANCH LABORATORIES.

GENERAL TABULAR STATEMENT.

The 22 branch laboratories maintained at the principal ports of entry for imported food and drug products and at the centers of distribution of domestic food and drug products are concerned principally with the work of enforcement of the food and drugs act.

Since the last report was issued the laboratory at San Juan, P. R., was established and began work in September, 1911.

The following tabulated statement from the reports of the branch laboratories indicates the nature and extent of the work accomplished. Comparison can not be made of the results of individual laboratories because of the varying conditions, size of forces, and periods of time required for routine and court work.

Food and drug samples examined in the various branch laboratories during the fiscal year ended June 30, 1912.

Laboratory.	Imported samples.				Interstate samples.			Miscellaneous samples.	Total samples analyzed.	Hearings.	
	Legal.	Illegal.	Released with out prejudice.	Floor in-spection samples.	Legal.	Illegal.	Check anal-ysis.			Personal.	By corre-spondence.
Boston.....	115	198	270	7,278	308	239	31	128	1,289	322	92
Buffalo.....	103	35	14	107	102	131	22	89	496	59	120
Chicago.....	208	196	7	2,870	263	323	72	59	1,128	279	161
Cincinnati.....	66	6	9	276	260	121	98	84	644	169	142
Denver.....	22	8	4	44	75	116	10	105	340	22	14
Detroit.....	43	25	6	258	144	54	14	66	352	51	206
Galveston.....	18	10	2	116	195	181	2	34	442	4	12
Honolulu ¹	14	48	0	791	0	1	0	3	66	18	26
Kansas City.....	11	5	1	20	106	192	25	72	412	58	34
Nashville.....	29	4	.....	6	181	100	22	8	344	20	74
New Orleans.....	139	58	46	3,624	109	169	21	89	631	123	11
New York.....	4,064	2,307	527	50,272	285	482	269	537	8,471	1,735	1,015
Omaha.....	.....	.....	.....	.....	165	76	4	29	274	24	17
Philadelphia.....	502	183	70	6,015	103	58	23	85	1,024	229	72
Pittsburgh.....	21	3	2	95	83	182	23	105	419	53	68
Portland.....	75	43	4	4,442	101	145	6	124	498	37	13
St. Louis.....	2	3	.....	.....	438	591	40	51	1,125	286	156
St. Paul.....	52	6	1	160	75	117	14	356	621	24	29
San Francisco.....	407	264	17	14,967	144	169	88	172	1,261	333	128
San Juan ¹	87	56	28	1,241	.....	.....	.....	.....	171	81	3
Savannah.....	256	76	20	128	112	147	8	90	709	10	64
Seattle.....	101	110	19	3,698	43	30	22	376	701	127	33
Total.....	6,335	3,644	1,047	96,408	3,292	3,624	814	2,662	21,418	4,064	2,490

¹ For seven months only.

BOSTON LABORATORY.

The work of the Boston laboratory has been about equally divided between the imported and interstate food and drug products.

The study of the arsenic content of shellac and the contamination of foods from this source was continued, and the results obtained were published in Circular 91 of the bureau. At the beginning of this investigation all of the shellac imported contained appreciable quantities of orpiment, the yellow sulphid of arsenic, which was added in India primarily for the purpose of improving the color of the shellac. It is now possible to obtain shellac in commercial quantities free from arsenic.

A milk campaign was carried out at Providence, R. I., in order to determine the character of the interstate milk shipped to that city. About 15 per cent of the samples examined were found to be watered, skimmed, or bacteriologically bad. Twenty-eight of these shippers have paid fines, and a large number of Providence milk cases are still pending.

The traffic of fresh raspberries and blueberries from New Brunswick and Prince Edward Island to Boston, for manufacturers of

jam, pie fillings, and similar foods, has seemed to be undesirable from the standpoint of food-law enforcement because of their fermented condition when they arrive in Boston. One of the largest receivers has discontinued the old method of having the berries shipped to Boston and is packing them in a factory on the Maine border, where the fruit may be received in a much more satisfactory condition. It seems to be impracticable to pack the goods at the place of production because of the duty of 35 per cent and 1 cent a pound.

During the past year great improvement has been made by a number of food manufacturers of New England in regard to their factories. Several have moved into new buildings and others have greatly improved existing sanitary conditions. There is an apparent tendency on the part of the higher-grade manufacturers of foods and drugs to get away from the use of artificial colors and preservatives in so far as possible, and a great majority of the food manufacturers and dealers evidence a willingness to cooperate with the department in its enforcement of the law.

CHICAGO LABORATORY.

FOOD AND DRUG INSPECTION.—The imported foods and drugs received at the port of Chicago consist chiefly of wines and liquors, tea, cheese, olive oil, olives, dried fruits, macaroni, tomato sauce, preserved and tinned fish, cacao, crude drugs, and medicinal beverages. Within the past year the food products most frequently at fault have been Italian cheese made from skimmed milk but not so declared, cordials containing artificial color without declaration, so-called gluten or diabetic biscuits with false or misleading claims, figs unfit for consumption because of worms and excreta, fruit extracts containing artificial flavors, and Dutch cocos without a statement of added alkali. The imported drug products at fault have been chiefly crude drugs not conforming to the United States Pharmacopœia, bitters, and other medicinal preparations without a declaration of alcohol.

The work of this laboratory is largely the examination of interstate food samples and the study of methods pertaining thereto. Among the common forms of adulteration and misbranding which have been detected during the year are the following: Flour bleached to conceal inferiority, condensed milk below standard, eggs decomposed and unfit for food, phosphate and alum baking powders containing arsenic, cream of tartar and cream of tartar baking powders containing lead, so-called egg noodles containing artificial color and but little or no eggs, sweetened coco sold as powdered sweetened chocolate, compounds of coffee, cereals, and chicory improperly labeled, mustard flour adulterated with charlock, ground mace adulterated with Bombay mace, black pepper containing added pepper shells, paprika containing added oil, prepared mustard containing mustard hulls and artificial color, maple products adulterated with cane products, confectionery containing talc and unpermitted colors, misbranded mixtures of olive oil and cottonseed oil, imitation cider vinegar sold as genuine, imitation extracts substituted for true extracts, fruit products variously adulterated with apple juice, improperly declared glucose, acid phosphate of lime, artificial colors, etc.

INVESTIGATIONS.—Methods for the determination of acidity and nitrites in the same weighed portion of flour have been studied and

a definite procedure recommended. Studies of methods of detecting chlorin bleaching have also been undertaken. The invention of the homogenizer has led to the manufacture of emulsions of butter, oleo oil, and cottonseed oil, with milk or skim milk, and the substitution of these products for cream, both for table use and the manufacture of ice cream. Examinations made of such products brought out the lack of suitable methods of readily ascertaining the nature of the fact, and to meet this need a method has been devised which has been tested for two years in cooperation with members of the Association of Official Agricultural Chemists with satisfactory results. Certain difficulties have been overcome in the detection of charlock, a weed seed separated from grain grown in the Northwest, extensively used to adulterate mustard flour and prepared mustard. A method of determining vanillin, coumarin, normal lead number and color values of the lead filtrate has been finally perfected and this, together with other methods, has been employed in the analyses of about 100 standard extracts prepared in the laboratory. A process of preparing the solution preliminary to the determination of tin has been developed and certain studies of methods for detecting other heavy metals undertaken.

NEW YORK LABORATORY.

IMPORTED FOODS.—As in previous years, the principal work of the New York laboratory was the inspection and examination of imported food and drug products. During the past fiscal year about 110,000 invoices of food and drug products were examined, from which 6,900 samples were taken and analyzed, an increase of about 1,700 samples over the previous fiscal year.

The examination of figs and black olives has been continued and a great improvement was shown in the quality of both of these products, especially in the figs from Turkey. The examination of green coffee from Java was undertaken, and the so-called "skimmings" were either shipped out of the country or picked and cleaned before being released.

During the year a number of imported insecticides were taken, and a large number of hearings under the insecticide act of 1910 were held on insecticides of domestic manufacture.

WHARF WORK.—At this port more than 50 per cent of the total importations are what are known as wharf examinations, and in the past great difficulty has been experienced by this department in obtaining samples promptly of perishable or semiperishable merchandise. In order to obviate as much as possible this difficulty, a system of wharf examination has been established during the year, two men being assigned especially for this work. This in a measure accounts for the large number of additional samples examined during the past year, and has proved so satisfactory it is hoped during the coming year that the work can be further expanded, so that many examinations of perishable food products, such as chestnuts, black olives, etc., can be made directly on the wharf, and if examination shows the quality satisfactory no official sample will be taken. This will to a certain extent relieve the office force of considerable clerical work.

GELATIN.—Among the substances regularly examined may be mentioned gelatin, which was found in many cases to contain surprisingly

large amounts of arsenic. From evidence secured from dealers it seems fairly well established that arsenic enters the gelatin through the raw material from which it is made or from acid used in the process of manufacture. Hides intended for the manufacture of leather are often treated with arsenical preparations in order to destroy the germs of contagious diseases, and when, through accident or carelessness, the trimmings from such material enter the gelatin stock, contamination with arsenic results. As a consequence of the analytical problems resulting from the estimation of arsenic in gelatin and in a great variety of other substances, it was found necessary to evolve rapid and accurate methods for this determination. Existing methods involve a long and tedious destruction of organic matter before the arsenic can be separated and determined. A method has been devised at this laboratory whereby this procedure is replaced by more rapid and accurate processes, and new means have been found by which amounts of arsenic ranging between very small and very large proportions can be conveniently estimated. (See Circular 102, Bureau of Chemistry.) This last process differs from those already in vogue in that the old method provided for the estimation of small amounts, ranging from traces to about 100 parts per 1,000,000, and for amounts greater than one-tenth of 1 per cent. The new method provides for the determination of amounts between the limits just given.

COLORS.—Investigation of methods for separating and identifying coal-tar colors in foods has been continued, and much new information on this subject has been obtained.

VINEGAR.—The study of vinegar has been continued during the past year by a chemist who has visited various plants where vinegar was made, a thorough examination being conducted of the initial, intermediate, and finished products, with a view to securing such data as will enable analysts to detect the extremely ingenious and sometimes baffling methods of sophistication practiced by some manufacturers. A prominent feature of the vinegar work has been the determination of formic acid in vinegar, adulterated with acetic acid made from pyroligneous acid.

LEAD.—The analytical estimation of lead in phosphate and alum baking powders has been studied at this laboratory during the past year with satisfactory results.

A. O. A. C. WORK.—Members of this laboratory have cooperated with the Association of Official Agricultural Chemists in the study of analytical methods for coffee, coco and chocolate, spices, colors, vinegar, flavoring extracts, heavy metals, moisture, egg noodles, and condiments.

DRUG WORK.—A new drug laboratory was established during the past year and the work in this line has greatly increased. The investigation of asafetida has been continued. Color reactions for the purity of this drug have been established, as well as a quantitative constant in the lead number of the purified resin. The semicarbazid method for benzaldehyde has been elaborated and applied in general to the aromatic aldehydes with satisfactory results. Particular attention has been paid to the estimation of morphin, and the investigation has shown that the morphin sulphate used in hypodermic tablets is usually adulterated with codein. The separation of morphin, codein, and atrophin has been studied and a method devised. The de-

tection of small quantities of quinin in bitters containing chinchona alkaloids has been studied, and the modified thalleoquin reaction was found to be capable of detecting as low as one one-hundredth of a milligram of quinin.

OTHER LABORATORIES.

BUFFALO LABORATORY.—During the year 147 samples of imported foods and drugs were submitted to this laboratory by the ports assigned to its jurisdiction. Conferences have been held with dealers and manufacturers regarding the labeling of their products and inspections made of factory methods. A method for the determination of milk solids in milk chocolate, especially for the estimation of casein, has been modified after an examination of 24 samples of coco butter. Various methods for the determination of fat in dried milk have been tried with some better success than last year. In the study of grape juice it was found that when cane sugar was added to the juice, in a few days much of the sucrose was changed to invert sugar, and after a month all of it was so inverted, thus making it practically impossible for an analyst to state positively from his sugar determinations only that sucrose had been added to the juice.

CINCINNATI LABORATORY.—In addition to the analysis of regular samples, hearings and routine investigations were made of the milk supply of Cincinnati and of the method of manufacture and the chemical properties of maraschino and maraschino cherries.

DENVER LABORATORY.—The studies of commercial vanilla extracts have been continued, a special effort having been made to determine the limits of composition of extracts made according to the United States Pharmacopœia formula, with particular reference to the vanillin content, color value, and the so-called lead number. A practical method has been devised for determining minute quantities of coumarin in the presence of vanillin. (See Circular 95, Bureau of Chemistry.) A promising method for the determination of the amount of oil of peppermint in alcoholic solutions, making use of the refractometer, has been devised. In collaboration with other bureau laboratories studies have been made on the composition of berry fruits sold in the Denver market.

HONOLULU LABORATORY.—The principal work was on oriental imports. Particular attention was given to the labeling of Chinese and Japanese drugs as to alkaloidal, alcoholic, and acetanilid content, and to the use of coal-tar colors in food products.

KANSAS CITY LABORATORY.—A considerable amount of investigation was undertaken on flour bleached with agents other than nitrogen peroxid, and some valuable preliminary results obtained. This work will, however, have to be greatly extended before definite conclusions can be drawn.

NEW ORLEANS LABORATORY.—A few of the Italian importers of New Orleans have been adding about 30 per cent of cottonseed oil to their imported olive oil after it has passed the inspection of this laboratory and selling it locally as pure olive oil. Since the discovery of this practice all olive-oil importations have been reported to the State food commissioner as soon as the inspection by this laboratory is completed.

OMAHA LABORATORY.—During the months of July, August, and September, 1911, the regular force of this laboratory with additional as-

sistants was engaged in the special egg investigation conducted at Omaha by the food research laboratory. In April, 1912, preparations were made for resuming this work, which commenced in May and continued throughout May and June.

PHILADELPHIA LABORATORY.—During the year certain investigations have been carried on, among which were studies of the best methods of estimation of crude fiber in prepared mustard and examination of certain samples of paprika pods of known history for the purpose of obtaining data of value in the detection of added oil. Various types of cherry products obtained from wild and cultivated and the maraschino cherry, both commercial and of known origin, some home made, have been examined during the year, in order that the composition of various cherry products could be determined. In the course of the examination of some of these commercial samples one product sold as wild cherry was found to contain considerable quantities of formic acid, which was undoubtedly added as preservative. Investigations were also made on methods for the separation and identification of coal-tar colors in mixtures and on various flavoring extracts of known composition. A considerable amount of time throughout the year was required in obtaining evidence regarding the views of the trade on ingredients, methods of manufacture, etc., on "Apricot cordial" and "Best quality white syrup;" also as to the meaning of the term "Mocha" coffee as it is understood at the present time among wholesale grocers. During June a small milk campaign was conducted, in which about 100 samples of milk, which had been in interstate commerce and intended for consumption in Philadelphia, were examined; the milk was generally a very high grade, and only a few samples were found to which objection could be made.

Owing to the shortage of the potato crop last year vast quantities of potatoes were imported through this port during the winter and spring from Ireland and Scotland, and the laboratory was required to condemn large quantities of potatoes, which had been frozen either on the boats or on the piers before delivery or had rotted in transit. During the year at various times chemists from Washington were stationed here temporarily for the purpose of conducting certain investigations into the methods of manufacture, ingredients, and composition of beer, particularly all malt beer made without the use of any malt substitutes. The manufacture of gelatin was investigated in somewhat the same manner.

PITTSBURGH LABORATORY.—A number of samples were examined for the Treasury Department and assistance given the Post Office Department in a drug case which involved the use of the mails for fraudulent purposes. The offender in this case received both a fine and jail sentence. Cooperation with the internal-revenue department resulted in the seizure by this department of a quantity of so-called temperance beer shipped into dry territory and the securing of a number of cases against the offenders by this department, these products being beer under another name. Assistance was rendered the Pennsylvania State authorities against varnished candies and has resulted in their elimination from the markets of this State, the fudges which were the principal kind of candies varnished having now the natural dull appearance due to the ingredients used. A few samples of candy varnished with shellac were found to contain

a small amount of arsenic in the varnish, the arsenic being added as sulphid in India for the purpose of coloring the product. A considerable number of fermented and distilled liqueurs and cordials were examined. A striking feature of the examination of the products submitted showed nearly all of them in violation of the law, the greater part of these being labeled in a manner implying that they were of foreign production when they were not.

PORTLAND LABORATORY.—Special work included: A study of methods submitted by the Treasury Department for detection of color and facing in tea, a study of the method for the detection of pepsin in gum, a study of the manufacture of vinegar at Salem, Oreg., and cooperative work on fruits.

ST. LOUIS LABORATORY.—During the year a certain amount of work was done at the request of the purchasing commissary of the United States Army, and cordial relations have been maintained between the two departments. A certain amount of work has also been done and various consultations held for the Internal-Revenue Division of the Treasury Department, aiding them to quicker action in cases which might be pending.

SAN FRANCISCO LABORATORY.—The work of the San Francisco laboratory during the year has been of a different character than that of the preceding year in that the subject of oriental proprietary medicines has been under investigation. Of the imported samples, 36 per cent were oriental drugs, and 40 per cent of the oriental drug samples examined were found to be illegal. Twenty per cent of the import samples examined were made up of tea, examined for coloring and facing. Of the domestic samples fruit products, fermented and distilled liquors, flavoring extracts, and saccharine products constitute the major portion. A number of analyses have been made of typical California fruits of varying degrees of ripeness to note their change in composition. During the latter part of the year the time of one man has been devoted to the analyses of fruits in connection with the experimental cannery established in San Francisco for the study of fruit-canning problems peculiar to California. A preliminary report on the nature and composition of gases given off by roasted coffee has been prepared, the investigation not being fully completed at this time. An investigation into a method for the separation of sound oranges from frozen oranges, based upon the specific gravity of the fruit, was undertaken, and considerable data collected, but with results which indicate that a commercial method for the positive separation of frozen from sound fruit is impracticable. A special investigation of all the breweries within the city of San Francisco was carried out to decide certain questions relative to what the brewers considered to be the proper raw materials with which beer should be made.

SAVANNAH LABORATORY.—A number of samples were examined for local branches of the War and Treasury Departments and two special investigations were begun which have not yet been completed. In the late spring a preliminary investigation of the oyster canning industry in the vicinity of Savannah was undertaken for the purpose of looking into the sanitary conditions, source of supply of raw material, and collecting data connected with the canning of oysters. Because of the suspected relationship between spoiled corn and pellagra, and the impossibility of the average consumer distinguishing

meal made from spoiled corn from that made from sound corn, an examination of the meals and grits offered for sale in the Southern States has recently been undertaken. The results show that 100 per cent of the meals examined had undoubtedly been made from spoiled corn, although in appearance they could not be told from meal made from sound corn.

SEATTLE LABORATORY.—The analytical studies and investigations included the changes in composition of fresh fruits (raspberries) due to keeping, the composition of noodles with varying egg content, cooperative work for the Association of Official Agricultural Chemists on heavy metals in foods, especially tin, and on headache mixtures, camphor, and food colors, composition of soy-bean products, and the canning of salmon.

EXAMINATION OF DAIRY PRODUCTS.

The work of the dairy laboratory, as in previous years, has covered the entire range of dairy products, including other articles closely related thereto, such as ice-cream thickeners or fillers, butter colors and flavors, malted milks, lactated infant foods, and other articles of minor importance. The total number of samples examined was 422, of which 372 were official interstate and import samples, the remaining 50 being of miscellaneous origin and consisting chiefly of samples examined for other departments of the Government. A classified list of the samples examined is as follows:

Evaporated milks	129
Sweetened condensed milks	39
Cheese	84
Butter	64
Dry milks	14
Fresh milks	37
Cream	21
Oleomargarins	12
Ice creams	3
Ice-cream thickeners	5
Malted milks and lactated foods	4
Miscellaneous, butter colors, butter flavors, artificial cream, etc.	10
Total	422

The greater part of the work under the food law during the year was upon evaporated, condensed, fresh and dry milks, cheese, and butter. In canned evaporated milks the most common fault is that of low concentration—thin milk. Several shipments have been seized because of low concentration and the goods condemned by the court.

A number of prosecutions have been brought on the misbranding of American cheddar cheese, showing excessive shortage in weight. The stenciled or pencil-marked weights placed on the boxes at the factory are too often assumed to be correct, without check or modification, even after the product has been for months in storage. Even if the factory weights were originally correct, which should not be blindly assumed, it is evident that a considerable shortage may occur when goods fresh from the factory are stored for several months and then sold on the original marked weights.

Another form of misbranding cheese is found in the labeling of "skims" or "part skims." In two cases the term "light skim" was

made use of in labeling cheese from which two-thirds or three-fourths of the fat had been removed from the milk at the time of manufacture of the cheese. In other cases "part skims" were sold as "full creams," or simply as "cheese," which is the same thing.

The sale of bulk condensed milk, both sweetened and unsweetened, that has been skimmed or partly skimmed for genuine condensed milk is still a more or less common practice.

Violations of the law in the butter trade consist mostly of the sale of butter containing an excessive amount of water, the substitution of oleomargarin for butter, and sometimes the sale of short-weight butter in pound prints.

A classified list of the cases prepared by this laboratory is as follows:

Milks and creams.....	157
Cheese.....	61
Evaporated milks.....	32
Ice creams.....	3
Sweetened condensed milks.....	13
Butter.....	16
Total.....	282

Of these 114 were prepared from analyses made in the branch laboratories of fresh milks, condensed milks, cheese, and butter. As usual, work has been done in the study of methods for the analysis of dairy products.

The decrease in the number of samples examined during the year is accounted for in a great measure by the small laboratory force for more than one-third of the year, due to two resignations.

SPECIAL INVESTIGATIONS.

PHYSICAL CHEMISTRY.

During the past year the study of an improved method for estimating sugar in foods and drugs by the use of the enzyme invertase has been continued, with good results. A large number of analyses and measurements have been made, and the use of invertase, which was favorably commented upon in the last report, has proved to be the best method for determining sugar in these products. A study of the occurrence of cane sugar in honey, in which invertase was used for the estimation, has shown that the amount of sugar in genuine honeys is considerably lower than has been heretofore supposed. Other studies included the chemical properties of the sugar raffinose, which occurs in many foods and drugs, a method for obtaining this sugar from cottonseed meal, and a method for estimating maltose and lactose in foods and drugs.

In March a study of the physical and chemical problems involved in the commercial manufacture of candy was begun and is now in progress. The causes for the aging of candy, which in some cases involves chemical changes producing rancidity and in others only physical changes, such as granulation of the sugar and hardening of the candy, are being investigated, as well as the influence of glucose, invert sugar, and like substances upon the character and keeping qualities of all of the common types of candy.

PLANT PHYSIOLOGICAL CHEMISTRY.

The work of the Laboratory of Plant Physiological Chemistry has been continued along practically the same lines as in former years. Besides the extensive collaborations with the various offices of the Bureau of Plant Industry, an extensive investigation of the methods of baking bread and of the conditions of the bake shops of the large cities in this country has been begun. An investigation has also been undertaken of the use of coloring matter in macaroni and the differences between macaronis made from different classes of flour.

Over 1,200 samples have been received in this laboratory during the past year, 600 being cereals, 300 flours, 40 macaronis, 120 other cereal products, 50 of foliage, 60 of beet roots, practically 100 of alkaline extracts, and over 100 miscellaneous samples, such as soy beans, hay, blueberry stems, etc. The work on these samples has necessitated the making of about 15,000 determinations.

Bulletin 138 gives the results of a study of the changes in composition which the wheat seed undergoes during the first two or three weeks of germination and growth, while Bulletin 149 gives the results of growing wheat seedlings in solutions of various degrees of acidity and alkalinity. This latter bulletin has a practical agricultural value in explaining why soils treated with ammonium sulphate, potassium chlorid, potassium sulphate, and similar substances become acid and refuse to remain productive unless a sufficient amount of lime is added to neutralize the acidity.

Much work has been done on methods of determining the amounts of cholin in ordinary flour and in cottonseed flour. This work may be useful later to show why cottonseed has been regarded as poisonous to young cattle and hogs.

Other subjects investigated have included starch and starch products, potato drying, graham flour, and canning tomatoes.

ANIMAL PHYSIOLOGICAL CHEMISTRY.

The work of this laboratory during the past fiscal year has greatly increased over that of the preceding year. There were 669 samples examined, as follows: One hundred and fifty-six of eggs, 396 pertaining to the infant food and cottonseed bread studies, 56 of fish, including canned salmon, sardines, and shad, 11 of meat extracts and bouillon cubes, 28 of gelatin, and 22 of a miscellaneous character, including work to determine evidence that potato chips had been peptonized, the analysis of so-called concentrated food preparations containing meat and chocolate, and the examination of oysters for evidence of decomposition.

The work on the analysis and study of the different brands of infant foods is nearing completion. A number of charts, which were made showing the composition of the different foods prepared according to the directions accompanying each, have been in demand throughout the country in connection with exhibitions on the care of infants and infant feeding.

The work on deterioration and decomposition of foods was devoted largely to studies on eggs. Assistance was rendered in the investigation conducted at Omaha, Nebr., last year and during this

season work is being conducted at a plant in Wichita, Kans., to secure data on desiccated eggs. Work of the same nature was done on samples of reprocessed or "do over" salmon and inferior grades of sardines.

Progress has been made in the study of the manufacture and the chemical composition of gelatin in collaboration with the Washington Food Inspection Laboratory. In collaboration with the Laboratory of Plant Physiological Chemistry a series of feeding experiments with bread on white rats and mice was started. Bread baked from ordinary white flour, graham flour, and bread containing different percentages of cottonseed meal were employed in the experiments, which were controlled by the analysis of the breads, weights of the animals, and the analysis and histological examination of the animals that died during the tests and of those killed at the conclusion.

MICROCHEMICAL EXAMINATIONS.

The microchemical investigations during the past fiscal year have been similar in character to those carried on in previous years, consisting largely of microscopical examination of samples. The volume of work performed, however, has been very much lessened through the resignation of two analysts and because of the time consumed in the preparation and presentation of evidence in connection with cases tried under the food and drugs act.

Certain investigations, however, have been conducted in the nature of spoilage of fruits and fruit products, nuts, and similar substances, which, through careless handling, may have been seriously affected. In the line of investigation of fruits visits were made to a few factories where such products were being packed, observations were made as to the kinds of fruits used and the process of handling, and samples of the finished product were examined microscopically. From this work as a basis, standards for judging such products were obtained.

The work begun last year upon the subject of insect powder for the determination of the amount of stem present in normal pyrethrum has been continued as far as time available for such work would allow. A trip was made to an establishment where the flowers were being ground, and samples were taken of the product before and after milling for the purpose of obtaining standards from which to judge of the amount of stem present in unknown samples.

During the fall of 1911, at the request of the Treasury Department, an investigation was begun on the question of detection of coloring matter and facing on teas. This investigation showed that a great proportion of tea was artificially colored or faced and resulted in the devising of a new method, which has, with certain slight modifications, been adopted as the official method of the tea testers of the Treasury Department.

The microscopical examination of proprietary, infant, and invalid foods in collaboration with the section of animal physiological chemistry has been in progress and many samples have been examined. It has been shown that the microscopical examination of these products gives information, not only as to the ingredients used, but also as to the method of manufacture and incorporation of the ingredients.

The work on drugs included an interesting sophistication of cardamom seed, in which many of the seeds were coated with clay, and quite a large portion of the substance was composed of gravel and what appeared to be bastard cardamom. A large number of samples of various drugs have been examined during the year to determine the amount of foreign material present, the results to be used as a basis for arriving at standards for these products. Among the drugs examined to determine the amount of foreign material present should be mentioned, in addition to cardamom, senna, buchu, coriander, and juniper berries.

The routine work has included the examination of a wide range of substances, the largest single item being that of paper. The examination of contract materials has included such materials as fabrics, insect powders, typewriter ribbons, scouring powders, and cotton wastes, this work being done usually at the request of other departments of the Government in collaboration with other laboratories in this bureau. A large number of fabrics, teas, coffees, and spices have been examined for the General Supply Committee.

The work performed under the food and drugs act included the examination of a wide range of substances, among which might be mentioned spices, jams, jellies and preserves, cattle foods, eggs, nuts, sausages, mincemeats, various dried fruits, olives, candies, chocolate and coco products, corn, peas, beans, etc.

Below is given a tabulated list of the number and kind of samples examined during the past year:

Miscellaneous samples:

Papers	1, 979
Foods (chocolate, tomato ketchup, nuts, figs, spices, olives, tea, coffee, etc.)	573
Drugs	231
Textiles	100
Typewriter ribbons	35
Cattle foods	21
Insect powders	20
Scouring powders, etc	13
Miscellaneous	22
Dextrin, miscellaneous foods, etc	72
Total	3, 066

Interstate samples:

Drugs	149
Tomato products (pulp, ketchup, etc.)	356
Jams, jellies, etc	67
Spices	38
Coffee, chocolate, coco, tea, etc	51
Cattle foods	218
Eggs	65
Nuts	53
Sausage, mincemeat	34
Miscellaneous fruits (apples, peaches, cherries, prunes, currants, figs, raisins, etc.)	112
Starchy foods and seeds (biscuit, bread, rice cakes, corn, peas, beans, etc.)	25
Miscellaneous	65
Insecticides	65
Total	1, 298
Total for year	4, 364

ENOLOGICAL CHEMICAL RESEARCH.

The work of this section for the past year has been chiefly along the following lines:

(1) The continuation of the examination of ripe grapes to determine their normal composition. The samples were collected in New York, Pennsylvania, Ohio, and Michigan in the northern grape belt and Virginia in the southern, both from the vineyards and from the factories which make unfermented juice and wines. Two hundred samples of fruit were examined and 1,440 determinations were made.

(2) The study of the composition of grapes for a period of several weeks during ripening. For this work representative plants of the more important varieties used for grape juice and wine, as Catawba, Clinton, Concord, Cynthiana, Delaware, and Norton, were selected and the fruit held intact for the purposes of this investigation. The period of study covered about 12 weeks, 147 samples being examined, comprising 3,381 determinations. The work on the above two lines, coupled with the previous investigation on grapes, resulted in securing valuable data for use as a basis in detecting sophistication of the food products made from grapes.

(3) The study of the composition of apples has been continued and is nearing completion. One hundred and ninety-two samples were examined during the year, comprising 2,658 determinations.

(4) The study of the normal composition of pure wines made from native grapes in this laboratory has received more attention than any other subject during the year. Twelve additional samples were made during the fall of 1911 from standard varieties used for vintage purposes for a special study on the acid elements of the fruit, young wine, and dry wine. The chemical work required 1,136 determinations. Of the wines made in this laboratory in former years 79 samples have been held for critical study on the normal composition both of the organic and inorganic elements, requiring 4,896 determinations. It appears from this work that certain elements, especially in the composition of the ash, are so constant in amount as to furnish very reliable data for the detection of fraudulent articles.

(5) Thirty-nine samples of commercial wine and grape juices have been analyzed for technical studies of their composition. The chemical data comprise 1,014 determinations.

(6) During the past three years much attention has been given to detecting errors in methods for the analytical work necessary on the samples handled in this laboratory. This has resulted in important modifications of the methods now in use for determining tartaric acid, cream of tartar, malic acid, and acid bound to alkaline earths.

(7) The studies with yeast organisms for the year comprised incubator studies to determine fermenting power at low temperature. Three hundred and fifty-two determinations were made on 32 samples.

MISCELLANEOUS INVESTIGATIONS.

WORK OF THE MISCELLANEOUS DIVISION.

The miscellaneous division conducts the examinations of waters, insecticides and fungicides, cattle foods, grains, trade wastes, and hygienic and miscellaneous samples and research work along these lines.

The administrative work and correspondence, especially that relating to the enforcement of the food and drugs act in so far as it applies to waters, cattle foods, and remedies and grains, and the preparation of cases involving the above-mentioned products, have required a large amount of attention from the chief of the division, who is also a member of the Insecticide and Fungicide Board, which has charge of the enforcement of the insecticide act of 1910. Work in connection with this board has occupied about one-third of the time of the chief throughout the year. Some time has been given to travel in connection with inspections of water plants and attending meetings of societies which have for their aim the advancement of science in so far as it applies to the substances considered in this division.

The miscellaneous division during the past year examined approximately 2,105 routine samples, besides a large number in connection with special investigations. Many of the samples required 20 to 30 individual determinations, and few of them required less than 8, so that probably about 25,000 individual determinations were made. In the following table appears a statement which shows in a concise form the number of samples of various materials examined:

Import mineral and table waters.....	43
Domestic mineral and table waters.....	202
Miscellaneous samples, principally waters.....	222
Imported cattle and poultry feeds and grains.....	2
Domestic cattle and poultry feeds and grains.....	502
Miscellaneous cattle feeds and grains.....	729
Import insecticides and fungicides.....	25
Domestic insecticides and fungicides.....	293
Miscellaneous and hygienic samples, principally insecticides and fungicides.....	87
<hr/>	
Total.....	2,105

In conformity with the policy of the Bureau of Chemistry to perform work from other departments of the Government and for other bureaus of the Department of Agriculture when such work is requested, many of the above-mentioned samples represent collaborative work of this character. Following is a concise statement of work performed for other departments, offices, or bureaus:

War Department.....	97
Department of Commerce and Labor.....	5
Members of Congress.....	6
Department of Agriculture:	
Bureau of Plant Industry.....	724
Bureau of Entomology.....	40
Forest Service.....	20
Bureau of Animal Industry.....	9
Office of Experiment Stations.....	10
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Total.....	911

Besides the above classified samples the division examined 54 samples for other divisions and laboratories of the Bureau of Chemistry and different branches of the Government service.

WATER LABORATORY.

During the year the water laboratory examined 467 samples, classified as follows:

Interstate samples.....	202
Foreign samples.....	43
Miscellaneous samples.....	222

Of the 202 interstate samples, 18 were found to be adulterated and misbranded and 2 seizures were made. Of the 43 foreign samples, 8 were found to be misbranded and their exclusion from the United States recommended. The miscellaneous samples examined for this department or other branches of the Government service were received from:

Members of Congress.....	6
Department of Commerce and Labor.....	5
War Department.....	4
Office of Experiment Stations.....	10
Forest Service.....	7
Bureau of Plant Industry.....	7
Unlisted.....	5

Investigations of mineral springs at source have been continued and the collection of the data of the springs of New York, New Jersey, and Pennsylvania has been completed.

An investigation of considerable magnitude was undertaken in collaboration with the bacteriological laboratory for the purpose of determining the character and source of pollution of the Potomac River and the effect of such pollution upon oysters and other shellfish. This work involved the examination of 133 samples of water and two trips down the river in the effort to determine the probable sources of contamination.

Investigation of the radioactivity of certain mineral waters has been continued, with special study of some of the Virginia mineral springs. A limited amount of time has been devoted in collaboration with other chemists of the Association of Official Agricultural Chemists to a study of methods for the analysis of water for sanitary, technical, and industrial purposes, report of which work was published in the proceedings for 1911. The investigation of the character of certain chemicals used in water purification and of their effect from hygienic and sanitary standpoints has been carried on.

The study of methods for the determination of lithium which has been in progress for the past three or four years has been brought to final completion, and the data obtained have been collated and published as Bulletin 153 of this bureau.

INSECTICIDES AND FUNGICIDES.

The composition and methods of manufacture of insecticides and fungicides, as well as the effect they have on foliage, are studied with the idea of increasing their efficiency and suggesting methods of avoiding injury to vegetation, and also of suggesting to the farmer or fruit grower how such products may be prepared. Investigations to improve and discover new insecticides are always under way, and methods of analyzing the various materials of this nature are being studied and any improvements made therein are adopted.

Besides making analyses of insecticides and fungicides for other bureaus of the department when requested, this laboratory is also charged with the chemical examination of insecticide and fungicide samples (other than cattle dips and related products) for the Insecticide and Fungicide Board in connection with the enforcement of the insecticide act of 1910.

During the year 405 samples were analyzed, many at the request of other bureaus, as follows:

Bureau of Entomology.....	40
Bureau of Plant Industry.....	25
Other laboratories and divisions of the Bureau of Chemistry and miscellaneous.....	22
Insecticide and Fungicide Board:	
Domestic samples, official.....	259
Domestic samples, unofficial.....	34
Foreign or import samples.....	25
	318
Total.....	405

Of the 259 official samples examined for the Insecticide and Fungicide Board, each representing interstate shipments of insecticides and fungicides, 131, or a little over 50 per cent, were recommended for prosecution, due to their being adulterated or misbranded, or both, under the insecticide act of 1910. Of the 25 foreign or import samples 14, or 56 per cent, were recommended to be detained at the port of entry for the same reason.

Numerous other products were examined, such as vegetables, fruits, foliage, and plants which had been treated with insecticides and fungicides, fruits, hops, and other materials used in the preparation of foods which may have been affected as a result of the application of insecticides, etc. An investigation relative to the toxic effect on fruit trees of certain elements, notably copper and arsenic which may accumulate in the soil as the result of using compounds containing these substances as sprays, has been under way for two years. The chemical work in connection with this investigation is now practically completed. A study of the solubility of Paris green in water is being carried on for the Insecticide and Fungicide Board in cooperation with members of the Bureau of Plant Industry and Entomology.

Methods for the analysis of lime-sulphur solution, Bordeaux mixture, Bordeaux lead arsenate paste, and various insecticides used for household pests have been given especial attention and accurate methods of analysis have been developed. About 300 to 400 individual determinations of the constituents of some of the common insecticides have been made in collaboration with other chemists of the Association of Official Agricultural Chemists during the course of a study of improved methods of analysis of these products.

Orchard tests with numerous insecticidal materials have been continued during the year to determine the cause of the injurious effects of such materials on foliage and to discover some way of overcoming the difficulty or some new effective compound that may be used on such tender foliage as the peach without causing injury.

CATTLE FOOD AND GRAIN INVESTIGATION LABORATORY.

The laboratory considered during the year a total of 1,233 samples, requiring approximately 7,800 separate determinations and in-

cluding samples of cattle and poultry foods, both foreign and domestic, examined under the provisions of the food and drugs act, as well as samples taken and examined for the solving of various economic problems, such as the feeding value of forage crops and the composition and value of various grains and cereals. A large number of samples were examined for the Bureau of Plant Industry in pursuance of their study of the deterioration of corn in storage. Studies of various methods of determining the constituents of cattle food and grains and improvements in apparatus were made.

Five hundred and four samples were taken in connection with the pure food and drugs act; of these 89 were found to be adulterated or misbranded. The distribution of the total number of samples analyzed was as follows:

Imported cattle foods and grains.....	2
Domestic cattle foods and grains.....	502
Miscellaneous cattle foods and grains.....	729
Total.....	1,233

The distribution showing cooperative work is as follows:

War Department	93
Agriculture Department:	
Forest Service	13
Bureau of Plant Industry.....	692
Bureau of Animal Industry.....	9
Other laboratories of the Bureau of Chemistry.....	18
Miscellaneous	9

TRADE WASTES LABORATORY.

This laboratory is organized for the purpose of studying the effects of trade wastes on agricultural products, on fruits, and on cattle. Particular attention has in the past been given to the effect of smelter wastes, the work being done at the request of the Department of Justice and in collaboration with the Forest Service. During the past year no work along this line has been requested, so the force engaged therein has been used for other pressing work of the division. A great deal of miscellaneous and hygienic work has been carried on by the different laboratories mentioned above.

EXAMINATION OF CONTRACT SUPPLIES.

The work of the contracts laboratory during the past year has been very similar to that of preceding years. The constant demand for results of examinations at the earliest possible moment leaves little or no time for systematic research. The greater part of the work of the laboratory has been the testing of miscellaneous contract supplies and the preparation and modification of specifications. Work has been continued on the study of the properties of rubber goods, with a view of drawing up specifications for this class of material, but the problem is an exceedingly difficult one, and from the unsatisfactory results obtained so far and the great lack of agreement among rubber experts on the proper interpretation of results of tests it has not as yet been deemed advisable to issue any specifications.

The investigation of paint materials and the work of inaugurating a very comprehensive series of white-paint tests in cooperation with the American Society of Testing Materials and the Bureau of Standards have progressed well. It is believed that the actual exposure will be started on the Arlington farm early in the coming fiscal year.

Work has been continued on platinum laboratory utensils and on enamel-ware cooking utensils. The methods of testing inks and typewriter ribbons have been given much study and, it is believed, have been considerably improved.

Publications from this laboratory during the year have covered the subjects of the refractive index of beeswax (Bureau of Chemistry Circular 86), the fluorescent test for mineral and rosin oils (Circular 84), the calcium-carbid method for determining moisture (Circular 97), and the use of paint on the farm (Farmers' Bulletin 474).

Two thousand four hundred and forty-two samples have been examined for the various Government departments. The attached table shows the distribution of the work according to the material examined and the departments for which the examinations were made. In addition to the samples reported in the table, over 1,800 pieces of apparatus were examined for the Bureau of Chemistry.

Number and distribution of samples of contract supplies analyzed in 1912.

Distribution.	Colors, paints, varnishes, etc.	Oils, greases, and waxes.	Soap and candles.	Miscellaneous.	Inks.	Chemicals.	Glues and adhesives.	Metals and alloys.	Rubber.	Typewriter ribbons.	Total.
General Supply Committee.....	415	63	220	109	108	29	79	.....	.....	250	1,273
Isthmian Canal Commission.....	213	170	27	56	6	65	.....	.....	.....	.....	537
Treasury Department ¹	108	10	26	16	2	.....	11	34	.....	1	208
Agricultural Department ²	3	31	29	58	.....	3	1	.....	27	17	169
Post Office Department.....	14	2	35	7	43	.....	12	.....	.....	4	117
War Department.....	2	23	1	.....	.....	.....	.....	.....	.....	.....	26
Commissioners, District of Columbia.....	5	3	14	1	9	1	.....	.....	.....	.....	33
Government Printing Office.....	.....	2	.....	2	.....	.....	1	.....	.....	.....	5
Department of Commerce and Labor.....	5	.....	20	3	3	2	.....	.....	.....	.....	33
Navy Department.....	3	2	9	.....	.....	.....	.....	.....	.....	.....	14
Smithsonian Institution ³.....	.....	7	.....	.....	.....	.....	.....	.....	.....	.....	7
Superintendent of Capitol.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Department of the Interior.....	.....	3	4	2	.....	.....	.....	.....	.....	10	19
	769	316	385	254	171	100	104	34	27	282	2,442

¹ Including Bureau of Engraving and Printing.

² Including Bureau of Chemistry.

³ Including National Museum and National Zoological Park.

INVESTIGATIONS OF THE LEATHER AND PAPER LABORATORY.

LEATHER.

The work on sole leather mentioned in the last year's report has been extended to embrace a number of other samples of more recent production, and the results have been prepared for publication. Much work has been done on bookbinding, carriage, automobile, and furniture leathers, showing that the same harmful practices which are prevalent in the tanning of sole and other heavy leathers exist among

the producers of these leathers. The effort to produce leathers of even, bright colors and of pleasing general appearance has led to the use of materials which are exceedingly harmful to the product. Bookbinding leathers should have extraordinary durability, because of their constant use and the cost of rebinding. So unsatisfactory have leather bindings been found, that in recent years a tendency has developed to substitute cloth bindings, which may prove more durable than the leathers which have been prepared through the use of harmful materials or processes. The same reasons for good quality apply to furniture, carriage, and automobile leathers, especially to the last. Automobiles are subjected to very rough usage and exposure to alternate sunshine and rain. Under such conditions the harmful effect of acids or other injurious materials is greatly accelerated, and the leather rapidly decays, becomes useless, and must be replaced. Generalized specifications for bookbinding leathers for Government publications have been forwarded to the Public Printer, who is making an effort to secure leathers which will comply in general with these specifications and be free from the materials which experience has proved detrimental.

PAPER AND PAPER-MAKING MATERIALS.

Experiments have been continued on the utilization of waste long-leaf pine for the making of paper and the recovery of wood turpentine, rosin oils, and wood creosote. These results confirm the opinion formerly expressed by the bureau that the utilization of the waste pine timber of the South from the cut-over lands is one of the most promising fields of industrial development which exists in the country. Bulletin 159 gives the results.

The work on a new method of cooking with gaseous chemicals has been continued as opportunity offered. Cooperative work with the Post Office Department through our laboratory at Dayton, Ohio, has been continued with satisfactory results. Routine work is also being done for the Post Office Department, the Bureau of Engraving and Printing, and the General Supply Committee in the testing of paper bought on contract and in the testing of samples for contract supplies. The chief of the laboratory has served with the Committee on Paper Specifications to the Joint Committee on Printing of Congress in the preparation of specifications and proposals for paper bought by the Government Printing Office. The report of this committee, which followed in general the lines suggested in Report 89 of the Secretary's office, was printed and adopted and the papers of the Government Printing Office are now bought in compliance therewith.

TURPENTINE AND ROSIN.

Standard, nonfading type samples for rosin have been devised. It is believed that the use of these type samples—which should be certified or at least checked by the Government, as millions of dollars change hands annually on the grading of rosin—will greatly promote the correct grading of rosin and at the same time prove more economical to the official graders. An instrument has been devised whereby the producer of rosin can easily grade his rosin at the still and thus know before shipment what grade of rosin he is sending to

market. Circular 100 describes the apparatus and the manner in which it is used.

For a great many years turpentine has been sold on the great turpentine markets of this country on the basis of its color according to standards prepared by the naval stores committee of the New York Board of Trade and accepted by the largest primary naval stores market of the world, Savannah. Examination of a number of the standard-type samples for turpentine has shown that different sets of these type samples do not agree closely in color. It is highly important that the standard-type samples should always remain the same from year to year, or at least that type samples can be replaced yearly with the full assurance that the color is the same as that previously used; therefore efforts are being made to get the primary naval stores markets to adopt specified colors which can always be duplicated by this bureau and which can be checked from time to time and certified to by the department, much as the cotton standards are now certified to by the department.

The work on production of wood turpentine, its refining, its value as a paint and varnish thinner, and its effect upon the workmen using it in paints has been continued in the laboratory, and the information thus obtained will be used in more extended experiments during the coming year.

MISCELLANEOUS WORK.

The testing of deliveries of papers, textiles, leather, turpentine, rosin, and other materials for the several Federal departments is being continued as heretofore and requires much of the time of the laboratory force. Miscellaneous samples, including fertilizers, phosphate, wastes, and other industrial materials have been examined at the request of the departments and of other bureaus of this department, and the laboratory is cooperating in the study of methods for the examination of leather and tanning materials. The work on the determination of iron and aluminum in phosphate has practically reached a successful conclusion. Various Government departments are adopting the specifications for paper, leather, etc., which are recommended by the laboratory, and other laboratories of the Government are following the lead of this department and have prepared to do testing which for many years was conducted only by this bureau. It is hoped that in the future the various Federal departments and other agencies will make even larger use of the experience and facilities of the laboratory.

The number of samples examined during the past year, including those examined in the laboratory at Dayton, Ohio, are as follows:

Paper and paper-making materials:	
Washington laboratory	2, 915
Dayton, Ohio, laboratory.....	3, 165
Textiles.....	194
Turpentines and rosins.....	209
Leather and tanning materials.....	148
Miscellaneous	81
Total.....	6, 712

NITROGEN WORK.

A laboratory is especially equipped for determining nitrogen and to it are referred all samples on which this determination is to be made. A total of 11,885 such analyses were made in the past fiscal year, the samples being referred not only from the laboratories of this bureau but from other bureaus of this department and also from other departments, as follows:

Department of Agriculture:	
Bureau of Plant Industry.....	1,718
Bureau of Soils.....	208
Bureau of Animal Industry.....	18
Office of Experiment Stations.....	2
Forestry Service.....	24
General supply committee.....	12
War Department.....	18
Isthmian Canal Commission.....	12
Treasury Department, Bureau of Engraving and Printing.....	42
Government Printing Office.....	74
Post Office Department.....	14
Total.....	2,142

The laboratory has also continued to collaborate with other nitrogen chemists in studies for the improvement of the present methods of analysis.

PUBLICATIONS AND PRINTING.

The following publications have been submitted to the Secretary and sent to press during the past year: Sixteen bulletins (1,051 pages), 24 circulars (212 pages), 3 unnumbered circulars (107 pages), 2 farmers' bulletins (62 pages), 1 Yearbook article (12 pages), 8 food-inspection decisions (9 pages), and 642 notices of judgment (1,143 pages, received from the Office of the Solicitor), making a total of 3,039 pages of new material published.

The food-inspection decisions included Nos. 139 to 146 and covered rulings on sweet oil, vinegars, maraschino cherries, saccharin, candied citron, canned foods, and bleached oats. The subjects of special interest treated in the bulletins are the processing of persimmons, production of wood turpentine, growth of wheat seedlings, elimination and toxicity of caffeine, enological studies, and canning of foods. The circulars cover a wide range of chemical investigations, as tests for mineral oils, determination of citric and malic acids, estimation of arsenic, grading of rosin at the still, studies on chicken fat and on eggs (fresh, frozen, and dried), and investigations of beeswax, mixtures of certain acid coal-tar dyes, American spearmint oil, gum tragacanth, coumarin, marking porcelain and silica crucibles, measurement of the translucency of papers, and calcium-carbid method for determining moisture.

There were issued 173 requests for job printing, covering all stationery supplies, forms, circular letters, etc., and 223 requests on the photographic laboratory for drawings and photographs in connection with the illustration of bulletins or the construction of laboratory equipment.

BUSINESS AND CLERICAL OPERATIONS.

The total appropriation for the Bureau of Chemistry for the fiscal year ending June 30, 1912, was \$963,780, of which amount \$107,200 was appropriated for the purpose of making investigations in regard to the application of chemistry to agriculture and for miscellaneous investigations and tests for other departments, \$4,280 for investigating the character of the chemical and physical tests which are applied to American food products in foreign countries and for inspecting the same before shipment, \$610,110 for the enforcement of the food and drugs act, and \$242,190 for salaries.

During the year a rigid examination has been made of the business and office system of the bureau in connection with the investigation by the President's Commission on Economy and Efficiency. The preliminary work for adapting and installing in this bureau the accounting system outlined by that commission was completed, and the system made ready for operation at the beginning of the new fiscal year. A uniform system for filing correspondence and keeping records for the branch laboratories was worked out. Improved equipment for copying records and documents and for sealing envelopes has been installed with increased economy and efficiency. Machines for recording dictation have been used in certain lines of the work with good results, and it is believed that their use can be extended with advantage.

During the year 2,851 purchase orders were drawn, 5,040 vouchers were checked and passed for audit and payment, and 678 letters of authorization for travel or station expenses were issued to the members of the bureau. One hundred and forty-three thousand letters were prepared, copies of which, together with approximately 71,428 letters received from 25,065 correspondents, were indexed and filed. One hundred and twelve thousand one hundred and fifty-eight mimeograph letters were made on 795 subjects.

In the interstate and import office 6,769 guaranties under the food and drugs act were examined, approved, and serial number assigned. Complete records of all interstate cases and seizures and all import cases were kept. The records, showing the action on each case at every stage and the progress of the case from the time the sample is received until the case is transmitted to the Solicitor, are voluminous and complex, involving a vast number of details. This office also keeps the bureau records of the cases under the insecticide and fungicide act, in which this bureau cooperates with the board charged with the enforcement of that act. The clerical force of the bureau reported 6,938 hearings before the Board of Food and Drug Inspection or at the branch laboratories.

The system of purchasing chemicals and chemical supplies in large quantities and distributing them from a central storeroom to the various laboratories, both in and out of Washington, has worked for economy and efficiency in several ways. Every shipment of supplies is tested before being accepted, which results in maintaining a high and uniform standard of quality with a low cost for testing.

SPECIAL WORK PLANNED FOR THE FISCAL YEAR 1912-13.

INSPECTION WORK.

Routine inspection matters and frequent short investigations will occupy the greater portion of the time of the inspectors during the coming fiscal year, but special assignments will be given attention as the subjects for inquiry may develop. As in all forms of police work, the detection of violations is difficult to anticipate and is based largely on methodical and constant surveillance of the producing, shipping, and consuming sections of the country.

The results of the investigations of medicines furnished to physicians by supply houses justify further collection of samples of this character.

Among the more important projects outlined is the continuation of a concerted investigation at the proper season of canneries, with particular reference to the packing of canned goods with excessive quantities of water, brine, sauces, and other useless fillers.

As in the past, there will be periodical inspections made of the fresh milk furnished to cities situated near State borders which receive a large part of their supply from producers in a neighboring State. Attention will also be given to the interstate traffic in canned milks.

Sufficient is known of the insanitary condition of oyster and clam beds to warrant wholesale collections when the shellfish season opens, provided necessary steps have not been taken in the meantime by the shippers or the owners to improve the state of their properties.

Certain inspectors will be required under previous departmental instructions to collect samples in the enforcement of the insecticide and fungicide act, 1910.

FOOD INVESTIGATIONS.

The work of the division of foods and the branch laboratories will continue to consist largely of the examination of samples of interstate and imported foods and drugs in connection with the enforcement of the food and drugs act. Analytical methods will be studied and new methods devised according to the needs arising from conditions of manufacture and the character of adulterations.

Special investigations planned during the year are as follows:

New shortening materials now appearing on the market, which are made by saturating the liquid glycerids of vegetable oils, will be investigated and a method for detecting synthetic stearin in lard compounds will, if possible, be elaborated.

The work on peanuts and peanut oil will be continued and the pecan investigation will be carried through another season.

The special work on the preparation of brandies and cordials will probably be finished during the coming year. It is further planned to make a study of the preparation of malt liquors from various kinds of raw material, especially along the line of determining the absolute composition of products made from barley, and of the composition of grape juice made on a commercial scale during the coming grape season at one or two large grape-juice factories.

Experiments in the shipping of food products will be carried out to get definite information as to changes caused by temperature, altitude, and humidity.

It is planned to continue the study of the coloring and facing materials in teas, the work on the identification and separation of coal-tar dyes which are used in foods, and the detection and identification as well as the separation of vegetable colors, especially attempting to apply spectroscopic methods for identification both on the vegetable and coal-tar dyes.

An attempt will be made to bring together all of the analytical data and experimental records in connection with the study of the manufacture of cider vinegar into the form of a completed bulletin, so that this data will be available.

Branch laboratories have submitted the following subjects to be considered for special attention during the coming year: Composition of standard and commercial vanilla extracts, a method for the determination of oil of peppermint and of oil of nutmeg in alcoholic solutions, rice and sake vinegar, estimation of glycerol in wines and vinegars, natural barrel fermentation of apple cider into vinegar, coal-tar colors, determination of saponin in food products, California fruits, sanitary conditions of the oyster-canning industry, corn meal in its relation to pellagra, determination of heavy metals in foods, composition of soy-bean food products, and the salmon-canning industry.

ENOLOGICAL STUDIES.

Studies on normal and sophisticated wines from native American grapes, on changes in composition of grapes during ripening, on methods of analysis of fruits, fermented and unfermented fruit juices, and on the fermenting power of yeasts at different temperatures, will be continued, and the study of commercial wines made from the *Vitis vinifera* grapes (California wines), and the manufacture of pure samples of wine from the *Vitis vinifera* grapes for the purpose of determining normal composition will be undertaken.

FOOD RESEARCH WORK.

An extra effort will be made during the coming year to push that part of the work dealing with the transportation of perishable products, including the comparative merits of shipping poultry, hard, frozen, and chilled. It is planned, also, to continue the present lines of work on precooling eggs and dry cooling dressed poultry, carrying the demonstrations to isolated packers by means of the perambulating refrigerator. This portable refrigerating plant can be made a forceful educational factor for inculcating progressive ideas in the countryside at large, showing shippers what it means to have good handling and refrigeration.

The investigation of the handling of frozen and dried eggs will be again pursued during the egg-breaking season in the producing section, using the Omaha laboratory as the center for laboratory work, and three commercial establishments, which have been equipped to handle eggs with bacteriological cleanliness, for a source of samples and locations in which experimental work on a commer-

cial scale can be done. When the egg-breaking season ends it is planned to follow the products frozen or dried to the bakers, working cooperatively with them to study the routine to which the egg products are subjected and their rate of deterioration after thawing or dissolving.

Many laboratory problems are contemplated which will, it is hoped, be applicable to industrial problems, even though they appear to be essentially scientific. Such, for example, is the pushing of work on the behavior of flesh enzymes in relation to the postmortem changes occurring in flesh foods, the variation in composition and flesh changes caused by blood remaining in the tissues, the behavior of various molds in relation to flesh changes, and the rapidity with which bacteria penetrate flesh.

Probably the most important plans which are being made are for the extension of the facts already obtained to the industry, that they may be utilized promptly and efficiently for the good of the people. It is comparatively easy to determine in the laboratory and by experimental observation wherein the shipper errs or the middleman fails, but it is extremely difficult to get this information to the shipper or the middleman in such wise that he will understand, believe, and apply it.

DRUG INVESTIGATIONS.

In addition to the routine analysis of drugs subject to the law, it is the intention to continue the investigations toward arriving at more satisfactory methods for the separation and determination of alkaloids in complex mixtures and the assay of crude drugs, and the analysis of fluid extracts and tinctures. As in the past, special attention will be given to the improvement of the methods of analysis of opium and complex mixtures containing varying quantities of opium. A study of the analytical methods now in use for the determination of morphin in tablets and liquid mixtures will be continued. It is the intention to investigate processes for the separation of codein in the presence of other alkaloids and to continue the investigation of the methods for the determination of nitroglycerin in nitroglycerin solutions and tablets. Attention will be given to the study of pepsin and of enzymic action in general, with a view to arriving at more satisfactory methods of assay. The study of the methods of analysis of senna, senna siftings, buchu, uva ursi, anise, fennel, coriander, cardamom, cubeb, and medicated soft drinks will be extended.

A continuation of the pharmacology of caffein and of tin, as well as biological testing and investigations of the action of digitalis, is contemplated.

MISCELLANEOUS DIVISION.

The survey of the important mineral springs of the United States, which includes a very comprehensive analysis of the water from source, will be continued as heretofore. The examination of foreign and domestic waters to determine whether or not they are properly labeled under the food and drugs act will be continued. Studies will be made of improved methods of mineral-water analysis and the radioactivity of certain mineral waters determined, the latter investigation applying especially to samples coming directly from source; of the pollution of certain waters with reference to the effects of the

pollution on the condition of shellfish grown in these waters; and of irrigation and drainage waters and methods of analysis especially applicable to them.

In addition to the examination of insecticides and fungicides and the carrying out of analyses in connection with chemical problems relating thereto, as called for by other bureaus of the department, the following work and investigations will be prosecuted: (1) Analyses of insecticides and fungicides for the Insecticide and Fungicide Board in connection with the enforcement of the insecticide act of 1910; (2) orchard and laboratory tests of poisonous compounds at present used as insecticides, with the view of finding some substance which may be so used on peach and other tender foliage; (3) the supposed injury to fruit trees from the accumulation of toxic salts in the soil, due to the use of insecticides, in cooperation with the Bureau of Entomology; (4) the arsenic and copper content of fruit, vegetables, etc., to which materials containing these substances have been applied in spraying operations; (5) improved and new methods for examining insecticides and fungicides.

The examination of cattle and poultry foods entering into interstate commerce will be considered, and extensive study will be made of range forage crops, necessitating a careful comparison of all published work done along that line. There will be, as in the past, much work done for other departments and bureaus of the Government, as well as for other laboratories of the Bureau of Chemistry, to aid in solving various chemical problems involving grains and cattle foods. Chemical methods of determining the deterioration due to molds, bacteria, etc., in cattle foods and improved methods of cattle-food analysis will be continued, and investigations of cattle-food manufacturing plants will be made with the idea of determining more definitely just what substances should be present in certain cattle-food materials which enter interstate commerce.

The study of the effect of smelter wastes on animal and vegetable life will be continued as such work is requested by the Department of Justice. If time permits, the effect of other waste on vegetation and animal life will be undertaken and sanitary studies relative to poisonous substances in household articles and foods and feeds will be continued.

SUGAR INVESTIGATIONS.

A continuation of the study of maple sap and its changes when stored in containers of various metals and when concentrated in evaporators made of different metals will be carried out during the maple season. The work on sugar-cane products and sorghum sirup and the study of the sugar industry of the South will be pushed during the manufacturing season. The environment studies on the sugar content of muskmelons will be steadily advanced.

PLANT PHYSIOLOGICAL STUDIES.

The work for the coming year will continue to be along the lines of collaboration with the different offices of the Bureau of Plant Industry, including (1) investigations on the influence of environment on the composition of cereals and other plants, and (2) a study of the value of wheat for milling and baking purposes. New investigations will be undertaken as follows: (1) Methods of bread

making in vogue in the principal cities of the country; (2) the study of macaroni made from different products, including the use of coloring matters; and (3) a study of the changes in the nutritive value of hay of various kinds when cured under different conditions.

LEATHER AND PAPER LABORATORY.

During the year 1912-13, besides continuing the routine testing of supplies for the various departments and serving as members of committees for the passing on these supplies or the preparation of specifications therefor, the laboratory force will conduct the following investigations: Continuation of the investigations on the production of wood turpentine and other products from the distillation of wood, with special reference to the industrial value and relation to health of wood turpentine; practical experiments on the value of various kinds of sole leather, treated in different ways, for the purpose of determining the characteristics of a suitable and durable sole leather and of devising laboratory methods for determining those qualities; experiments on the tanning of leather, primarily for the purpose of determining the proper procedure for the production of a high-grade durable leather, that the raw materials (which are now entirely inadequate for the demands of the nation) may be conserved and made to more nearly supply our national need; the study of unusual paper-making materials; methods of cooking stock and methods for the utilization and disposal of paper-making wastes; investigations looking to the improvement of the quality and quantity of rosin and methods for grading the same; testing of turpentine and rosin for adulterants under the food and drugs act; and a study of analytical and testing methods for determining the purity and use value of materials within the province of the laboratory.

CONTRACTS LABORATORY.

The work will be mainly the examination of miscellaneous material purchased by the Government. Work will be continued on paint and painting materials, and what is believed to be the most carefully worked out series of white paint exposure tests that has yet been started will be exposed on a fence constructed for the purpose on the Arlington farm. This work is in cooperation with the American Society for Testing Materials and the Bureau of Standards.

Work will be done toward drawing up a standard specification for copying ink on enamel-ware cooking utensils and on rubber and platinum laboratory utensils.

It is hoped that more standard specifications for various materials can be adopted. Many materials, such as soaps, certain pigments and oils, inks, etc., can be more advantageously bought on properly drawn up specifications than on samples, but great difficulty is encountered in inducing purchasing officers to follow this course.

The work of the laboratory should be largely investigating methods of testing rather than examination of such a large number of samples, and with a proper use of specifications it is probable that even with the present force an appreciable fraction of the time could be devoted to such work, while under the present system very little systematic work of this kind is possible.

