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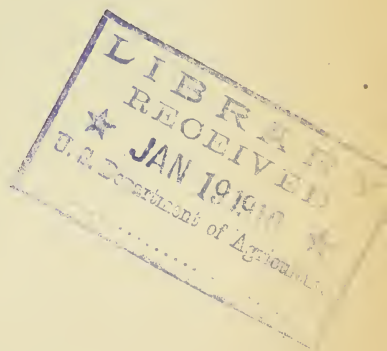
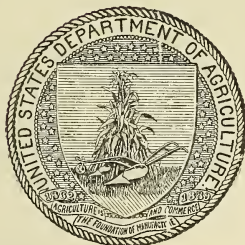
42
U. S. DEPARTMENT OF AGRICULTURE.

REPORT
OF
THE CHEMIST

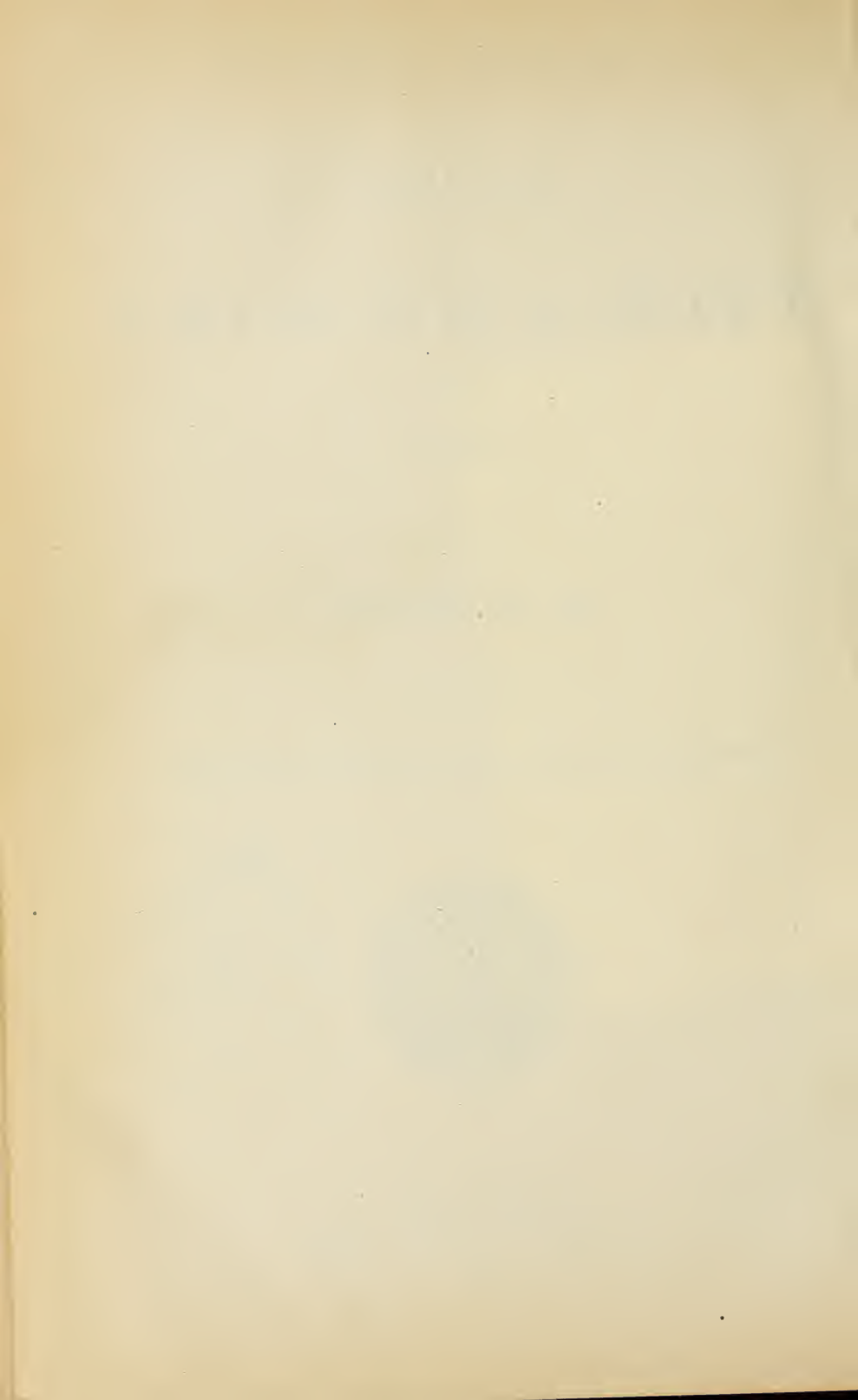
FOR
1909.

BY
H. W. WILEY.

[FROM ANNUAL REPORTS OF THE DEPARTMENT OF AGRICULTURE.]



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1909.



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REPORT OF THE CHEMIST.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY,
Washington, D. C., September 1, 1909.

SIR: I have the honor to transmit herewith the annual report of the Bureau of Chemistry for the year ending June 30, 1909, together with plans of the work proposed for the year ending June 30, 1910.

Respectfully,

H. W. WILEY,
Chief of Bureau.

HON. JAMES WILSON,
Secretary of Agriculture.

SPECIAL INVESTIGATIONS.

DENATURED ALCOHOL INVESTIGATIONS.

A special appropriation was made by Congress in the spring of 1908 for the purpose of demonstrating the manufacture of denatured alcohol on a scale applicable to the needs of the farmer or associations of farmers. To this end a small experimental distillery, with a capacity of about 100 gallons of proof spirits per day, was erected and equipped to utilize various kinds of raw materials. When this plant was ready for operation, a course of instruction in the form of lectures and actual practical operation of the distillery was given, and a number of students from the various agricultural experiment stations of the country, as well as others interested in the subject, attended. This course extended over six or eight weeks, during which time about 40 lectures were given dealing with the machinery to be used in a distillery, raw materials available for the production of alcohol, and the principles and practices of yeast making and fermentation, as well as of distillation. Experimental mashes were made using corn, potatoes, molasses, watermelons, apples (usually of unmerchantable or inferior grades), and other waste materials. The lectures and general instructions have been collected in the form of a bulletin, which covers the whole subject of fermentation and distillation as applied to the manufacture of denatured alcohol.

EFFECT OF ENVIRONMENT ON CHEMICAL COMPOSITION.

SWEET INDIAN CORN.

Following the general principles established in the study of the storage of sugar in the sugar beet and in sorghum with which these investigations of the Bureau began, the work was continued during the past year particularly with sweet Indian corn, barley, and wheat, in collaboration with the Bureau of Plant Industry and with the assistance of the experiment stations in Florida, South Carolina, Maryland, New Jersey, Connecticut, and Maine. This has been the fifth year of the systematic study of the conditions affecting the sugar content of corn at the time when it is used for edible purposes—that is, when the starch is in the dense milky state just previous to hardening. The results of the first four years of this investigation have been collated and digested, being now in course of publication.

The following general conclusions have been drawn from the work:

(1) The content of sugar in sweet Indian corn does not depend so much on temperature and length of day as is the case with the sugar beet. In the latter case the content of sugar varies inversely with the temperature, provided the latter is such as to permit normal growth, while in the case of sweet Indian corn a higher average sugar content is found in South Carolina and Florida than in Connecticut and Maine.

(2) The content of sugar in sweet Indian corn rapidly diminishes after the ear is separated from the stalk. The speed of the diminution depends largely on the temperature, being more rapid with a higher and slower with a lower temperature. Sweet Indian corn intended for the table, therefore, should be harvested as short a time as possible before being delivered for consumption, and during the intermediate period should be kept at as low a temperature as can be secured without freezing.

(3) The chief difference between the Indian corn of the extreme North and that of the extreme South is found not so much in its content of sugar as in its succulence, the lower temperatures of the North making the corn more tender and edible for a longer period than the extremely high temperatures of the South. Although the southern-grown corn had a high sugar content, it was inferior in yield and general physical appearance, but its superiority in point of sweetness opens up a possibility of acclimating the most favorable varieties and by selection and careful cultivation greatly improving the southern-grown product.

(4) Of all the factors of the environment which affect the edible quality of green Indian corn, it appears that the amount and distribution of rainfall are the most important. A moderate and well-distributed rainfall, especially during the growing season, is necessary to produce a crop having the best qualities. Excessive rainfall in the latter part of the growing season or a great deficiency during the germinating and growing period equally interferes with the quality of the crop.

VEGETABLE-PHYSIOLOGICAL INVESTIGATIONS.

The section of Vegetable Physiological Chemistry, in collaboration with various offices of the Bureau of Plant Industry, has made the

following studies of the chemistry of plants and their products as affected by environment, etc.:

(a) The influence of environment on the composition of the various cereals, with a view to the improvement of the quality and quantity of the crop and to the adaptation of any particular variety to any locality. This study includes the analyses of grains grown in various parts of the country, and experiments to show what influence climatic conditions exert on their physical and chemical properties. Some of these experiments, which have been called "triangular experiments," are being carried on as follows:

A common wheat, Crimean, is being grown in Texas, Kansas, and California from the same original seed obtained in Kansas. At each point the seed has been grown continuously. On adjoining plots was sown seed from each of the two other stations. There were thus three plots of the same variety grown at each point. The crops were examined chemically and physically, the results showing that all three plots in any one locality give seed which are identical in appearance and in composition, as is shown by the following table:

Physical and chemical analysis of the seed of Crimean wheat sown in Texas, 1907.

Source of seed.	Protein.	Weight per 1,000 grains.	Weight per bushel.	Starchy grains.
	<i>Per cent.</i>	<i>Grams.</i>	<i>Pounds.</i>	<i>Per cent.</i>
Texas seed, 1906.....	12.1	30.8	58.9	
California seed, 1906.....	10.4	34.0	59.4	64
Kansas seed, 1906.....	19.2	22.7	58.8	

The crops grown in Texas from the above seed showed the following composition:

Physical and chemical analysis of crops of Crimean wheat grown in Texas, 1907, from seeds from various sources.

Source of seed.	Protein.	Weight per 1,000 grains.	Weight per bushel.	Starchy grains.
	<i>Per cent.</i>	<i>Grams.</i>	<i>Pounds.</i>	<i>Per cent.</i>
Texas seed, 1906.....	18.2	23.6	58.6	5
California seed, 1906.....	18.2	22.7	57.3	
Kansas seed, 1906.....	17.0	23.6	58.6	2

In the same way the crop grown in California was identical in all three plots although the composition of seed sown varied greatly.

Physical and chemical analysis of seed of Crimean wheat grown in California, 1907, from seeds from various sources.

Source of seed.	Protein.	Weight per 1,000 grains.	Weight per bushel.	Starchy grains.
	<i>Per cent.</i>	<i>Grams.</i>	<i>Pounds.</i>	<i>Per cent.</i>
California seed, 1906.....	11.3	33.3	61.8	40
Kansas seed, 1906.....	11.0	33.8	61.3	50
Texas seed, 1906.....	11.4	33.0	61.3	50

The same facts were observed in all three plots grown in Kansas in 1907, and at each apex of the triangle in 1908, and also with another variety of wheat (*durum*) which has been grown in Kansas, California, and South Dakota.

The experiments have shown that the same variety of wheat will give the same crop, physically and chemically, when grown in any one locality, even though the seed used may have had a very different composition and appearance and may have been grown under widely different conditions. Thus, a California Crimean containing 11 per cent of protein and a Kansas Crimean of 20 per cent of protein give crops identical in composition when grown in the same environment. Thus, the Kansas Crimean with 20 per cent of protein fell in one year to 11 per cent of protein when grown in California; that is, it yielded a crop identical with that produced by the California Crimean in California. On the other hand, the California seed with 11 per cent of protein and the Kansas seed with 20 per cent, when grown in Kansas the following year, both contained over 18 per cent of protein. These results show that crops must be improved by selection, etc., in the very locality in which they are to be grown, there being apparently no advantage in importing an improved seed into another locality of widely different climatic conditions.

(b) Soil-climate experiments carried on in collaboration with the physicist, bacteriologist, and cerealist of the Bureau of Plant Industry to supplement the "triangular experiments." To show what rôle the soil might have played, 75 cubic feet of earth were exchanged by California, Kansas, and Maryland, and four plots at each place prepared with the four different soils. These were sown with the same kind of wheat, the first crop being harvested this year, and its analysis will furnish further data as to the rôles played by the soil and climate.

(c) The composition of the different cereals at various stages of growth in order to understand how plants absorb plant food: at what stages they require and absorb the various elements and to what extent; whether they retain the plant food absorbed to their maturity, and in what proportion these plant foods are removable through rain or other climatic agencies. A study of the organic constituents of the plants at different stages of growth shows that young barley plants contain over 20 per cent of soluble carbohydrates (mostly sugars), and this fact tends to explain why it is that when such young barley plants are plowed under they serve so beneficially in aiding the bacterial activity in soils. The study of the other organic constituents—for example, pentosans, fiber, starch, etc.—at different periods of growth is also being carried on.

(d) The results of the study of the amount of salts present in cereal crops at different stages of growth and of the amount removed by leaching show that a very large amount of phosphorus, calcium, magnesium, potassium, and sodium is removed by rainfall, especially from the dying and wilted leaves, the amount removed from green or young plants being relatively small. The results of this study show that on ripening the salts contained in the juices of plants tend to migrate from the dying to the living tissue, that the migration is upward; that plants exude their salts upon the surface of the leaves, and that rain water may wash these salts back into the soil, and that therefore the analysis of plants for ash ingre-

dients may give erroneous results, especially if it be desired to arrive at the amount of plant food absorbed by or essential to plant growth, unless the amount of these ingredients removed from the plants by rain, dew, etc., be taken into consideration.

(e) The chemical and physical changes of grains on storage, and the chemical changes of the ground seeds when kept for several years. This study has shown that the ground grain changes more rapidly in composition than the unground, and of all the cereals under investigation the changes in the composition of corn were most marked, the amount of sugar falling off very rapidly on storage.

(f) The relative value of American barleys for malting purposes—the malts to be used either for brewing or for the conversion of the starch of raw materials into sugar for the production of denatured alcohol—were studied, the preliminary results being published as Bulletin 124 of the Bureau.

(g) Greenhouse experiments with cereals to determine the influence of the amount of water applied to the soil, before and after heading, the influence of various fertilizers on the composition of the straw and grain, the influence of the magnesium-calcium ratio and the effect of manganese, etc., on the growth. Although the lack of a suitable greenhouse has handicapped the work, the results show that the addition of much water to the soil tends to the production of those white spots so often seen, especially on durum wheats, thus corroborating observations in the field, which show that during a cold, rainy season the proportion of soft or starchy kernels is far greater than during a hot, dry period, and that in consequence the protein content is correspondingly lowered.

(h) Collaborative experiments with various experiment stations at Reno, at Logan, and at Fort Collins on the influence of different amounts of irrigating waters applied to the growing crop on the composition of the grain; at Knoxville on the influence of various phosphate fertilizers on the constituents of the wheat; at Maryland, Kansas, and California on the influence of the exchange of soils on crop growth and composition.

(i) The proper amount of acidity which peat should possess in order to grow blueberries, in collaboration with the botanist of the Bureau of Plant Industry. One of the questions solved was the determination of the amount of acid in peat best suited for blueberry culture and a method was found for correcting the condition of peat in which the plants will not thrive.

(j) The amount of alkaline salts removed from alkaline lands by leaching. This work was done under the direction of the Office of Western Agricultural Extension of the Bureau of Plant Industry.

(k) The changes taking place in the mineral constituents and in the nitrogen of the seed of wheat and other grains during germination and during the very early stages of growth.

(l) The absorption of plant food by plants grown in the Great Plains area, a work carried on in collaboration with the Office of Dry Land Agriculture and the physicist of the Bureau of Plant Industry.

(m) The kind of sugar present in wheat and the various ways for improving our methods of analyses.

In order to carry on all this work it has been necessary to make over 10,000 determinations of all kinds.

ANIMAL-PHYSIOLOGICAL CHEMISTRY.

Investigations in animal-physiological chemistry have been conducted along the following lines:

A series of metabolism studies conducted by feeding organic and inorganic phosphorus to rabbits was completed and the results published as Bulletin 123. This line of work was further pursued by a similar investigation on feeding animals with different forms of sulphur to determine the variations and form of the urinary sulphur compounds eliminated. Another series of experiments in feeding animals with different kinds of carbohydrates to determine their comparative food value was begun.

An important part of the work of this laboratory has been the enzym studies, in which several papers have been published, dealing with the laws and action of enzymes, and the preparation, in large amounts, of different enzymes in concentrated form. The special application of this research is the relation of enzym reactions to ordinary and special analytical methods, and already much valuable progress has been made. This work will be prosecuted vigorously during the coming year.

Work on methods for the examination of meat has been conducted especially with a view to measuring the progress of deterioration by accurately determining the increase in ammonia, previous work having shown that the deterioration of meat was evidenced chemically largely by an increase in this product.

Four hundred samples were examined, from three to five determinations being made, as a rule, on each sample.

ENOLOGICAL-CHEMICAL RESEARCH.

Work in enological-chemical research has been continued on the lines previously followed and the enlargement and better equipment of the laboratory and cellars have made it possible to extend the investigations in several directions, notably to undertake an important series of experimental studies of yeast races, using for this purpose both races isolated from American products and those secured from foreign laboratories. This study is designed:

(a) To determine the fermenting power of these yeast organisms in natural fruit juices, and in the same juices when fortified with gradually increasing percentages of cane sugar. The points determined are: (1) Ability to ferment promptly the natural fruit sugar; (2) to invert and ferment added cane sugar; (3) the degree of alcohol obtained for sugar decomposed; and (4) the acid content of the fermented product, especially volatile acids. Other subsidiary data are also determined.

(b) To determine the ability of these yeast organisms to ferment fruit juices in the presence of varying amounts of preservatives, as (1) sulphur in various forms; (2) sodium benzoate; (3) salicylic acid, etc.

(c) To determine the maximum temperature limit at which these yeast races can carry to completion a sound fermentation.

Final results along these lines can not be obtained for several years, but important data have been secured under section (a) which are now available for practical work in the factories. These studies

have required during the fiscal year the incubation of 228 separate cultures, and more than 3,400 chemical determinations have been made.

The distribution of yeast cultures has been continued as in previous years. The aim has been not to exploit or urge the use of yeasts, but to furnish reliable cultures on request for the purpose of testing their use in practical work. Instructions for the use and propagation of the cultures are furnished, so that those receiving them are able to extend their use as they see fit. In the past year cultures have been sent to 25 States, and the reports made are in many instances very favorable. The results of this work will be summarized, so that all interested may benefit by the experimental data obtained.

The work of collecting and studying native American wines has progressed as rapidly as the pressure of other work would permit. One hundred and ten samples of such wines have now been subjected to chemical analysis and to organoleptic tests.

In all, 622 samples have been examined chemically, and in some cases microscopically, during the fiscal year, from 2 to 15 determinations being made in each case.

BACTERIO-CHEMICAL EXAMINATIONS.

The bacterio-chemical investigations pertain largely to the enforcement of the Food and Drugs Act. The samples examined may be classified under inspection or interstate samples and research work:

Interstate samples.

Ketchup	28
Cream	11
Ice cream	30
Milk	18
Water, bottled (each containing from 1 to 12 bottles per sample)	51
Miscellaneous	37
Total samples	175

Research work.

Antiseptics, disinfectants, preservatives	22
Ketchups	16
Cream and ice cream	11
Eggs and egg products	63
Codfish	10
Gelatin	26
Milk	26
Oysters, clams, and quahogs—liquors and washings	133
Water:	
Bottled, market	68
City hydrant	44
Sea	69
Well and spring	46
Miscellaneous, including ice	16
Miscellaneous	102
Total research	652
Sum total	827

The miscellaneous research samples examined consisted of bread, butter, condensed milk, starches, canned salmon, cream puffs, lacto-

bacilline preparations, fruit juices, canned fruits, soft drinks, water cress, yeast cakes, zymine, and paper used for wrapping hams.

The most extensive investigations conducted during this year were those relating to the shellfish industry. The most important problems considered were: (1) The possibility of shellfish pollution from sewage-polluted waters, including a study of the effects produced by floating, drinking, plumping, etc.; (2) sanitary conditions of the establishments and of the practices pertaining to the shucking, handling, and shipping of shellfish. This work was done in cooperation with the Division of Foods and in connection with the Water Laboratory of the Miscellaneous Division.

The need for bacteriological investigation becomes greater as sanitary ideals in the preparation and handling of food materials advance, and it is the policy of this laboratory to extend its researches to the most urgent cases as rapidly as efficiency will permit.

IMPORTANT FOOD INVESTIGATIONS.

SPECIAL RESEARCH WORK OF THE DIVISION OF FOODS.

OYSTERS.

The investigation of shellfish begun by the Division of Foods during the last fiscal year has been continued. This has included the examination of the waters from which shellfish intended for interstate commerce are taken and the investigation of the plants in which they are packed, the methods of handling, and the materials used. In collaboration with the Oyster Packers and Growers' Association a number of experimental shipments were made on a commercial scale, oysters being taken from several localities of the United States and shipped by the various methods in ordinary practice. The shipments were made under seal to the inspection laboratories in Omaha or Chicago, where the packages were opened and re-iced, again sealed, and shipped to the Bureau of Chemistry in Washington, where final examination was made.

The results of the investigations warrant the conclusion that washing should be limited to the shortest practicable time, and that the oysters should be shipped in closed packages protected from direct contact with ice. The study has also been extended to clams and scallops, of which, however, no commercial shipments were made.

FRUIT.

Experimental work relative to fruit products in collaboration with the pomologist in charge of field investigations of the Bureau of Plant Industry has been continued. The fruits used in the investigations were grapes, apples, Japanese persimmons, avocados, peaches, plums, strawberries, raspberries, currants, blackberries, huckleberries, pineapples, oranges, and lemons.

As a result of the prohibition laws enacted in some of the Southern States, the Department was requested to suggest a means of utilizing the southern grapes of the Scuppernong type which had formerly been used in the preparation of wine. In order to compare the juice prepared from this variety of grapes with that of the ordinary North-

ern American varieties, the juices of the Scuppernong, Concord, and Catawba grapes were employed. The preservation in clear form of the Scuppernong juice offered no greater difficulties than did that of the juice of the other varieties mentioned. Some difficulty, however, was encountered in separating the juice of this grape completely from the pulp without the application of heat, and this process is undesirable, as a cooked taste is usually developed when grapes are heated before pressing. It therefore appears that further study must be given to the technics of heating and pressing, clarifying, and sterilizing on a commercial scale.

The work on apple juices previously reported has been extended. Sterilized juices were prepared from 15 varieties of apples, and a study of these juices was made with respect to their composition, flavor, and other qualities, and especially the permanence of their flavor when properly preserved.

The study of Japanese persimmons has been continued and considerable progress has been made in the development on a commercial scale of the alcohol method of treating persimmons, rendering them nonastringent and edible while still firm. The results have been successful and the study will probably be completed during the next fiscal year. The preparation of persimmon vinegar and of dried persimmons has also been studied.

The juices of strawberries, red and black raspberries, currants, huckleberries, blackberries of several varieties, oranges, lemons, and pineapples have been prepared and preserved by sterilization and their composition studied. The analysis of these products includes the study of the naturally occurring organic acids. The investigation of the pineapples includes the production of a dried and sugared preparation.

TOMATO KETCHUP.

A large number of typical samples of tomato ketchup were submitted to examination for the purpose of establishing methods by which their character and quality might be determined, with the result that methods were elaborated by which it is possible to distinguish with a considerable degree of certainty ketchups made from waste material and trimming stock and those made from whole tomatoes.

THE INFLUENCE OF TIN RECEPTACLES ON THE CHARACTER AND COMPOSITION OF FOODS.

A systematic study has been undertaken during the past year of the character of material used in the manufacture of food receptacles and of the influence of these receptacles on the character and composition of the foods preserved in them. The investigation also includes the study of the effect of the temperature and method of treating, time of storing, and, as far as possible, all other conditions entering into the question. Samples of tin plate of various kinds have been carefully examined, the various grades of cans employed in the United States receiving special attention as preliminary to the investigation. Samples of various types of food canned at different times, with as full data as possible regarding the methods of their preparation, have been secured and examined. Samples have also been prepared in the presence of representatives of the Department,

with a view to examining from time to time products regarding which full information is available. The results thus far obtained are only of a preliminary nature.

ANALYTICAL METHODS.

Material progress has been made in the improvement of methods for the detection of food adulteration, distilled liquors, flavoring extracts, and preservatives having received special attention.

As in the past, analyses have been made of samples of foods submitted by the Commissary-General of the Army and the Paymaster-General of the Navy for the purpose of assisting in the purchase of supplies, and the Bureau has also been called on to collaborate in prescribing specifications for such purchases.

FOOD TECHNOLOGY.

The work of the Food Technology Laboratory is divided into three sections: First, that pertaining to the enforcement of the Food and Drugs Act; second, research work on methods for the analysis of flavoring extracts and essential oils; and, third, the investigation of the question of producing citrus fruit by-products in California. Until April 15, 1909, all food cases for presentation to the Board of Food and Drug Inspection were passed on by this office. After this date, however, the system of handling these cases was somewhat changed, and the work of the laboratory in regard to the administration of the Food and Drugs Act was confined to preparation of cases concerning essential oils and flavoring extracts, 63 analyses having been made of such samples. All of the routine work which had formerly been done in the Washington Food Inspection Laboratory on this subject was transferred to this laboratory, and the initial analyses from the Washington district, as well as check analyses from other districts, were made here.

The research work has been confined to methods for the detection of adulteration in flavoring extracts. After finishing the examination of the authentic samples from Sicily, the assistant in charge of the essential oil analyses spent considerable time in developing a method for the detection of added lemon terpenes to lemon oil. This work was finished January 1, and 25 samples of lemon oil were examined in this regard to test their legality under the Food and Drugs Act. The method developed for the detection of lemon terpenes, it is believed, is satisfactory, and special apparatus is now under construction for installation in the food and drug laboratory at New York to facilitate the examination of imported oils for this adulteration.

Other investigations on flavoring extracts include the solubility of lemon oil in ethyl alcohol at varying temperatures and dilutions, the effect of storage on lemon extracts and terpeneless extracts of lemon, and a practical method for manufacturers for the estimation of citral in lemon extracts. Some little work has also been done on the detection of artificial coloring matter and of prune juice in vanilla extracts.

This laboratory has also undertaken an investigation of the possibility of profitably producing citrate of lime, oil of lemon, oil of orange, and other orange by-products in California.

CANNING INVESTIGATIONS.

The following investigations, which are especially opportune and of great practical value at this time, were conducted for the purpose of promoting the preservation of foods by sterilization:

CANNING PEAS, CORN, AND TOMATOES.—Experimental work is being continued on the canning of peas, corn, and tomatoes to determine the effect of different methods of handling and processing on spoilage and on the quality of the finished product. The methods which will prevent swells, sours, etc., are well understood by canners in general, so that the losses from this source are becoming less and less each year. The general limits recommended for time and temperature are usually high and give a margin for any contingency. The canners are not so familiar, however, with the effect of handling and processing on the quality of the goods. It is believed that a large part of the goods on the market are not of so high a grade as they might be if the effects of each step were better known. Some of the results of grading and processing of peas have been pointed out, and from the interest manifested by the canners it is evident that improvements will be attempted at many factories.

GRADING OF CANNED GOODS.—A line of cooperative work is being conducted to determine what should be the reasonable requirements for the different grades of canned goods. It is generally recognized that the consumer does not know what he will receive in making a purchase of a can of goods. The grading of the different manufactures on quality is not uniform, and therefore the brand is more important than the grade claimed. The determination of what may reasonably be expected from a can of any grade will evidently be to the advantage of the better class of packers and to the consumer.

SHRIMP.—Experiments were made in canning shrimp in the style generally known to the trade as "headless." Shrimp are canned with all the shell removed, and it has been claimed that they could not be canned with the shell on. The object in following the latter procedure is that it saves labor and expense at the time of canning, gives a more attractive appearance to the finished product, and conserves a delicate flavor which is lost in the ordinary method. In preliminary experiments some lots of the headless shrimp have been put up successfully, but the work has not yet been duplicated, as there was no spring catch of shrimp this season.

RESEARCH WORK ON THE DETERIORATION OF FOODS.

On July 1, 1908, the Food Research Laboratory was formally established for the special purpose of studying the causes and progress of the deterioration of foods on keeping. The work, as heretofore, has dealt chiefly with the changes undergone by flesh foods, including milk and eggs, during storage, but has been extended to include changes at ordinary temperatures as well as at the refrigerator temperatures used commercially.

Seventeen analyses were made of samples consisting of from 9 to 18 individual eggs. Plymouth Rock eggs and Leghorn eggs were analyzed separately, and also fall eggs and spring eggs. A bacteriological study of the number and kinds of organisms present in

the yolk and the white of the egg was made, as well as a chemical analysis of each, the examination including the fat constants, water, ash, total nitrogen, and the distribution of the nitrogen in the various protein combinations in the white of the egg.

ANALYTICAL AND BACTERIOLOGICAL EXAMINATIONS.

For the laboratory examinations it has been necessary to revise and adopt methods, both bacteriological and chemical, for the investigation of the condition of the fowls as compared with normal, perfectly fresh birds. The extent of the analytical work is better indicated by the number of determinations and their distributions, the number of samples giving no adequate idea of the amount of work done.

Quantitative determinations of fat (butter, egg, and chicken)-----	378
Determination of constants on 144 fat samples (iodin, saponification, Hehner, Reichert-Meissl numbers, acid value, and index of refraction) -	1, 008
Determinations of ash-----	199
Determinations of total solids-----	420
Determinations of nitrogen-----	2, 365
Miscellaneous determinations (phosphoric acid, sulphur, sucrose, indol, etc.) -----	124
Total -----	4, 494

The naturally occurring mixtures of protein in milk, eggs, and flesh have been analyzed for soluble and insoluble nitrogen, coagulable and noncoagulable, albumoses, and nitrogenous extractives, as follows: Milk protein, 18 samples; chicken protein, 74 samples; and egg protein, 24; a total of 116.

The bacteriological examinations include the quantitative determination of the number of organisms, their species in many instances, their adaptability to heat conditions, etc. The question of temperature has, of necessity, been carefully considered, and many sets of cultures have been made and grown varying from blood heat to below 0° C. In the study of chicken flesh, light and dark meat were examined separately and evidences of the coli group especially sought. Yolks and whites of eggs have also been separately studied and a large number of organisms isolated from this source.

HANDLING OF POULTRY.

The study of cold-stored market chickens, begun several years ago, indicated that it must be supplemented by an investigation of chickens of known history in order that the results might be compared and properly interpreted. Such studies have been made and are now being prepared for publication. They include chemical, bacteriological, and histological data and are compiled from the analysis of a large number of birds of different breeds and ages.

Just as the study of commercial chickens led to the study of those of known history, so the work on the latter has pointed to the need for an investigation of the handling of poultry previous to storage in relation to the effect of its keeping qualities, and, therefore, its fitness for food. During the past year such an investigation has been planned and is now under way. Packing houses, transportation agents, warehousemen, commission merchants, retailers of poultry, in fact, all branches of the industry, have been visited and the cordial cooperation and assistance of each have been extended to the Department in its efforts to insure better poultry in the markets.

It is planned to make as complete a study as possible of all the conditions to which a chicken may be subjected from the time it is killed until it reaches the consumer. To this end an accurate record is kept of every step in the packing house—killing, bleeding, picking, cooling, packing, and shipping. The details of transportation are obtained with equal thoroughness and the condition of the poultry when it reaches its first destination is carefully noted, both by ordinary inspection and also by laboratory examination, bacteriologically and chemically. Should the goods be consigned to a cold-storage warehouse, and reshipped from it to a near-by or distant point, they are again inspected on their arrival at either a second warehouse or the commission merchant's. Should a shipment go into commerce immediately, it is kept under observation until it does get on the market. In this way there will be a complete record of the conditions which may affect the final result, as well as the result itself, thus enabling one to correlate cause and effect with accuracy.

Such a study made in many and varied warehouses in different parts of the United States, with long and short hauls, where the goods are intended for immediate use and where the consumption is delayed for months and cold storage is used as a preservative, is not only of value as an addition to our scientific knowledge of the decomposition of flesh as influenced by various commercial methods, but should also prove most valuable to the consumer, since it makes for better food, and to the poultry industry, which is very desirous of improved methods and better final products.

EXAMINATION OF DAIRY PRODUCTS.

The Dairy Laboratory makes examinations of dairy products of all kinds and studies methods of analyzing them. It also examines all samples of the various kinds of dairy products taken in the enforcement of the Food and Drugs Act.

During the past year a large number of importations of foreign cheeses, including many varieties, has been examined, with the result that a considerable amount of fraud has been detected and suppressed, the greater part consisting in the offering of skimmed-milk products under the guise of whole-milk or full-cream cheese. In many cases the relabeling of the goods to conform with the facts has been required, and in a few instances where the goods were in very bad condition they have been denied entry as being unfit for human food. The advent into commerce of fancy tinned cheeses, purporting to be preserved by heat, introduces a new risk to the consumer, since a handsomely labeled tin box may, on opening, prove to contain a cheese not well sterilized and sometimes in a condition unfit to be eaten.

Of the dairy products in interstate commerce, those to which most attention has been given are fresh market milks, condensed and evaporated milks, and cheeses. Fresh milks marketed in Chicago, St. Louis, Kansas City, and Cincinnati, from the adjoining States, were examined by the Dairy Laboratory in collaboration with the inspection laboratories in the cities named, with the result that the adulteration of milk for city consumption proved to be more prevalent than had been thought. The milk of Chicago, as a whole, was much better

than that of the other cities named, that of St. Louis was next best, and that of Cincinnati was the worst. Here watering was surprisingly in evidence, the claim being made that ice was put into the milk cans to cool the milk. While the use of ice for cooling milk, if applied in the right way, is most commendable, the addition of it to the milk itself is not to be tolerated. It is intended to follow up this work at intervals in the future.

The examination of interstate samples of domestic cheese has shown that while, as a rule, goods of this class are honest and honestly labeled, there are still some manufacturers who attempt to sell skimmed-milk cheeses under the guise of the whole-milk product. Even adulteration by the addition of a foreign substance is sometimes, though rarely, practiced; in one instance, an entire case of so-called "Neufchatel" cheese was found to contain upward of 20 per cent of corn starch.

The subject of evaporated milk has demanded a large share of attention during the past year, for the reason that many of the manufacturers have claimed that the standard for total solids, namely, 28 per cent, is unreasonably high, alleging that it is impossible to attain this standard at all seasons of the year, fall and winter especially, and still produce a smooth, homogeneous, marketable product. To investigate this claim and to gather data for an opinion as to the justness of the existing standard has been one of the duties of the Dairy Laboratory, the performance of which has involved a great amount of labor. Observations of the process of manufacture have been made at several different factories and analyses have been made of more than one hundred samples of the product manufactured under varying conditions and after storage for different periods of time. More observations of a similar nature are to be made during the coming autumn and winter, and no pains will be spared to obtain all necessary data for reaching a just decision in the matter.

A classified list of samples examined is as follows:

	Number of samples.
Fresh milks-----	421
Cheeses-----	404
Evaporated milks-----	177
Condensed milks (sweetened)-----	53
Butters-----	47
Creams-----	13
Miscellaneous (ice creams, oleos, etc.)-----	25
Total-----	1,140

Of these, 239 were received from the food-inspection laboratories, 711 were inspectors' samples, and 126 concerned the investigation of evaporated milk.

SUGAR-PRODUCING PLANTS AND THEIR PRODUCTS.

The Sugar Laboratory has made a special investigation of the maple sugar and sirup industry of the United States, collecting about 720 samples of pure products of known origin, over half of which have been analyzed. The results will be of value in more clearly defining the character and limits of composition of the pure product from various sections, thus enabling one better to determine the many forms of adulteration practiced. The manufacturing data collected

in each case when considered in connection with the analytical results will point to the best methods to be followed. The analysis of the remaining samples will be finished and some additional field work done during the coming maple season, which will complete the present investigation. In carrying out this study the laboratory has had the help of the official inspectors and of the chemists from several of the food-inspection laboratories.

During the first part of the year the quality of honeys imported into the United States was studied. About 100 samples were collected and a complete analysis was made in each case. The results will show the general composition of this class of honey, and in connection with the investigation methods of detecting adulteration have also been studied.

Investigations are being made looking to the improvement of the methods of analysis of beet, cane, and sugar-house products. This work will be of value to the farmers producing these sugar-bearing plants, as they are quite often sold to the factories by analysis, and also to the sugar factories in determining the per cent of sugar in all classes of samples. The analyses of all beet samples coming from the experimental work of the Bureau of Plant Industry are made in this laboratory.

The general methods of sugar analysis are constantly being studied and experiments conducted to improve their efficiency and to establish new methods. Some work has been done on the effect of temperature on polarization of sugar products, also on the use of the refractometer in the estimation of dry substance.

A total of 1,125 samples has been analyzed during the past year, which may be classified as follows to show the field covered:

	Samples.
1. Beets, sorghum, and sugar cane-----	345
2. Official food samples (maple and cane sirups, molasses, and honeys) --	31
3. Imported honeys -----	73
4. Sugar-factory products (bagasse, molasses, and cane sugar)-----	64
5. Maple sirup and sugar-----	385
6. Samples for other laboratories and Departments:	
Dextrin, starches, and glucose (Bureau of Engraving and Printing)-----	29
Mannose solutions (Animal-physiological laboratory)-----	60
Raw material, mashes, and beers for denatured alcohol plant-----	60
7. Miscellaneous sirups and samples-----	55
8. Starch products-----	23
Total-----	1,125

DRUG WORK.

INVESTIGATION OF DRUGS ON THE MARKET.

The investigations conducted by the Division of Drugs are chiefly concerned with the composition, adulteration, and misbranding of drugs and chemicals as found on the American market and shipped in interstate commerce in violation of the Food and Drugs Act. The chemical reagents used by the Bureau of Chemistry in its general analytical work are also examined. These lines of work require a study of the methods of analysis, of the standards at present official for certain products, and of normal products, with a view to establishing standards and supplying the necessary data on which to base

action. The study of the keeping qualities of hydrogen peroxid and of the deterioration of certain plant products and preparations derived from the same was also continued.

Much work has been done with the view to establishing quantitative and qualitative methods for estimating the several constituents present in drug mixtures such as the drug-addiction treatments, so-called cancer cures, consumption cures, asthma cures, etc., and other preparations containing habit-forming drugs, such as morphin, cocain, acetanilid, antipyrin, chloral hydrate, opium, heroin, diacetyl-morphin, the eucains, etc. During the fiscal year ending June 30, 1909, there were examined in this division 2,080 samples. Of this number 601 were chemical reagents, 1,220 imported drugs, and 860 domestic articles. These samples include all materials, whether collected under the Food and Drugs Act, for information, or to be used as a basis for establishing data on which to fix standards, or examined for the various other Departments.

The quality of drugs imported has materially improved. When the work was first begun it was rarely found that an importation of belladonna root was not adulterated with some foreign root, such as pokeroot, scopola root, etc., and the same was true of the leaves. At present it is rare to find this drug so adulterated. Attention should be called to the fact that some importers are persistently offering assafœtida of a low grade, claiming that the better article can not be secured abroad, but this has been conclusively shown to be erroneous, as some assafœtida of the character prescribed by the Pharmacopœia is received. A considerable number of samples of powdered assafœtida examined show that this commodity is highly adulterated. This article, furthermore, is of questionable value as a medicinal agent, inasmuch as a large proportion of the active medicinal agents are volatilized in the course of drying the original material for powdering purposes. The agents commonly employed as diluents are magnesia, starch, etc. It has also been found that the soluble material present in some of the powdered products is not derived from assafœtida proper. Henbane leaves also still show adulteration, and it is maintained by some importers that this commodity can not be purchased of the alkaloidal strength prescribed by the Pharmacopœia. The examinations made at the ports, however, show that the material offered since January 1, 1909, has been up to the standard in this respect; and, furthermore, the physical appearance of this drug has materially improved during the past few months, showing that the new crop has been collected with more care and discrimination.

The examination of the samples collected in interstate commerce develops some interesting facts. Colocynth, for example, is one of the drugs most commonly adulterated. The Pharmacopœia specifically states that the seeds shall be removed before the article is used in the preparation of medicinal agents, but some of the colocynth at present on the market is either a mixture of pulp and seeds or consists largely of the seeds themselves. The latter practice is most censurable. A sample of kamala was found to consist of nothing but red sand. Powdered conium and ipecac have been found adulterated with powdered olive stones, gentian mixed with ground peanut shells, and *Hyoscyamus muticus* substituted for henbane leaves, the label being *Hyoscyamus*, U. S. P.

CHEMICAL REAGENTS.

The chemicals examined were those regularly supplied to the Bureau of Chemistry on contract and requisition, to be used in the analytical work of the Bureau. All chemical reagents are examined in the Drug Division and supplies sent to the branch laboratories from the general supply office in Washington.

It is of interest to note that during the past year the quality of these reagents has markedly improved as compared with those examined during previous years, especially at the time when a systematic investigation of chemical reagents was first instituted, in 1903. Chemicals of inferior character, contaminated with insoluble matter and impurities so as to render them unsuitable for chemical analysis, are not now as often found. To illustrate the willingness of chemical manufacturers to cooperate in improving these supplies a few examples are cited:

Dealers who had the contracts for supplying ethyl acetate and carbon tetrachlorid repeatedly maintained that a product of the purity demanded by the Bureau was not available and could not be purchased. These statements were known to be incorrect, inasmuch as the Bureau had not only purchased the latter article of satisfactory quality, but had made it for its own use. One of the manufacturers then instituted a series of experiments and found that the quality desired could be supplied, since which time no difficulty has been experienced. Correspondence and interviews with manufacturers also established the fact that there was no difficulty in supplying ethyl acetate of proper quality, if the proper price was paid.

One of the chemical reagents with which considerable difficulty has been met in the past is acetic acid, 99 per cent pure, to be used in determining certain constants in fatty oils. Very little of the production on the market will comply with the rigid sulphuric-acid-bichromate test.

An investigation was also instituted to determine the quality of the various glacial phosphoric acids on the market. This was done both because this agent is used in analytical work and because it forms the basis of a number of medicinal agents. It is well known that the glacial phosphoric acid on the market is not a single substance, but a mixture of meta-phosphoric, para-phosphoric, and ortho-phosphoric acids, together with more or less sodium phosphate. The latter is added for the purpose of causing solidification of the product, thus enabling the manufacturer to supply an article of attractive physical appearance. Investigation showed that the various brands were not only contaminated with sodium phosphate, but that reversion from the lower hydrated acids to the higher hydrated products was continually taking place, the rapidity of such reversion depending on a number of factors, namely, temperature, concentration, and the nature of the associated substances.

Hydrogen peroxid is used to a considerable extent in chemical analysis, the strength of the article usually supplied being 3 per cent hydrogen peroxid, commonly called "10 volume." Most of the brands tested, while complying with the standard prescribed by the United States Pharmacopœia, which is not intended to supply a product of absolute purity, contained acetanilid, which may interfere with chemical analysis, and one sample also contained caffen.

ESSENTIAL OILS.

The Essential Oils Laboratory investigates the composition of these important constituents of drug products, as well as the methods for their identification.

Numerous complaints have been received relative to the standard of the Pharmacopœia for oil of peppermint and the inefficiency of the various tests for detecting the adulteration of oil of wintergreen with oil of birch, methyl salicylate, or mixtures of the two. In order to ascertain existing conditions it was decided to make an investigation of the producing regions and trade conditions before making any extensive chemical examination of the various products on the market. For this purpose representatives were sent into the peppermint-oil fields to secure information as to the kinds of plants used in preparing the various grades of oils, the care exercised in keeping the oil after distillation, etc. A number of authentic specimens have also been collected and submitted to analysis to determine the reliability of the dimethyl sulphid test.

Some investigations were also made in the field relative to the methods of producing oil of wintergreen and oil of birch. It soon became evident that very little genuine oil of wintergreen was produced. Data were collected as opportunity presented, and when it became known to the trade that an investigation was in progress, greater care was exercised in the handling of the natural oil of wintergreen, under which name oil of birch is commonly sold. In fact, several dealers made investigations for themselves, and when one firm published the fact that at present there was no oil of wintergreen available and that, with few exceptions, the article sold to the trade was spurious, consisting of oil of birch or mixtures of oil of birch and methyl salicylate, quite a sensation was produced. It was the belief six months ago that less than 25 pounds of oil of wintergreen were on the market. Some producers claim that the manufacture of this oil at present prices is an impossibility, the production of the genuine oil costing from \$10 to \$12 per pound. Before prosecuting these fraudulent transactions it was necessary to provide reliable methods for establishing the genuineness of a given sample of oil of wintergreen, none being known as far as could be determined. A considerable number of samples have been collected and the work is progressing. Many of the oil of cassia importations, as well as the domestic samples, are contaminated with undesirable metallic substances, and it is usually claimed in such cases that the oil is "for technical use only."

The percentage of alcohol present in medicinal products has been estimated in 200 samples, including products which contain, among other ingredients, essential oils. It is well known that the essential oils tend to vitiate the results obtained by the regular methods for determining alcohol. Experiments were instituted for the purpose of determining to what extent this is true and also to ascertain what methods would be most suitable for the various kinds of products. It has been found that the method of shaking out a saturated salt solution with petroleum ether and subsequently distilling the aqueous portion gave results which are closely in accordance with the facts. The refractometer and ebullioscope were also employed, but the results were not as satisfactory as desired.

COOPERATION WITH THE POST-OFFICE DEPARTMENT.

During the past year the Division of Drugs made analyses of 15 medicinal agents represented as cures for various maladies sent or prescribed through the mails in violation of the postal laws. The investigations required not only the analysis of the samples of medicines used in the treatments, but also a study of all of the claims and representations made for the treatments, that the Postmaster-General might be advised as to whether or not false and fraudulent representations and promises had been made. Generally the treatment included several agents. In most cases these remedies consisted of mixtures of ordinary medicinal agents which are useful and of service, but which can not in any sense be considered as cures for the numerous diseases for which they are advertised and sold. A single instance will illustrate this point: A so-called "cancer cure," advertised and exploited under the name "Radol," consisted of two aqueous solutions which it was claimed had been "radiotized" by radium emanations. An investigation, however, showed that they did not possess any greater radio-activity than ordinary water, if as much, and that the fluorescence present in one of the solutions, said to be due to the radium emanations, was introduced by means of quinine sulphate, the whole being acidulated with an inorganic acid. The statements made as to the constituents of the remedies proved to be equally false, and a fraud order was issued, with the result that the business was discontinued. Simultaneous with the issuing of the fraud order a criminal case was filed in the courts of St. Louis; the promoter of the remedy appeared in court, pleaded guilty to the charges, and was fined \$100. There are about eight other cancer-cure treatments under investigation, besides tuberculosis cures, vitality restorers, and similar remedies, all plainly of a fraudulent character.

SO-CALLED "CANCER CURES."

The Drug Division has in its possession the entire treatment, directions, etc., of a considerable number of these "cures" and correspondence is under way in regard to many other cases. The promoters of these treatments, in order to bring them to the attention of the public, use in their advertisements, correspondence, and circulars many gross misrepresentations and promises. In fact, there is hardly any other line of business which is equal to the cancer-cure treatments in this respect. The methods of obtaining patients vary slightly in each case, but the general principles are the same, and the mixtures employed also have some similarity. Their treatment consists chiefly in using a tonic medicine, a local application, and some escharotic to destroy the cancerous tissue. It is immaterial whether the cancer is on the surface or is internal; they will represent that this malignant disease can be successfully treated by their remedies. One promoter represented at the hearing that the arsenical paste in his hands would accomplish results entirely different from those obtained by medical practitioners. Exactly how this is accomplished he was unable to explain. Another treatment consisted of a dough in which was incorporated a small amount of zinc chlorid. Experiments made upon the human body indicated that this combination has little, if any, escharotic effect. Another treatment employs a so-called "absorbent,"

consisting of a muslin bag inclosing a certain mixture, which constitutes the basis of the treatment and the absorbing action. Analysis fails to find the presence of any agent excepting charcoal which could be considered as absorbing any substance emitting from an open wound or cancerous growth. The method of diagnosing the affliction of the patient in absentia by symptom blanks is virtually worthless. It is well known to medical practitioners that an absolute diagnosis of cancer can only be made by the use of a microscope in the hands of a competent pathologist.

PREScription SCHEME REMEDIES.

Since the passage of the Food and Drugs Act there has been placed upon the market a line of preparations, the advertisements of which embody a prescription, which contains several well-known agents, together with a coined name of some unknown product. In order to fill this so-called "prescription" it is necessary to purchase the agent sold under the coined name. Analyses of these products were made and the actual value compared with the claims made for them, the results showing that these mixtures usually consist of the cheapest and commonest ingredients known to the medical profession. The patient, on the contrary, is led to believe from the advertisement that the products sold under these coined names are new and rare and that the remedy is a panacea for consumption, Bright's disease, asthma, etc., when, as a matter of fact, the medicines do not contain any agent which could be looked upon as possessing any curative properties for these diseases. Such remedies are plainly fraudulent and harmful, since the patients are led to use them and thus lose valuable time which might be employed by resorting to proper treatment.

HARMFUL EFFECTS OF ACETANILID, ANTIPYRIN, AND PHENACETIN.

Prosecutions under the Food and Drugs Act developed the fact that there was much difference of opinion as to the harmful nature and effect of acetanilid, antipyrin, and phenacetin. In one case one physician testified that whereas he had formerly used acetanilid rather freely, he now prescribed it very guardedly, because of the unexpected and untoward effects which had been found to follow its use; another stated that he employed it to good advantage, and that though he often noted "bluing of the skin" he regarded this symptom merely as a signal or warning as to the further administration of the drug. It was, therefore, decided to make a thorough investigation of this subject, both by correspondence with physicians and by a survey of the medical literature. Four hundred responded and the data so supplied constituted a part of a publication issued on this subject.

The number and nature of poison cases, deaths, and habitual use of these commodities, as recorded in the medical literature, are also given, proving conclusively that these drugs are unsuitable and dangerous for use in proprietary medicines without medical supervision.

It seems, however, that the number of headache mixtures is increasing daily. It is true here and there a certain brand is discontinued,

but new ones are introduced. The essential ingredients in these mixtures are acetanilid, acetphenetidin (phenacetin), antipyrin, monobromated camphor, caffeine, sodium bicarbonate, ammonium carbonate, bromids, codein, and those mixtures that possess laxative properties, containing, in addition, effervescent material which consists chiefly of citric acid or tartaric acid and bicarbonate of sodium. During the past year about 350 samples have been collected, a large number of which have been analyzed. Some of these mixtures are taken in very large doses, and the amount of harm done to the public by their use can not be estimated, though some idea may be obtained by reading the data collected and published. While the ingredients present in these commodities may not be harmful when used under proper medical supervision, their promiscuous and indiscriminate use frequently produces poisoning, drug addiction, and in some cases even death.

MEDICATED SOFT DRINKS.

During the fiscal year ending June 30, 1908, approximately 80 samples of medicated "soft" drinks were examined. Since that time additional official samples have been collected of such products, and in 13 such samples the presence of cocain was established. It is true in most cases the amount of cocain is small, but the presence of such a deleterious agent in a beverage sold without restraint, and to children as well as adults, must be considered as illegal and very harmful, irrespective of the amount present. Very small quantities of cocain undoubtedly affect the nervous system of many individuals, and in many cases where the drug habit has been broken off the individual is liable to be unbalanced by the very small quantity he may obtain through the consumption of several glasses of a beverage containing this dangerous and habit-forming drug. In some cases the quantity of cocain present is declared upon the barrel, keg, or jug, but this information does not come to the attention of the public. The addition of cocain to a food product is undoubtedly one of the most pernicious practices in vogue.

SO-CALLED DRUG ADDICTION CURES.

There are about 35 institutions, combinations, or individuals engaged in the practice of treating drug addiction, opium, morphin, cocain, etc., by sending to persons addicted a treatment with instructions. In some cases these packages contain as much as 32 grains of a morphin salt to the fluid ounce. In other words, a 4-ounce bottle would contain enough of this poisonous, habit-forming agent to kill at least 100 men. Such mixtures are sent from one State to another, in many instances not only in violation of the federal law, but also in violation of the laws of the State, Territory, or the District of Columbia, from which or into which they are shipped. Seldom is a "poison" label attached to any of them. In other instances from 10 to 18 bottles are sent, the bottles being marked from 1 to 10 or 18, respectively, and every bottle containing the same amount of the habit-forming agents, though the treatments purport to gradually decrease the dose. For example, one treatment consisted of 10 bottles marked as indicated, and the amount of morphin and dionin present in an ounce of the material was 4 and $2\frac{2}{3}$ grains, re-

spectively, in each bottle. Another treatment sent out contained 16 grains of morphin sulphate and 8 grains of dionin, the latter being a derivative of morphin and possessing similar habit-forming properties. Many of the promoters of these remedies carry on their letter head the names of a number of prominent individuals or persons connected with philanthropic work who are represented as indorsing the treatment. An investigation showed that most of these persons are dead, and such as are still living have never authorized the promoter to represent to the public that they have indorsed the medicine in any shape or manner. A number wrote that according to the information brought to their attention the treatment apparently is accomplishing beneficial results.

The Drug Division has obtained the full treatments given by nearly all persons or firms claiming to cure drug addiction through the mail. It has also in its possession a number of samples of cocain sent by wholesale druggists and physicians to persons in the District of Columbia. The selling of these commodities in the District of Columbia is in violation of the law.

MISCELLANEOUS COOPERATIVE WORK.

At the request of the General Supply Committee, 26 samples of beeswax and 8 samples of paraffin were examined, with the result that all of the paraffin was found to be satisfactory, but 14 samples of the beeswax were either adulterated or pure substitutes. The beeswax present varied from 25 to 50 per cent of the whole, the remaining portion being paraffin, stearic acid, and other waxes. It is also of interest to note that some of the most highly adulterated samples are quoted at the highest prices. For example, the price of adulterated yellow beeswax varies from 18 cents to 45 cents per pound, the latter price being the highest quoted. In the case of white beeswax, the prices vary from 24 cents to 60 cents per pound for the adulterated product, while the highest price quoted for a pure product is 46 cents. It is apparent that the price for which an article is offered is no criterion on which to base a judgment as to its purity. Out of this practical work has grown a study, in cooperation with the Bureau of Entomology, on the constants of pure beeswax. The Bureau of Entomology supplies the Division of Drugs with authentic specimens of beeswax collected throughout the United States and foreign countries. So far 25 samples have been obtained, 12 of which have been analyzed. The results indicate that the constants of pure beeswax are uniform, irrespective of the location or kind of bees producing it, contrary to the claims made at times by manufacturers and dealers.

The chairman of the committee on the Drug Market of the American Pharmaceutical Association submitted for examination 10 samples of turmeric, purchased on market, with the result that 5 were found to be adulterated, 2 were barely up to the standard, and 3 were of excellent quality. These samples were purchased in the open market in Boston.

DRUG LEGISLATION IN THE UNITED STATES.

Various federal, state, territorial, and other laws governing the sale and labeling of drug products in the United States and its terri-

tories have been compiled and issued. The laws in general prescribe the qualifications necessary for a pharmacist to engage in the practice of selling medicinal agents, regulate the sale of poisons and narcotics, and forbid the sale of adulterated and misbranded drug products. It should be noted that at present there is no federal law which prohibits unregistered or unlicensed persons from sending into interstate commerce such commodities, although they can not be sold locally by them, nor indiscriminately even by registered or licensed pharmacists or physicians. It is believed that the state laws will reach some of the offenders, but in order to establish this fact it will be necessary to bring a number of cases.

SYNTHETIC PRODUCTS.

The principal lines of work conducted by the Synthetic Products Laboratory during the past fiscal year are as follows:

There were examined 108 interstate and 8 import samples, including preparations for the treatment of headache, neuralgia, la grippe, rheumatism, etc., 35 of the interstate samples proving to be illegal. This work is part of a comprehensive scheme to investigate all headache remedies and other preparations containing (synthetic) habit-forming drugs, such as dionin, heroin, acetanilid, antipyrin, pyramidon, acetphenetidin (phenacetin), caffein, etc.

Research work on headache mixtures was inaugurated in 1908 with a view to establishing reliable methods for estimating the constituents present in preparations containing caffein, acetanilid, acetphenetidin, etc. After the tabulation of the analytical data now on hand, it is believed that the methods for the separation and estimation of acetanilid and caffein in headache mixtures will have been practically perfected. Some investigations were also made looking to the recovery of caffein when occurring in or introduced into various vegetable and animal tissues.

During September and October the chief of this laboratory investigated the conditions involved in the manufacture and sale of certain synthetic drugs in Germany and Switzerland, more especially, however, the process now in vogue for making acetphenetidin (phenacetin). It developed that this drug is no longer made in quantity from phenol (carbolic acid), the view quite generally prevailing in this country and found in much of our chemical literature. On the contrary, the method now most commonly employed for producing this commodity has as its starting point the well-known substance benzol. The isomeric chlornitro benzols resulting in this process of manufacture find ready employment in the preparation of certain dyestuffs. The presence of chloracetanilid frequently detected in some brands of phenacetin is readily explained from the fact that the manufacturers in question did not take the precaution to properly purify their crude aethoxynitrobenzols.

PHARMACOLOGICAL RESEARCH.

Much attention has been given to the equipment and organization of the Pharmacological Laboratory. The outfit was planned to insure both economy of time and accuracy in the work. The apparatus and appliances include holders for large and small animals, two kymographs, mercurial manometers, oncometers, apparatus for the

perfusion of the heart, a full equipment of surgical instruments for aseptic operations on animals, apparatus for the study of muscular changes, cages for small animals, and four cages for dogs, constructed so as to collect the excreta separately. The Pharmacological Laboratory will be equipped for the study of the action of drugs on circulation, respiration, muscles, secretion, metabolism, etc.

Researches carried on are as follows:

STUDIES ON FLOUR.—(1) Chemical. Both alcoholic and aqueous extracts were prepared from unbleached, commercially bleached, and overbleached flours containing up to 50 milligrams of nitrogen, calculated as sodium nitrite per kilogram of flour. Some extracts were also made from flour which had been treated with nitrogen peroxid until it assumed a distinct yellow color. About 50 different extracts were prepared.

(2) Physiological. Experiments included the feeding of the extract to rabbits, intraperitoneal injections into guinea pigs, and studies of the effects of extracts of bleached and unbleached flour on blood pressure in dogs. A large number of experiments have already been performed, but the work is not yet completed.

STUDIES IN THE PHARMACOLOGY OF CAFFEIN.—(1) Experiments on tolerance to caffein performed on rabbits and dogs are nearing completion.

(2) An extended series of observations has been made of the toxicity of caffein on rabbits, dogs, cats, pigeons, guinea pigs, and frogs, and is nearing completion.

(3) Some experiments have been made on the effect of caffein on the toxicity of acetanilid, including studies on blood pressure. As soon as time will permit, this investigation will be extended to anti-pyrin, phenacetin, and alcohol, all of which are supposed to counteract the effects of caffein in the body.

(4) The fate of caffein in the body, a subject of absorbing interest from a theoretical but more so from a practical standpoint, has been studied with reference to its elimination in the bile of dogs and rabbits and decomposition in the liver.

(5) An investigation on the production of caffein glycosuria in rabbits, dogs, and guinea pigs is in progress. The experiments on the effect of calcium chlorid on caffein glycosuria in rabbits have yielded very interesting results.

(6) Studies have also been conducted on the effect of caffein on protein metabolism, with special reference to high and low protein diet and the elimination of kreatinin, but no satisfactory results have as yet been obtained.

TOXICITY OF THE ALCOHOLS.—Experiments on the comparative toxicity of ethyl and amyl alcohol have been carried out on frogs and rabbits, and studies on blood pressure have been made on dogs and cats.

EXPERIMENTS WITH BOVININE.—A study on the effect of bovine has been made by feedings and intraperitoneal injections into rabbits, feeding experiments with dogs, and absorption from the stomach in the case of dogs.

PHYSIOLOGICAL TESTING AND CONTROL OF METHODS.—A number of samples have been tested physiologically for the presence of various

constituents. A good deal of time has been devoted to a critical study of methods used in analysis in connection with metabolism work on animals to facilitate future work and insure greater accuracy of results.

MISCELLANEOUS CHEMICAL INVESTIGATIONS.

STUDIES CONDUCTED BY THE MISCELLANEOUS DIVISION.

SCOPE OF WORK AND NUMBER OF DETERMINATIONS.

By order of the Secretary, the Miscellaneous Division was created July 1, 1908, four laboratories and one section being organized, as follows: Water Laboratory, Cattle Food and Grain Investigation Laboratory, Insecticide and Fungicide Laboratory, Trade Waste Laboratory, and Hygienic and Miscellaneous Section.

This expansion and reorganization was necessary for the proper execution of the work assigned to this division under the Food and Drugs Act, and because of the growth of the several lines of investigation which previously had occupied the attention of the Miscellaneous Laboratory.

To the Water Laboratory, formerly the Insecticide and Water Laboratory, is assigned the examination, under the Food and Drugs Act, of bottled mineral and table waters, foreign and domestic, found on our markets; the examination of public water supplies for the purpose of detecting causes of pollution and suggesting remedies for correction of the same; the examination of waters for irrigating and technical purposes, and the examination of samples from source of all the important mineral springs of the United States.

The Cattle Food and Grain Investigation Laboratory examines samples of cattle and poultry foods and remedies collected under the food law, and is also charged with the investigation of such economic problems as the feeding value of range forage crops, the feeding value and adaptability of grains, the milling quality of cereals, and the effect of bleaching on flour.

The Insecticide and Fungicide Laboratory investigates the composition and methods of manufacture of insecticides and fungicides and their effect when sprayed upon foliage, with the idea of increasing the efficiency of these products and also suggesting methods by which injury to vegetation may be avoided.

The Trade Waste Laboratory studies the relation of the disposal of harmful trade waste to agricultural operations. Particular attention has been given to the injury produced by smelting and mining operations.

The hygienic work includes investigations relating to public health; that is, the examination of wall papers and fabrics for poisonous or deleterious materials, the examination of poisons and poisonous substances in common use, the composition of the atmosphere of schools, public buildings, railroad cars, etc. The work of the miscellaneous section also includes investigations of an official and public nature which may be properly made by this Bureau but are not provided for in other established laboratories.

The administrative work and correspondence relating to the proper enforcement of the Food and Drugs Act, as applied to mineral and

table waters and to cattle and poultry foods and remedies, has greatly increased during the year, and together with the preparation of cases recommended for prosecution to the Board of Food and Drug Inspection occupies a great portion of the time of the chief of the division. The traveling necessary in the study of the effect of smelter wastes on agriculture has also consumed considerable time. During the year 2,092 samples, requiring approximately 15,000 determinations, have been examined, as follows:

Imported mineral and table waters.....	92
Domestic mineral and table waters.....	412
Miscellaneous waters.....	142
Imported cattle and poultry foods and grains.....	157
Domestic cattle and poultry foods and grains.....	269
Miscellaneous feeds and grains.....	164
Insecticide and fungicide samples.....	203
Trade waste samples.....	335
Miscellaneous and hygienic samples.....	318
Total.....	2,092

About one-third of these examinations have been made at the request of the several divisions and bureaus of this Department, and for other Departments of the Government according to the following classification:

War Department.....	9
Department of Commerce and Labor.....	18
Department of Justice.....	115
Isthmian Canal Commission.....	2
United States National Museum.....	1
Government Printing Office.....	2
Commissioners of District of Columbia.....	25
Department of Agriculture:	
Bureau of Plant Industry.....	238
Bureau of Entomology.....	184
Bureau of Forestry.....	3
Bureau of Animal Industry.....	2
Irrigation and Drainage Investigations.....	6
Total.....	605

WATERS.

During the year 646 samples have been examined in the Water Laboratory, 92 being foreign mineral waters, of which 17 were recommended for exclusion from entry into the United States because of false and misleading statements on the labels. Four hundred and twelve interstate samples of bottled mineral and table waters were examined. Continuing the investigation of mineral springs at source, 62 waters have been subjected to complete analyses. Eighteen complete analyses have been made of waters from fish-hatching stations, this work being performed by request of the Bureau of Fisheries of the Department of Commerce and Labor. Miscellaneous analyses made during the year for other branches of the Government service were as follows: War Department, 7; Isthmian Canal Commission, 1; Government Printing Office, 2; Bureau of Plant Industry, 20; Bureau of Entomology, 7; Irrigation and Drainage, 6; Forestry Service, 2. Twenty-five samples of gas were examined incident to an investigation made at the request of the Commissioners of the District of Columbia. As time has permitted, two lines of original research begun last year have been continued, namely, the study of the methods

for determining small amounts of lithium and a study of the radio-activity of mineral springs. Both of these investigations have an important bearing on certain aspects of the enforcement of the food law.

CATTLE FOOD AND GRAIN INVESTIGATIONS.

This laboratory has examined during the year 590 samples, 269 of which were samples of commercial feeding stuffs obtained by inspectors on the market and analyzed to determine their compliance with the provisions of the food law. Sixty samples were found adulterated or misbranded, and prosecution has been recommended to the Board of Food and Drug Inspection. There have also been examined 157 imported samples, including oats, barley, wheat, cottonseed meal, barley sweepings and cleanings, pea meal, etc., to determine whether entry into this country should be allowed.

In cooperation with the Office of Grain Investigation of the Bureau of Plant Industry 5 wheat and 58 sorghum samples have been analyzed, and for the Office of Farm Management 52 samples of hay have been examined and 2 of alfalfa. Forty-six additional miscellaneous samples were analyzed for various bureaus and laboratories of the Department.

INSECTICIDES AND FUNGICIDES.

Two hundred and three samples of insecticides, fungicides, and weed killers have been examined by the Insecticide and Fungicide Laboratory, and considerable work along related lines has been performed in cooperation with the Bureaus of Entomology and Plant Industry. Numerous samples of soluble oils and proprietary insecticides have been examined at the suggestion of the Bureau of Entomology to determine the commercial cost of preparation of these articles, and it was found in some cases that the price asked was out of all proportion to the value and cost of the material.

The investigation of lead arsenate, which was begun last year, has been completed. The method of manufacture of lead arsenate and the effect on the character of the finished product of impurities contained in the raw materials have been studied exhaustively. The possibilities of homemade lead arsenate and the effect of different lead arsenates and the various impurities therein on tender foliage have been investigated, as has also the quantity of arsenic remaining on the ripe fruit of trees that have been sprayed. A bulletin embodying the results and conclusions has been prepared, and it is believed that the information will be not only timely but of great value to the farmer and the orchardist as well as to the manufacturer of this product. An investigation of the toxic effect of certain materials, notably copper and arsenic on plants which are sprayed with combinations of these substances has been undertaken. Some apprehension exists among orchardists that the excessive use of lead arsenate may cause an accumulation of toxic salts in the soil and result in serious injury to the trees. This matter is receiving special attention.

In collaboration with the Bureau of Entomology, an investigation of the efficiency of sodium cyanid as a substitute for potassium cyanid in fumigating operations has been begun. The proper proportions

of cyanid, acid, and water to be used to obtain the highest efficiency of hydrocyanic-acid gas will be determined, as will also the effect of any impurities which these reagents may contain on the foliage and on the amount of hydrocyanic acid formed from a given amount of potassium cyanid. This work is nearly completed, and results have been obtained which it is believed are of considerable economic importance.

TRADE WASTES.

The Trade Waste Laboratory, under the immediate charge of the chief of the division, has examined 335 samples. One hundred and fifteen of these were obtained in cooperation with the Bureau of Forestry, at the request of the Department of Justice, and constitute a part of the study begun the previous year to determine the injury to vegetation, particularly within forest reserves, produced by the fumes and refuse of smelting operations.

The effect of certain gases and toxic salts, produced as a result of mining and smelting operations, on greenhouse and field specimens has been studied under such conditions that the quantity of the several materials used could be accurately determined and the results exhaustively investigated. Part of the investigation of conditions in the vicinity of the smelters at Anaconda, Mont., has been completed and the results prepared for publication, while other studies of a similar nature are also nearing completion.

MISCELLANEOUS AND HYGIENIC SECTION.

The miscellaneous and hygienic work for the year has resulted in the examination of 318 unclassified samples, quite a number of which were for other Departments of the Government service as well as for the several bureaus and offices of this Department.

INVESTIGATIONS OF THE LEATHER AND PAPER LABORATORY.

The leather and paper investigations have been seriously impeded because the specially trained men necessary for these lines of work can not be secured. It has therefore been necessary to train chemists for these investigations, after which they have resigned in several instances to accept more remunerative commercial positions. Nevertheless the work of the laboratory has steadily increased, as is shown in the following summary of samples handled during the year:

Paper and paper-making materials, Washington.....	3,844
Paper and paper-making materials, Dayton laboratory.....	1,459
Leather and leather-making materials.....	32
Turpentine, tars, oils, and wood products.....	416
Miscellaneous	63
Total.....	5,814

The extent to which these examinations are called for by other Departments is shown by the fact that of the total 5,814 samples, 4,849 were made for other branches of the Government, of which 1,559 were paper examinations for the Government Printing Office and 2,528 papers and leathers examined for the Post-Office Department.

PAPERS AND PAPER-MAKING MATERIALS.

Paper tests are regularly made for the Post-Office Department, both in Washington and at Dayton, Ohio, for the Government Printing Office, for the Treasury Department, for the General Supply Committee, for the Isthmian Canal Commission, and for other branches of the Government. Special investigations were made for the Post-Office Department in connection with the purchase of postal cards and for the General Supply Committee to assist in the awarding of contracts. This laboratory has now the equipment, force, and experience necessary for testing all papers purchased by the Government and is in a position to prepare specifications and test the deliveries in such a manner, it is believed, that the cost will be much decreased and the interests of the Government better served.

Paper-making materials not now in general use and pulps made from them have received attention. No material has so far come to the attention of the Bureau which, under present conditions, can compete with rags, wood, straw, and the commonly used fibers in quality or in cost of papers made therefrom, except possibly under special local conditions. The need of a substitute for wood from which paper equal in quality and as cheap can be made is evident to all. Many have recently turned their attention to supplying this material, and there is grave danger that through the excessive enthusiasm, or less worthy motives, of the exploiters of such alleged materials, many uninformed persons may invest in ventures which will of necessity fail financially. This is not probable in the case of experienced paper makers, but it is likely to occur where the people of a community who know nothing about paper making are persuaded to invest in establishing a new industry which theoretically looks exceedingly promising. It should be borne in mind that experienced paper makers have made practical tests with most of these suggested materials and found them unprofitable.

TURPENTINE.

Approximately 300 samples of spirits of turpentine have been examined in connection with the administration of the Food and Drugs Act, June 30, 1906. The purpose of this examination was not only to determine how extensive is the practice of adulteration, but to learn at what stage of marketing this article is adulterated; whether by the producers, the primary buyers, or the wholesalers and retailers. The samples were collected from all parts of the United States and from dealers in paints and oils who sell largely to druggists. It was found that but few samples collected from producers were adulterated, but about 20 per cent of the samples from the stock of primary buyers and about 27 per cent of these from the stock of wholesale and retail dealers were sophisticated; or, in other words, about 20 per cent of the samples collected were adulterated. The average amount of adulterant present was 6.5 per cent, though many of the samples contained 20 per cent and some as much as 75 per cent of mineral oil. An adulteration of 6.5 per cent of mineral oil reduces the market value between 80 cents and \$1.20 per barrel, and the purchaser of the oil is defrauded to that amount. The percentage both of adulterated

samples and the amount of adulterant present is greater in samples taken from the wholesale and retail dealers than in samples taken from primary buyers. The results, on the whole, show a serious sophistication of spirits of turpentine now found on the American market.

Experiments on an industrial scale in the refining of wood turpentine, both by steam and destructive distillation, have been conducted, using two forms of column stills. It was found that while a wood turpentine of superior quality can be thus produced, it is not possible to secure a sharp separation of oils having a given boiling point. That is, if all the oils boiling below 170° C. are distilled, a small percentage of oils distilling above 170° C. is also carried over. Further work with these various products, such as paint and varnish thinners, is being done on a practical scale. The laboratory continues to test samples of tars, pitches, and turpentines at the request of other Departments.

LEATHERS.

The investigations on leathers have been continued. Sole and rough leathers of different tannages are being analyzed and tested to determine the factors that control quality, but no conclusions have as yet been reached. Work on leathers has also been done at the request of the several Departments, and an investigation of bag and belting leathers has been begun as a result of these inquiries. The studies on tanning materials have been confined to native materials, work on American sumacs and on the tannin content of barks at different seasons of the year being under way. The leather and tanning work has been handicapped most severely for lack of men trained in the testing and examination of these products.

MISCELLANEOUS WORK.

Miscellaneous samples, including fertilizers, peats, oils, soaps, and other industrial materials, have been examined during the year for other bureaus of this Department and for other Departments.

EXAMINATION OF SUPPLIES FURNISHED ON CONTRACT.

This work is done in the Contracts Laboratory, being conducted along the same lines as in the past, with the exception that there has been a greatly increased demand for tests of contract supplies, the number of samples being more than double that of the preceding year. This increased demand has taxed the resources of the laboratory to the utmost, so that very little research work was possible, although the field afforded for such investigations is practically unlimited, owing to the miscellaneous character of the supplies offered for examination and their complexity of composition. A method for the rapid analysis of Babbitt metal has been developed and considerable work has been done on the study of other methods for testing the various materials examined.

The laboratory has been working for several years on testing paint and varnish materials, and during the past year 1,076 samples of these materials were analyzed, most of which were examined at the request of other Departments. The chief of the laboratory has acted

as a member of an inspecting committee on an extensive series of exposure tests of paints on wood and also on iron and steel, conducted by an association of paint manufacturers, which promises to be very instructive. Though these experiments have not been under the control of this laboratory, an unusual opportunity has been offered for the discussion of paint problems with experts representing both consumers and manufacturers.

The 2,606 samples examined during the year are classified in the following table to show the more important kinds of materials analyzed and for which branches of the Government the work was done. In addition, this laboratory has examined 5,511 pieces of apparatus, of which only 399 were rejected, which indicates that the inspection of apparatus, which has gradually been developed, has resulted in a decided improvement in the quality of material sold to the Bureau.

Number of samples of contract supplies analyzed.

Department requesting analysis.	Paints and varnishes.	Oils, fats, grease, and waxes.	Metals and alloys.	Soaps and candles.	Ink.	Typewriterribbons.	Dry colors.	Rubber.	Glue.	Chemicals.	Boiler compounds.	Miscellaneous.	Total.
Isthmian Canal Commission	189	160	170	25	.....	.....	.....	75	.....	40	17	93	769
General Supply Committee.....	512	75	.....	29	20	69	.....	.....	37	.....	.....	.....	742
Treasury Department ^a	3	94	32	42	3	.....	295	.....	44	.....	.....	13	526
Commissioners, District of Columbia.....	253	57	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	310
Department of Agriculture ^b	118	34	9	16	.....	4	.....	.....	.....	.....	.....	14	195
Government Printing Office.....	.....	38	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	40
Post-Office Department.....	1	.....	.....	.....	9	.....	.....	.....	.....	.....	.....	.....	10
Interior Department.....	.....	5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5
War Department.....	.....	.....	.....	3	.....	.....	.....	.....	.....	.....	.....	.....	3
Department of Commerce and Labor.....	.....	.....	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	3
Navy Department.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	1	2
Department of Justice.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	1
Total	1,076	463	214	115	35	73	295	76	81	40	17	121	2,606

^a Including Bureau of Engraving and Printing.

^b Including Bureau of Chemistry.

MICROCHEMICAL INVESTIGATIONS.

The investigations of the Microchemical Laboratory have been, as in former years, largely conducted in collaboration with other laboratories and branches of the government service. Routine work, supplementing chemical analyses by the microscopical examination of samples, occupies much time, though several lines of research work have been pursued. Samples of mustards grown last season were collected when mature, and as soon as opportunity permits the microscopical work on them will be done to establish characteristics for their identification and the detection of adulterants.

Considerable attention has been paid to the investigation of eggs stored in various methods to provide means of identification of the storage product when offered for sale. The dried egg products have

also been studied and both lines of work are of importance in the enforcement of the Food and Drugs Act.

The investigation begun last year on alkaloids has been continued, with most encouraging results. Up to the present time over 40 compounds, natural or synthetic, have been studied more or less thoroughly, and the data are being used regularly in the identification of alkaloids or of some of their derivatives in drug and food products.

In connection with the analysis of certain products made wholly or in part from nuts it was found necessary to make a study of many varieties for the purpose of developing histological methods for their identification, and the results of these investigations are being used practically at the present time in the examination of such products.

A microscopical study has also been made of a few substances offered for paper making, though the most of the work on papers has been in their routine examination for the several branches of the Government. These samples have come mainly from the Government Printing Office, Post-Office Department, General Supply Committee, and the Bureau of Engraving and Printing. The determination of the quantity and quality of the pulp entering into the manufacture of envelopes for the Post-Office was an important feature of this work.

The food work has covered a large variety of samples, including nutmegs, coffees, cocoa and chocolates, tea, rice, nuts, honeys, peppers, peas, and miscellaneous products.

The general work on cattle foods and grains has consisted largely in the investigation of imported samples, the most important point being the detection of poisonous weed seeds.

While the microscopical examination of paint pigments is not always of service, still certain points regarding their character can be determined by such an examination, and over a hundred samples, including lampblacks, chrome greens, yellows, white and red leads, were so tested.

The work on interstate samples in connection with the operation of the Food and Drugs Act has required the examination of over 800 samples and included a large variety of substances, such as eggs, cocoas, coffees, flours, peppers, ketchups, jellies, and yeasts. Of stock feeds the list includes whole grains, such as oats and wheat, as well as simple ground feeds and a large number of compound feeds made of mixtures of various ingredients. Of interstate samples of drugs, various alkaloidal residues have been identified and also many powdered drug products, as well as such materials obtained from medicinal products. About 240 photomicrographic negatives have been made, mostly in connection with the studies on nuts and alkaloids. A classified list of the various samples analyzed during the year is as follows:

General samples.

Papers.....	3,491
General food samples.....	653
Stock feeds.....	158
Pigments.....	124
Drugs.....	149
Unclassified samples.....	79
Total.....	4,659

Interstate samples.

Foods.....	427
Stock feeds.....	144
Drugs.....	314
Total.....	885
Sum total of samples for year.....	5,544

NITROGEN DETERMINATIONS.

The section devoted entirely to nitrogen work, which plays so important a part in many examinations, especially in determining quality in the administration of the food law and in metabolism experiments, has made 12,000 such determinations on samples from all divisions of the Bureau and from the Bureau of Plant Industry, exceeding by 3,250 the figures for the previous year. Investigations for the improvement of methods used in the determination of nitrogen have been continued.

FOOD AND DRUG INSPECTION.

The inspection work of the Bureau in the enforcing of the Food and Drugs Act of June 30, 1906, is specifically assigned to an inspection force of 39 men under a chief inspector with headquarters at Washington, to a food and a drug inspection laboratory at Washington, and to 21 branch laboratories in various parts of the United States, including 1 in Honolulu.

THE FOOD AND DRUG INSPECTORS.

During the fiscal year 1909 the food and drug inspectors continued the inspection work on the same general lines as in the preceding year, collecting samples suspected to be adulterated or misbranded and investigating factory practices. The number of inspectors remains the same, and, with a very few exceptions, the assignment of stations has been unchanged. The installation of a laboratory at Nashville, Tenn., caused the abandonment of the inspector's post at Memphis and his transfer to Nashville. In order to make a more equal distribution on this account, the inspector at Knoxville was transferred to Charleston, W. Va., and the inspector at Birmingham, Ala., to Atlanta, Ga. The amount of work at New Orleans, Chicago, and Cincinnati required the assignment of an additional inspector to each of these cities, making five laboratories altogether, including New York and Boston, where two inspectors are stationed, a plan which might be followed to good advantage at other strategic points if the force were sufficiently strong numerically to permit it.

A civil-service examination for food and drug inspectors was held by the Civil Service Commission on May 5 and 6, and two appointments have been made from this list to fill vacancies caused by resignations.

The major portion of the year's work consisted in the collection of food and drug samples for examination and in the inspection of factories engaged in interstate traffic. About 1,300 factories have been inspected, and the number of samples collected amounts approximately to 15,000. The class of products sampled was similar to those obtained during the fiscal year ended June 30, 1908, namely, extracts, spices, olive and salad oil, milk, liqueurs, wines, whiskies, molasses, vinegar, diabetic and gluten flours, maple and cane sirups, coffee, cheese, honey, breakfast foods, misbranded morphin and cocain prepa-

rations, and drugs labeled as cures. To this list have been added preserves, jams, fruit butters and jellies, and a great many powdered drugs, besides those drug samples requested specifically from time to time by the Division of Drugs. Coordinately with the submission of official samples, each inspector is required to forward a report giving an inventory of the stock in possession of the consignee and detailing the nature of interstate delivery in order that condemnation proceedings may be instituted, provided that the sample indicates that the goods are adulterated or misbranded. In this manner more than 200 recommendations for seizures have been referred to the Board of Food and Drug Inspection, of which 185 were approved.

In seizure cases it is usually necessary, in order to make proper identification of the product before attachment, that the inspector originally reporting the matter should proceed to the point of destination and acquaint the district attorney with all of the detailed facts in connection with the sale and interstate shipment. In addition to procuring copies of label and other records pertaining to the case, assistance in making the seizure is given in connection with every case. A large number of criminal prosecutions have been referred to various district attorneys within the past year. These prosecutions, whenever practicable, have been instituted against the manufacturer.

During the months of August and September, 1908, concerted milk campaigns were held at Kansas City, Chicago, and Cincinnati, at which more than 1,500 samples were collected, resulting in convictions and assessments of fines against shippers of adulterated milk to those points.

Assistance has been rendered the Division of Foods in making a special investigation into the methods and practices of plumping oysters; aid has been given in the same manner to the sugar laboratory in connection with its investigation of the maple-sirup industry. General investigations have been made concerning the canning and the cheese industries, particularly in New York and Ohio, and special examinations have been made in regard to the source and sanitary condition of mineral and spring water and the canning and packing of herring roe along the Potomac River. The inspectors have submitted reports on food supplies furnished to various hospitals and navy-yards at the request of the Navy Department: also on the character of foods furnished to inmates of charitable institutions. A special examination was made of the sanitary condition of bakeries offering products in interstate commerce.

The investigation of the coffee situation has been continued, with particular reference to the quantity of imported coffee and the sources of importation, in order to devise some means of suppressing the practice of indiscriminately labeling inferior coffees as Mocha, or Java, or blends of the two. A number of prosecutions, including the seizure and condemnation of large shipments of coffees so misbranded, have been reported during the past year, with the result that the mislabeling and sale of these brands have been largely reduced.

In connection with the Miscellaneous Division, extensive inquiry has been made into the practice of marketing misbranded and adulterated stock feed, and prosecutions have been brought under sections 2 and 10 of the act for the adulteration of oats with barley, the addition of material low in feeding value to various grades of feeds, or gross misbranding with reference to protein and fat content.

The matter of artificial ripening of Florida fruit and the shipment to northern points of fruit imported into Florida and labeled in a manner to indicate that it was a product of Florida has been looked into in a preliminary way in order to develop some plan for a full investigation. Attention has also been given to vinegar factories which manufactured certain classes of imitation apple-cider vinegar, resulting in frequent confiscations and the institution of criminal prosecutions based on the interstate shipment of distilled colored vinegars labeled as "Pure Apple Vinegar," or "Cider Vinegar."

An inquiry into the practices of commission merchants and wholesale egg dealers in preparing and shipping for bakers' use desiccated and canned eggs, consisting in whole or in part of "spots," or eggs in the first stage of decomposition, is under way, as well as a general inspection of all mills engaged in bleaching flour intended for interstate commerce.

WORK OF THE WASHINGTON FOOD INSPECTION LABORATORY.

The Washington Food Inspection Laboratory has as its special object the checking of the analytical work of the branch food inspection laboratories and the examination of food-inspection samples taken in the vicinity of Washington under the Food and Drugs Act of June 30, 1906. During the year ending June 30, 1909, much work was done in checking the various methods of analysis, statement of results, and analytical work of the branch inspection laboratories in an effort to bring about uniformity of practice.

The total number of samples examined during the year was 2,600, half of which were samples of imported foods taken at the various laboratories and 200 of which were miscellaneous samples for experimental work. All the analytical reports on food products from other laboratories, with the exception of flavoring extracts, dairy products, stock feeds, grains, and waters, pass through this laboratory for examination and the preliminary selection of cases for prosecution is made, these cases being then prepared for the consideration of the Board of Food and Drug Inspection. Analysts of the laboratory are called on to testify in court on cases brought under the Food and Drugs Act.

An investigation was begun at the commencement of the fiscal year of the methods of handling distilled spirits, and the study of the changes taking place in storage under varying conditions has been continued. To this end, 60 barrels of whisky, part of which has been stored in an experimental warehouse in Louisville and part in the various distillery bonded warehouses in different sections of the country, have been under observation and samples analyzed from time to time. The investigation of methods for the analysis of distilled spirits has been continued, with the result of further improving the methods for the determination of fusel oil and the estimation and separation of coloring matter. Similar investigations of the composition of rums, and of the composition of pure cider vinegar, including the methods of manufacture used in this country, are under way, information being especially needed in the latter case for the enforcement of the Food and Drugs Act. During the year a study has also been made of the composition of extracts of coffee, occasioned by the necessity for information as to the proper labeling of certain imported products.

The analytical methods used in foreign countries to test American food products have been investigated in order to bring about some international agreement as to the methods for testing fats and oils. The necessity for this work can not be overestimated, as this country exports great quantities of animal and vegetable fats and oils, the value of which is based on chemical analysis, and much trouble has arisen in the past over the nonagreement of analytical results, due largely, if not entirely, to the use of different methods.

EXAMINATION OF DOMESTIC AND IMPORTED DRUGS IN THE WASHINGTON DRUG INSPECTION LABORATORY.

The Washington Drug Inspection Laboratory, established July 1, 1908, examines all samples of drugs for which special provisions have not been made.

DOMESTIC DRUGS.—During the past year 936 samples of domestic drug products have been examined, of which 860 were collected to test their legality under the Food and Drugs Act and 76 for study. One hundred and fifteen of the former were referred to the Board of Food and Drug Inspection as being illegal. A number of consignments of drugs were seized on libel proceedings for condemnation, it being found that they were either adulterated or misbranded within the meaning of the law.

The violations met with have been largely misrepresentations appearing on the label of the carton or bottle, or in the accompanying literature, and the absence or incorrectness of the declaration of alcohol, opium, morphin, cocain, acetanilid, chloroform, etc. Gross adulteration of various powdered drugs has also been found, and the numerous analyses made of so-called "cancer" and "drug addiction" cures have disclosed much fraud.

IMPORTED DRUGS.—Of the 1,220 samples of imported drugs analyzed in this laboratory, 495 represent samples of consignments taken by the various port laboratories and subsequently released without prejudice pending further investigations as to their conformity to the law. Seven hundred and five of the 1,220 samples represent consignments which were found to be illegal. Certain precedents have been established under which the port laboratories may act with reference to the disposition of detained shipments, but all cases without established precedents, together with appeals by the importers, are regularly referred to the Washington Drug Inspection Laboratory for investigation and recommendation. The character of violations is very largely the same as those encountered in domestic drugs, namely, false claims and misrepresentations on the labels of the cartons or bottles and in the literature accompanying the packages. The adulteration of crude drugs, however, is less frequent than when the law first went into effect. Various shipments of drug products which are considered dangerous to the health of the people of the United States are regularly excluded. Among these are inferior and deteriorated drug products, such as digitalis, henbane leaves, etc. Preparations, moreover, containing habit-forming drugs, such as cocain, morphin, codein, etc., and recommended for the treatment of afflictions peculiar to children are refused entry.

Special investigations have been made in cooperation with the Microchemical Laboratory relative to the identification of minute

quantities of various alkaloids, with valuable results, a number of the common alkaloids used in the manufacture of medicinal preparations being positively identified by this means. Preliminary investigations have been made on a number of samples of absinthe to ascertain their actual composition, for the purpose of securing information which may be of service in determining whether or not these products are dangerous to the health of the people of the United States.

FOOD AND DRUG INSPECTION AT THE BRANCH LABORATORIES.

In addition to the food and drug inspection laboratories at Washington, 21 branch laboratories have been established in various parts of the United States, including 1 at Honolulu, for the purpose of conducting the greater part of the routine work and many of the investigations relating to the enforcement of the Food and Drugs Act. Four of these branch laboratories have been in operation only this year, the new laboratory established at Pittsburg having begun work in December, 1908; those at Omaha and St. Louis in January, 1909; and that at Nashville in June, 1909. The samples of foods and drugs collected by these laboratories in their respective localities are examined and hearings are called at the laboratory most convenient to the firms cited. The laboratories also form convenient headquarters for inspectors and for such analytical and field work as may be necessary in the investigations of the Bureau relative to the enforcement of the law.

Food and drug samples examined in the various branch laboratories during the fiscal year ended June 30, 1909.^a

Laboratory.	Imported samples.				Interstate samples.			Miscellaneous samples.	Hearings conducted.
	Legal.	Illegal.	Total.	Floor inspection samples.	Legal.	Illegal.	Total.		
Boston	288	$\left. \begin{matrix} 208 \\ b\ 202 \end{matrix} \right\}$	698	11,447	139	202	341	153	425
Buffalo	66	17	83	171	275	189	464	162	95
Chicago	179	142	321	2,520	1,409	640	2,057	8	469
Cincinnati					546	518	1,154	87	610
Denver	18	1	19		458	244	702		123
Detroit	59	7	66		259	141	400	62	216
Galveston	54	30	84	641	242	189	431	35	122
Honolulu	102	107	209	152				2	86
Kansas City	2		2		386	126	512		258
New Orleans	94	119	213	1,384	243	145	388	113	433
New York	2,827	1,690	4,517	44,388	360	380	740	589	2,338
Omaha ^c	11		11	3	184	77	261	38	130
Philadelphia	521	164	685	6,283	128	88	216	33	200
Pittsburg ^d	30	21	51	192	97	82	179		157
Portland	146	74	220	4,115	147	59	206	82	149
St. Louis ^e			5	70	185	98	283	48	391
St. Paul	70	19	89	302	206	84	290		^e 140
San Francisco	^f 465	303	768	6,149	256	201	457	^g 64	^h 232
Savannah	12	1	13	19	206	150	356	49	244
Seattle	298	124	422	1,412	130	64	194	118	83
Total	5,243	3,233	8,476	79,248	5,856	3,677	9,631	1,643	6,901

^a The laboratory established at Nashville, Tenn., is not included in this report.

^b Released without prejudice pending further investigations.

^c This report covers six months, as the laboratory has been in operation only since January 1, 1909.

^d This report covers seven months, as the laboratory has been in operation only since December, 1908.

^e Record of hearings includes only those held since January 1, 1909.

^f Including 235 Chinese drugs.

^g Collaborative work and commissary samples.

^h Represents 163 samples.

BOSTON LABORATORY.

About two-thirds of the samples examined at the Boston laboratory are imported goods, totaling almost 700 samples, the most important classes of foods analyzed being dairy products, distilled liquors, fruit products, meat and fish, and spices and condiments. Over 60 per cent of the dairy products were declared illegal and over 45 per cent of the distilled liquors, the other classes named not exceeding 26 per cent of illegal shipments and usually being much less. Of the 341 interstate samples, about one-third of the oils and fats and spices and condiments were found to be illegal, over one-half of the dairy products, about 65 per cent of the saccharine products, and nearly three-fourths of the flavoring extracts. Of the 425 hearings granted, 71 were on dairy products and 41 on saccharine products, 34 each on drugs and flavoring extracts, and 35 each on cereal products and on distilled liquors. The following investigations are in progress or have been terminated in the Boston laboratory during the past year as having a direct bearing on the administration of the food law:

VANILLA EXTRACT.—Analyses have been made of several vanilla extracts made in the laboratory from the different kinds of commercial beans and also of 12 samples made by representative manufacturers under commercial conditions and by commercial methods from the standard quantity of beans. The kind of bean, the strength of alcohol, the other ingredients used, and the detailed conditions of manufacture were ascertained in the majority of cases. The leading numbers were fairly uniform even when the solids not sugar showed a wide variation.

COCOA PRODUCTS.—Varnishes used in the manufacture of chocolate and other confections have been studied. Many of the manufacturers of plain or bitter chocolate in this country are using a varnish in finishing their retail package goods, which is usually applied by dipping the chocolate in an alcoholic solution of the material employed. These coatings differ widely in composition, shellac and rosin varnishes being more commonly used. Shellac is generally employed in the case of confectionery, and was found in percentages varying from 0.4 to 0.75 per cent on many cheap chocolates, chocolate cigars, peanut bars, and other penny goods. Cocoa shells in small quantities are still often found in cocoa products, and as some brands are free from shells it is apparent that their presence is due to faulty manufacture or to deliberate adulteration.

BENZOIC ACID.—The naturally occurring benzoic acid content of authentic samples of ttleberries from Norway and foxberries from Nova Scotia, members of the cranberry family, has been determined. The percentage present does not differ in a marked way from that found in our domestic cranberry. In an effort to shorten the time required for the determination of benzoic acid in food products, and, if possible, to improve upon the accuracy of the other methods, a procedure of double extraction, making use of ether and subsequently chloroform has been developed, which gives very promising results.

COLOR AND EGG CONTENT OF BAKERS' PRODUCTS.—The investigation of the color and egg content of bakers' products, with special reference to cake, has been continued. About 75 per cent of the samples

examined contained coal-tar colors, naphthol yellow S and the fast yellows being extensively used. In no case was a highly colored, bright yellow article found to contain more than one egg per pound, and in general these samples showed a much smaller content of egg than those of lighter color.

FISH.—Some physical constants have been determined on the body oils of a number of samples of codfish and of the fish usually substituted for cod, that is, cusk, haddock, hake, and pollock. The body oils give quite different constants from the liver oils and appear to be of a complex nature. In the case of dried fish the oil was much oxidized. This work is being extended to an investigation of the nitrogenous compounds of these fish.

DETERMINATION OF SULPHUROUS ACID IN GELATIN AND OTHER FOOD PRODUCTS.—Various methods of determining sulphurous acid in food products were compared to determine the validity of certain criticisms directed against the official method. The best results were obtained with the Gudeman method.^a In gelatin and beer the results obtained by this method were in accord with those obtained by the official method. With dried fruits especially the results obtained were much better than those by the official procedure, since the size of the portion used for analysis is not limited and distillation can be carried as far as desired. In the case of molasses, the official method gave high results, due to the formation of iodine-reducing substances necessitating the use of copper-sulphate solution. It is believed as a result of this work that volumetric estimations of sulphurous acid are wholly satisfactory under proper conditions. Gelatin prepared in the laboratory was found to be free from sulphurous acid and to give off no iodine-reducing substances under the conditions of the methods used.

EFFECT OF TEMPERATURE AND CONCENTRATION ON THE SPECIFIC ROTATION OF COMMERCIAL GLUCOSE.—This work was done on pure hydrolyzed starch products of typical specific rotations and on a number of commercial samples representing the grades of glucose at present on the market. The specific rotation was found to decrease with increased concentration; in many of the samples there was a notable decomposition at temperatures above 85° C. No definite relation was found between the concentration of the glucose and the ratio of its invert polarization at 87° to the direct polarization at 20°, except that this ratio is smaller at the lower concentrations.

BUFFALO LABORATORY.

The 83 samples of imported products examined at the Buffalo Laboratory consisted chiefly of distilled and fermented liquors, meat and fish, and oils and fats, and it will be noted that a rather small proportion were illegal, about 20 per cent. Port inspections are made at Rochester, Niagara Falls, and Dunkirk monthly, and oftener if the collector calls attention to a special case. Of the 464 interstate samples examined, about 41 per cent were found to be illegal, the principal classes of foods inspected being dairy products (24 out of 44 samples illegal), flavoring extracts (67 out of 137 samples illegal), saccharine products (37 out of 112 samples illegal), spices and

^a J. Ind. Eng. Chem., 1909, 1: 81.

condiments (19 out of 62). The 162 miscellaneous samples reported in the tabulation were taken for study in the elaboration and improvement of methods of analysis.

Investigations undertaken during the past year included the examination by chemical and physical methods of 86 samples of canned peas with a view to establishing data from which to distinguish soaked goods from fresh. Some valuable results were obtained which have been of assistance in passing on commercial samples submitted in the course of routine food inspection. The laboratory also conducted investigations of flavoring extracts in testing the colorimetric method for the determination of citral in lemon extract. In addition, a test of the comparative merits of a number of methods for the estimation of benzaldehyde in almond extract is in progress and considerable work has been done on the determination of starch and crude fiber in cocoa products.

CHICAGO LABORATORY.

The samples examined at the Chicago laboratory include, in addition to those collected in the inspection of foreign and domestic goods, various products submitted for examination by the local representatives of the Treasury, Interior, and War Departments, and also by the Council on Pharmacy and Chemistry of the American Medical Association. As this is the only Government laboratory in Chicago equipped for general work, the need of cooperation with other branches of the Government service is obvious.

Considerable time has been devoted to the study of analytical methods and to the analysis of products of known origin, although as yet only two short papers have been published. A method has been developed for the determination of vanillin, coumarin, and the lead number in one weighed portion of vanilla extract, which, it is believed, will facilitate the distinction of true vanilla extract from imitations. Vanilla extracts have also been prepared from a wide variety of vanilla beans of different grades and lengths, representing the product of different countries. The analysis of these extracts will yield valuable data for use in the interpretation of analyses of the commercial product.

Examinations have been made of a large number of samples of flour, both bleached and unbleached, representing the products from different sections of the country. The work included determinations of nitrogen as nitrites and the color values of the petroleum ether extract. Papers on this subject were presented at the Bakers' Institute, held under the auspices of the University Extension Department of the University of Wisconsin, at Milwaukee, October 26-28, 1908.

As several chemists, owing to temporary transfers to other laboratories for special work, have been absent during part of the year the degree of efficiency to be expected under normal conditions could not be attained. Because of the importance of Chicago as a distributing center for groceries, flour, and other food products, the demands made on the laboratory are steadily increasing and the volume of work will be much augmented another year. Reference to the tabulated statement shows that of the 2,057 domestic samples examined 640, or about 31 per cent, were illegal. The principal classes of foods ex-

aminated were cereal and dairy products, flavoring extracts, saccharine products, oils and fats, and spices and condiments, over 40 per cent of the flavoring extracts being misbranded or adulterated and about 35 per cent of the saccharine products. Of the 321 imported foods examined 142 were found to be illegal—dairy products, distilled liquors, meat and fish, and drugs showing the highest percentages of illegality—more than half of those examined proving to be below the requirements of the law.

CINCINNATI LABORATORY.

The total number of samples analyzed in the Cincinnati laboratory was 1,154, of which number 546 were legal, 518 illegal, and 87 were miscellaneous. Of these, 740 were dairy products, and about 100 samples each of flavoring extracts, saccharine products, and spices and condiments were tested. Of the three latter classes, from 24 to 30 per cent were adjudged illegal.

In regard to the dairy products it should be noted that the milk situation in Cincinnati demanded special attention with reference to the shipment of watered and adulterated milk from Kentucky and Indiana into Cincinnati. When this special investigation was begun in September, 1908, of the samples analyzed about 60 per cent were shown to be adulterated, and this percentage decreased to about 9 or 10 per cent during March and April, 1909. Of the total number of dairy products examined, exactly 50 per cent were found to be illegal. A total of 610 hearings on interstate samples has been held at this laboratory.

The work has been along the general lines of food inspection, very little research work of any kind having been attempted except in the checking of methods used. About one dozen samples were analyzed for the Treasury Department and 18 analyses were made for the Post-Office Department, principally of distilled liquors sold through the mail-order houses in this district.

DENVER LABORATORY.

The proportion of illegal interstate samples examined at the Denver laboratory, as shown in the tabulation, amounts to more than one-third of the total. A large number of these, however, were so classed because of trivial infractions of the law that did not interfere with their being placed in permanent abeyance. By far the most common violation was found to consist in shortage of weight or measure, and, though often small, the shortage in one instance ran as high as 30 per cent. Misbranding by reason of extravagant or false statements was also prevalent, but actual willful adulteration by gross substitution of foreign material, such as was doubtless common before the enforcement of the food law, was found to be extremely rare. Only one case of what might be termed poisonous adulteration was found, namely, an almond extract containing hydrocyanic acid. This case was prosecuted in court.

While in the main the larger dealers in this part of the country seem to be sincere in their expressed support of the food law and are evidently trying to comply with its provisions, some are still apparently ignorant or indifferent as to its bearing on their business, the value of guaranties, and their own responsibility under the law.

Following is a brief abstract of the experimental or research work done:

A simple and convenient colorimetric method was devised and tried out for the determination of citral in lemon extracts and oils by the use of an alcoholic solution of metaphenylene diamine hydrochlorid. Two important advantages of the method are that it may be carried out at room temperature and that it does not require the use of aldehyde-free alcohol. Incidentally the working out of this method has led to an investigation of a certain apparent impurity occasionally found in citrus products, such as oil of lemon and limonene. In view of the issuance by the French Government of regulations forbidding the use of lead, internally or externally, on tin cans used for food products after August 1, 1909, an investigation was made as to the conditions prevailing in French cans for preserving foods prior to the adoption of the regulation. Fifty-eight samples, containing the products of 47 manufacturers, were submitted to examination. In no case was any lead found in the tin plate used. The solder employed on the side seams and ends was almost invariably confined to the outside of the can, and in the rare instances where an appreciable amount of solder was exposed inside the can, it was apparently accidental. The solder varied in lead content between the limits of 45 and 72 per cent, averaging about 60 per cent.

The experimental work has also included a brief investigation of the proper polarizing value to be assigned to the grade of commercial glucose known as "mixing" or "M" glucose, for calculating the percentage of that product present in compound honey, molasses, etc. The main object is to test the accuracy of the formula now commonly used for this purpose. Samples of lemon extract submitted for cooperative work on methods of examination were analyzed and reported.

DETROIT LABORATORY.

Of the 400 interstate samples examined at the Detroit laboratory about one-third were found to be illegal, and of the 66 imports only one-ninth, practically all of which were drugs. The miscellaneous samples, 62 in number, included the examination of butter and fermented and distilled liquors for the internal-revenue collector; also samples of raw peanuts, which were examined for boric acid for the purpose of determining whether this were a normal constituent of peanut butter. Of the 216 hearings conducted at this laboratory the greater number pertained to dairy products, 36; flavoring extracts, 34; saccharine products, 20; vinegars, 22; and drugs, 44.

GALVESTON LABORATORY.

The more important classes of interstate samples examined at the Galveston laboratory included cereal products, flavoring extracts (65 out of 74 found to be illegal), oils and fats, saccharine products (37 out of 51 samples adjudged illegal), and spices and condiments, a total of 189 illegal samples out of the 431 samples examined. Of the 84 imported samples analyzed, 2 were ordered to be reshipped and 28 to be relabeled. The hearings held on 92 interstate and 30 import cases have consisted largely in the former instance in the filing of guaranties and taking evidence of interstate shipment.

In addition to the regular routine work, considerable time has been devoted by the acting chief of the laboratory to collaborative work on methods for the determination of fusel oil and of caramel in whisky, of sodium benzoate in ketchups, and of colors in food products. Some work was also done under the direction of the chief of the Division of Foods on the analysis of oysters, samples of which were taken directly from the reefs and packed under varying known conditions.

HONOLULU LABORATORY.

The report of the Honolulu laboratory represents the work of the chemist in charge, who acts both as analyst and inspector. Of the 209 imported samples analyzed, 107, or about 51 per cent, were found to be illegal, the meat and fish samples and drugs being the worst offenders. The inspection work was confined entirely to imported food and drug products, approximately nine-tenths of the shipments being from China and Japan. As there was no systematic inspection prior to the installation of this laboratory, it was necessary to give considerable time to instructing the importers in the provisions of the law and the regulations.

In connection with the routine inspection of imported products, it became necessary to study somewhat fully some of the peculiar conditions and substances concerned. For example, an inquiry into the manufacture and branding of Chinese liquors was made; an investigation of the Japanese beverage "sake" and the keeping qualities of the nonpreserved article, and the use in Japanese food products of anilin colors.

As Honolulu is the only port in Hawaii through which food and drug products are entered in foreign commerce, there has been no inspection made at the other ports of entry in the Territory.

During the year, 86 hearings were held on illegal imported shipments and 21 shipments were released without prejudice to future decisions.

KANSAS CITY LABORATORY.

The work in the Kansas City laboratory is devoted to interstate samples entirely, and of the 512 examined during the year 126 were adjudged illegal. Of the 259 dairy products analyzed only 37 were found to be adulterated or misbranded, in sharp contrast with the conditions found in Cincinnati. Thirty-six flavoring extracts out of 84 samples were declared illegal, and of the saccharine products 19 out of 44. Of the 258 hearings held at Kansas City the greater number concerned flavoring extracts and saccharine and dairy products.

NASHVILLE LABORATORY.

The Nashville laboratory has just been installed and the chemist in charge reached Nashville on June 10. In addition to the regular work in the enforcement of the food law, considerable time will be spent on a special investigation of methods for the analysis of vinegars.

NEW ORLEANS LABORATORY.

The results of the regular inspection work at the New Orleans laboratory, as reported in the table, show that of 213 imports ex-

aminated about 56 per cent were found to be illegal, and of the 388 domestic samples about 37 per cent were either misbranded or adulterated. The more important classes of materials examined included dairy products, flavoring extracts, saccharine products (32 out of 98 samples found to be illegal), and spices and condiments.

Apart from the regular inspection work, 113 unofficial samples were examined. These included an examination of foods offered to the Purchasing Commissary for use in the Army, and resulted in many instances of rejection of the supply offered. Food samples taken by the inspector from the public institutions in the State, such as the charity hospital, Confederate soldiers' home, State insane asylum, and the State penitentiary were also analyzed. Some chemical work was done for the grain standards laboratory, in connection with the board of trade, to aid in the selection of a suitable seed corn for use in experimental corn growing in Louisiana.

Research work done covered the following points: (1) In the determination of heavy metals in molasses considerable trouble was experienced, especially in the determination of zinc and tin. After some work, certain modifications were applied to the official method, which largely obviated this difficulty. (2) Some preliminary work has also been done to devise, if possible, a method for the detection of mixtures of small quantities of corn oil with cotton-seed oil.

NEW YORK LABORATORY.

New York being the principal port for the entry of foreign products into this country, the work of that laboratory is confined largely to the inspection and analysis of imported food and drug products. This inspection has been carried on for about five years, and has caused marked changes both in the character of the goods shipped to this country and in the manner in which they are labeled; particularly is this true of those products which have been fully investigated and thoroughly covered by the inspection. Investigations as to the character and the composition of the various products that are presented for entry are constantly being made, and in many instances have already resulted in fixing standards for purity and comparison whereby entry has been denied inferior and refuse products.

The inspection of crude drugs, begun at this laboratory two years ago, has yielded especially marked results during the past year. Practically all shipments of the ordinary crude drugs imported into this country have been subjected to both a chemical and a microscopic examination, with the result that a great many have been rejected because of adulteration or low quality, and a much better grade of products is now being presented for entry. This inspection has brought to light numerous products of which there is little or no knowledge as to the composition or character. These are being studied to determine their composition and methods of identification.

During the past year 52 samples of oils were received for analysis for certification for the export trade. The largest classes of imports analyzed were drugs (1,090 samples, of which 45 per cent were misbranded or adulterated) and dairy products (1,475 samples, of which about 42 per cent were illegal). In other cases, however, the percentage of illegal samples was much lower, only 73 out of 351 spices and condiments falling below the requirements, 28 out of 215 cereal

products, and 39 out of 133 vegetables. The meat and fish samples and the fermented and distilled liquors, however, again show a high percentage of illegal shipments, 47, 52, and 61 per cent, respectively. Over 44,000 floor inspections were made for the purpose of passing on the labels, methods of packing, etc., to aid in the judicious selection of samples for analyses. The percentages of adulteration and misbranding given, therefore, in no wise represent the condition of the trade as a whole, only suspected samples being examined.

Aside from the samples taken by the two local inspectors and the check samples from other laboratories, the work on domestic products at the New York laboratory was largely confined to vinegar. Of the 740 interstate samples examined, 543 were vinegars, of which about one-half were found to be illegal.

Another important line of work pursued has been the chemical control of the colors for food products submitted for certification under the provisions of Food Inspection Decision No. 77. In all, 53 samples of colors were received for certification, each of which was submitted to a complete chemical analysis and to certain physical tests necessary to determine their purity. This work has necessitated the study of existing methods of color analysis, and has resulted in at least two instances in the development of new methods, one for the determination of iodine in erythrosin and the other for the detection of Orange II in Orange I.

One of the most important products studied during the past year is coffee. Several shipments of so-called "Black Jack" and "Triage" have been refused entry. Type samples of both the roasted and unroasted beans of the various varieties of coffee have been secured for comparative purposes. Many samples of roasted coffees have been received for identification, the laboratory securing the services of a coffee expert for this branch of the work.

Another important line of work is the examination of the food supplies for the Isthmian Canal Commission. During the past year this work has been extended at the request of the Secretary of War to cover drugs and medical supplies, including in all about 500 samples.

A few samples of patent and proprietary medicines have been examined for the Post-Office Department in connection with the issuing of fraud orders, and material assistance has also been rendered to the Treasury Department in the analysis of samples and the presentation of cases before the Board of General Appraisers and in the courts in connection with the levying of duties on olive oils.

In addition to those already specifically mentioned, the following studies have been undertaken to provide new methods of analysis or improve those in use, all being necessitated by the exigencies of the inspection work: Comparison of the Allen-Marquardt and titration methods for determination of fusel oil in liquors; detection of added oil in paprika; the separation of the essential oil of balsam copaiba and a study of its resin; analysis of Peru and Tolu balsams, styrax, and gum benzoin; analysis of wintergreen oil; determination of small quantities of lime in magnesium oxid; standards for saffron and gentian, and the quantitative determination of morphin in galenicals, particularly in the presence of glycerin and sugar.

OMAHA LABORATORY.

The Omaha laboratory has been in active operation only six months. The examination of official samples is confined almost entirely to domestic goods, and 130 hearings have been conducted in connection with the interstate inspection work, 261 samples having been analyzed. Retail dealers generally produced a satisfactory guaranty from the jobbers or manufacturers, who in every instance desired to assume responsibility for the violations and seemed to be entirely in sympathy with the law. The violations appeared to be largely the result of ignorance or oversight, and there is evidently a uniform and sincere desire to correct existing faults whenever they are brought to light.

Thirty-eight miscellaneous samples have been examined for the local internal-revenue office of the Treasury Department. These included samples of wines, cordials, and alleged nonalcoholic beverages (determination of alcohol), butter (for the determination of moisture), and oleomargarin (for added color), on all of which a prompt preliminary test was desired and obtained without the loss of time which would have resulted in transmitting the samples to the Treasury laboratory at Washington.

Research work on methods for the determination of benzoic acid in ketchup has been conducted, and considerable time was spent on the estimation of the maple content of mixed sirups made from maple and cane sugar sirups; as an aid in this estimation a modified Winton lead number has been proposed and found useful.

PHILADELPHIA LABORATORY.

The more complicated character of the foods examined during the past year at the Philadelphia laboratory and the increased amount of executive work required on interstate products, together with a decrease in the force, have somewhat limited the number of samples examined. As shown by the tabulation, the inspection of imported goods has constituted the principal feature of the work, and about 24 per cent of the 685 importations examined were found to be illegal. Over 6,000 floor inspections were also made; drugs, oils, fats, and fermented and distilled liquors receiving special attention. The principal classes of domestic food examined were cereal products, coffee and cocoa, flavoring extracts, oils and fats, saccharine products, and spices and condiments, about 40 per cent of the 216 domestic samples analyzed being found illegal. In this connection it is only fair to state that many apparent violations of the law are due to not thoroughly understanding its requirements, and at the 200 hearings held in connection with these, in many cases the manufacturers and importers voluntarily made the necessary changes either in the composition of the formula of the product or in its label, when the matter was called to their attention.

Research work on methods of analysis has been conducted along the following lines: Determination of benzoic acid in ketchup, estimation of citral in lemon oil and extracts, determination of ether extract in paprika, identification of coloring matters, determination of sucrose, lactose, and crude fiber in cocoa products, and the estimation of fusel oil in whisky.

PITTSBURG LABORATORY.

The Pittsburg laboratory has been in operation about seven months. The work of installation was begun in August and completed in November, 1908, an assistant chemist reporting for duty soon afterwards.

Practically all of the time has been devoted to the regular routine work of examining imported and interstate samples. A method for the determination of sugar in chocolate, which materially shortens the time of analysis, has been worked out, and a rapid method for the determination of fat in cocoa and chocolate is being elaborated in connection with the examination of samples of this character.

The import work has resulted in the examination of 51 samples, 21 of which were illegal. These samples were misbranded along certain general lines, and most of the labels have since been corrected. Of 66 interstate samples of flavoring extracts 50 per cent were found to be illegal, and of 38 fruit products 23 were contrary to law, as were one-third of the 27 samples of saccharine products analyzed.

One hundred and fifty-seven hearings on domestic samples have been held. In the greater number of cases the manufacturers have since corrected their labels and others have taken advantage of the proximity of the laboratory to ask for information regarding the labeling of their products.

PORTLAND LABORATORY.

Of the 220 imported samples analyzed at the Portland laboratory one-third were found to be illegal, and of 206 domestic or interstate samples analyzed nearly 29 per cent were adjudged misbranded or adulterated. In addition to the routine work of the laboratory, 82 miscellaneous samples were examined, as follows: For the Treasury Department at Portland, 27 examinations of silk and cotton cloth, sugar, and pineapple; for the War Department (commissary of subsistence) at Vancouver, Wash., 9 analyses, including flavoring extracts, baking powder, olive oil, spices, and butter; in cooperation with investigations in the food division of the Bureau of Chemistry, 33 analyses were made of ketchup (for benzoic acid), oysters, and whisky. The remaining samples were check analyses on interstate work. Five standard extracts (U. S. P.) have also been prepared from imported vanilla beans to be used for comparison and study.

As a result of the examination of imported samples 72 hearings have been called, and, in addition, 76 hearings on interstate samples have been held. All show a desire to comply with the law, and cases of adulteration and misbranding have been due more to carelessness or ignorance than to any willful intent.

ST. LOUIS LABORATORY.

The St. Louis laboratory was installed and in working order on January 1, 1909; the acting chief took charge on that date and an assistant chemist was assigned during May. The work reported therefore covers a period of only six months, and the greater part of the time was devoted to hearings, 391 having been held. Of the 283 interstate samples examined over one-third were adjudged illegal,

including 26 out of 67 saccharine products, 29 out of 50 flavoring extracts, and 14 out of 23 cereal products. The 48 miscellaneous samples reported were food products examined for the local purchasing department of the United States Army, only one sample being found to be below the requirements.

ST. PAUL LABORATORY.

At the St. Paul laboratory the investigations on the extraction and estimation of the higher alcohols in distilled liquors, begun during the last fiscal year, were completed.

While the baking tests on cereal products were necessarily discontinued, owing to the transfer of the baking expert, the chemical investigation of cereal products has been continued, especially in regard to the bleaching of flour and its effects.

Much of the time of the chief of laboratory was necessarily occupied with hearings on interstate cases. With a few marked exceptions the evidence has shown entire willingness on the part of the manufacturers and jobbers of food products to comply with the law. It was developed at these hearings that the practice of adulterating rye flour with low-grade wheat products in amounts varying from 20 to 60 per cent and the sale of the same under the caption "Family Rye Flour" was quite prevalent. It is believed that the millers have come to see this offense in its true light, and in this vicinity the practice is largely discontinued. Saccharine products and spices and condiments were the principal classes of interstate goods examined, the former showing 26 per cent of illegal samples and the latter 46 per cent. Of the 51 flavoring extracts only 8, or about 15 per cent, were adjudged illegal.

Work at this laboratory has been further curtailed during the past year by the transfer of two chemists to the Galveston laboratory and the detail of another to Washington. The inspection of imports at St. Paul and Minneapolis has caused the detention and rebranding of skim cheeses, with the result that recent shipments from Norway and Holland have been plainly branded, as to their quality, when received. Other cases of misbranding as to weight have been corrected by label.

It also developed that clove stems are brought into this country in large quantities to be ground with cloves as an adulterant; one instance of a 20 per cent adulteration of this kind was found. The importations in question were disposed of locally and no evidence of interstate shipment was obtained. It is hoped that a way may be found to exclude from entry such products as are used solely for the fraudulent adulteration of foods and drugs. An effort has been made to extend port inspection by correspondence to Duluth.

SAN FRANCISCO LABORATORY.

A study has been made of the Chinese drugs entered at the port of San Francisco with a view to classifying them under the United States Pharmacopœia. The bulk of these importations are drugs of distinctive Chinese origin and use. Their identification is at times very difficult, owing to the meager information that is available in the Chinese Herb Book and the difficulty of translation when information is obtainable only by word of mouth from Chinese physicians.

Some collaborative work has been done on methods of analysis of citral in lemon extract, fusel oil in whisky, benzoic acid in ketchup, and in the analysis of oysters taken from San Francisco Bay. From time to time studies have been made of special methods of analysis of various foods with a view to expediting inspection work.

In the routine of inspection 1,289 samples of imported and domestic foods and drugs were examined. The more important classes of imported products include distilled liquors (73 out of 97 samples found illegal), fermented liquors (14 out of 37 samples), meat and fish (108 out of 173 samples), dairy products (27 out of 57), and oils and fats (25 out of 47 samples illegal). Of the domestic goods, out of 50 samples of cereal products 50 per cent were illegal; of 57 flavoring extracts, 63 per cent; of 134 saccharine products, about 39 per cent, and of 69 spices and condiments 20 per cent were found wanting.

The administrative feature of the work of this laboratory covers about equal quantities of imported and domestic foods and drugs. In the case both of imported and interstate foods the violations consist mainly in misbranding. It appears that foreign manufacturers will continue to be negligent just as long as merchandise is allowed to be relabeled after reaching this country, though in the main misbranding is corrected when it is specifically called to their attention. At this port all European goods are bought subject to sight draft on arrival, and the importer has no redress if the importation does not conform to the requirements. A more rigorous enforcement of the law by reshipping misbranded merchandise would have a very beneficial effect on the labeling of products offered for entry.

The greater number of the 163 hearings on interstate products also consisted of misbranding violations. From the statements made by the parties cited it appears that the violations were due to misunderstanding the law or to neglect in obtaining information regarding it. Some were due to unavoidable accidents and few, if any, were the result of deliberate intent. In only a few cases have the manufacturers felt that the analyses made by the Department have been in error and results of their investigations have confirmed the findings of the Department in every case. The hearings have at all times been marked by a spirit of cooperation on the part of the manufacturers and a willingness to meet the policy of the Department more than half way.

The general effect of the Food and Drugs Act on the manufacture and marketing of food products which are distinctly Californian in character has been excellent. The production of "quality" products has been augmented and their increased appearance on the market has been accentuated by the decline in the production of inferior goods. This is particularly true of California wines, brandies, olive oils, honey, and fruit products, although this effect extends in some instances to products not distinctive of the State, several manufacturers having declared their intention to pack no more cheap products since first-quality goods no longer have to compete with inferior grades. This condition has been brought about by the rigorous enforcement of the California State laws, as well as by the enforcement of the Food and Drugs Act.

SAVANNAH LABORATORY.

The work of the Savannah laboratory for the past year has been devoted largely to the analysis of interstate samples, there having been only a small amount of imported foods entered at this port, as is shown in the tabulated statement. The miscellaneous samples represent for the most part collaborative work on methods for the examination of whisky, flavoring extracts, and preservatives. About 42 per cent of the 356 interstate samples examined were considered illegal.

SEATTLE LABORATORY.

The work of inspection of imported foods and drugs at the Seattle laboratory has shown an increasing effort on the part of the importers to comply with the law, and in most cases the trouble is apparently due to the indifference of the shippers abroad. Considerable attention has been given to Japanese drug products and to the coating of oriental rice with a mineral matter which appears to be a siliceous earth used in removing the outer hull and coatings of the uncleaned rice.

About half of the 33 domestic samples of flavoring extracts examined were found to be illegal and nearly one-third of the 66 samples of saccharine products. Of the imported samples, 22 out of 38 drugs were declared illegal, 18 out of 40 dairy products, 11 out of 28 fermented liquors, 27 out of 82 samples of meat and fish, and 12 out of 42 cereal products. This brief summary of the more important classes of products examined serves to give some idea of the tendencies disclosed by the inspection and of the need of the work. As shown in the summary table, 298 imported products were declared legal and 124 illegal, while of the interstate samples 130 were found to be according to the law and 64 illegal.

Of the 83 hearings on domestic products held in this laboratory, about half were on flavoring extracts and saccharine products and presented no points of special interest.

This laboratory has also analyzed 48 samples of food supplies for the War and Navy Departments and examined 70 samples of miscellaneous imports for the Customs Division of the Treasury Department, to aid in making the proper classifications.

THE NEW BUILDING.

Since the enactment of the Food and Drugs Act of June 30, 1906, the work of the Bureau of Chemistry in Washington has been greatly augmented, and the space occupied has increased from one building to eight. Many of these buildings are small and poorly adapted to the purpose for which they are used, and their remoteness from each other has greatly handicapped the Bureau in its work.

During the last year a new building, to accommodate the entire Bureau situated in Washington, has been constructed and is now being equipped. The building is of reinforced concrete construction and contains six floors and basement, with a total floor space of about 63,000 square feet.

PUBLICATIONS.

During the past fiscal year 15 bulletins have been prepared, 13 of which have been published; 17 publications in circular form, includ-

ing four Yearbook articles and the Report of the Chemist; 11 food inspection decisions and 79 notices of judgment, aggregating in all 1,765 pages of original matter.

The orders for job printing totaled 302, consisting principally of index cards and forms, circular letters, and stationery; 237 requests were drawn on the photographic laboratory of the Division of Publications, of which 133 were requests for drawings, a great deal of expert drafting having been done in that section for the Bureau in the drawing up of plans and specifications for the port laboratories and for the new laboratory building at Washington, D. C.

SUPPLIES AND CLERICAL WORK.

The plan of distributing supplies to the branch laboratories from a central storeroom in Washington, inaugurated during the preceding year, was carried out with considerable advantage. All chemicals and apparatus are systematically tested and passed on by the Contracts Laboratory or Drug Division before being accepted, thus insuring a high and uniform grade, very essential for accurate analytical work.

The clerical work on the records and the correspondence in connection with the interstate cases under the Food and Drugs Act has been greatly increased. This work is intricate and has to be done with dispatch and accuracy.

WORK OUTLINED FOR THE FISCAL YEARS 1910 AND 1911.

OFFICE OF THE CHIEF INSPECTOR.

The greater portion of the fiscal year 1910 will be devoted to the collection of official samples of food and drug products for examination and to the inspection of manufacturing establishments, with the view of observing the character of raw materials which enter into the composition of food and drugs and whether the same are prepared under sanitary conditions and among unobjectionable surroundings. In addition, it will be necessary to take up for special investigation such questions as are referred by the various laboratories, and also problems which arise through reference for prosecution in cases of violation of the law where additional information is necessary.

Investigations already begun will be continued to probe into the practice of shipping citrus fruit in an immature state to markets where the same is subjected to chemical or other artificial treatment to give it the appearance of fruit ripened by natural process.

The investigations, which have been made for some time, to locate interstate shipments of flour which has been bleached with peroxid of nitrogen will also be continued.

The practice of marketing fish which are incorrectly branded as to variety or origin is now the subject of an investigation which will be further carried on to suppress this illegal trade custom.

The use in foods of eggs or egg products which are unfit for consumption because of the unwholesome character of raw materials from which prepared, or the insanitary conditions under which manufactured, will be investigated, and wherever violations are discovered steps will be taken to have the same prosecuted.

In addition to the above, investigations will be continued to suppress illegal traffic in adulterated or misbranded wines, liquors, coffees, stock feeds, milk, vinegars, and waters.

DIVISION OF FOODS.

The investigations in the chemistry, physiology, and technology of fruits will be continued with a view to increasing our knowledge of the nature and composition of this class of products and of studying and preparing new forms for their preservation and preparation for the market.

The study of the influence of receptacles on the character and composition of foods will be continued. It is important that full information be obtained as to the relative value of materials used in the preparation of such receptacles for foods of different types, leading to their improvement.

It is proposed to continue such examinations of foods as may be desired by the Commissary Department of the Army and the Pay Department of the Navy for the purpose of assisting in the preparation of specifications and determining whether the deliveries made are in accordance with them.

The work in the Washington Food Inspection Laboratory will be a continuation of the special work for which the laboratory was established; that is, the checking of results, and the examination of regular food inspection samples of this locality. In addition, the study of the maturing of whisky, begun a year ago, will be continued, as well as the study of methods of analysis for distilled spirits, and especially of the quantitative separation of the coloring matter present.

Special attention will be given to the study of the composition of cider vinegar, methods of analysis, and the detection of adulterants.

Further work will be done toward the unifying of the methods or reporting analyses in the various laboratories; and the work of bringing about some international agreement as to the methods of analysis to be applied to American fats and oils in foreign countries will be continued.

In the Oil, Fat, and Wax Laboratory, which has just been established, a further study of the oils, fats, and waxes commonly used with foods will be made, with a view to obtaining more specific information regarding them and to improving the methods used in their examination.

For the ensuing year it is proposed to finish the investigations on lemon oil in the Food Technology Laboratory and to offer for publication a report on this subject. In addition to this, vanilla and other extracts will be studied more fully. A large amount of time will also be given to consideration of problems presented by the California by-product work.

DIVISION OF DRUGS.

The Drug Inspection Laboratory, as heretofore, will examine domestic drugs, check analyses of imported drugs not provided for by the special laboratories, and keep systematic records of domestic and imported drugs required for the handling of cases. Special investigation of certain drug products imported into the United States

which may be dangerous to the health of the people will be continued, such as the investigation of products containing habit-forming drugs. In this connection particular attention will be given to the improvement of methods of analysis, such as the detection and determination quantitatively of the various alkaloids and other plant constituents contained in the complex mixtures on the market.

The activities of the Synthetic Products Laboratory will cover, as in the past, the examination of imported and interstate samples involving ingredients of a synthetic character.

In the Pharmacological Laboratory the investigation with regard to the influence of caffeine and caffeine products on metabolism will be continued, and, in addition, studies relative to the chronic toxicity of this drug will be made, as well as to the extent to which one drug may counteract the undesirable effects of another. To the investigation of the poisonous effects of amyl and ethyl alcohols will be added studies with regard to the toxicity of other alcohols and aldehydes. Physiological tests of drug products for the purpose of determining their activity and usefulness and the elaboration of methods to confirm physiologically the presence of certain medicinal ingredients when indicated by chemical analysis will be continued. The present methods of analysis in connection with the studies of animal metabolism will be further exploited with a view to their improvement.

The Essential Oils Laboratory will investigate essential oils and products in the manufacture of which the same are used. This work will include the study of the Pharmacopœia standards for essential oils and the variability of genuine oils. The chemical and physical properties of oils of different origin and produced under different conditions will be compared, and the character and extent of any adulteration found will be investigated. In addition to the study of oil of peppermint, which is now in progress, oil of gaultheria will be investigated. In cooperation with the Bureau of Entomology, the study of the constants of pure beeswax, obtained from various parts of the world, will be extended through the fiscal years 1910 and 1911. The investigation of so-called "soft drinks" which contain ingredients that may be deleterious to health and domestic products containing habit-forming drugs will also be continued.

MISCELLANEOUS DIVISION.

The mineral water survey of the United States which was begun in 1904 will be continued and the portion of the work so far completed will be prepared for publication. The examination of bottled mineral and table waters found on the market, for the purpose of securing data for the proper enforcement of the Food and Drugs Act, will be continued, as will also the examination of the water supplies of cities and towns when the exigencies of the public service demand the same. Improved methods of analysis for mineral waters and the radio-activity of certain mineral springs will be studied.

Work on methods will include especially those for the analyses of insecticides and the determination of soluble arsenic in the same.

The composition of cattle and poultry foods and remedies as they appear on the market will be examined in relation to the proper enforcement of the Food and Drugs Act, and the study of range

forage crops will be continued in cooperation with the Bureau of Plant Industry. The investigations already under way on the feeding value, commercial importance, and adaptability of grains will be extended so as to include studies on the milling and baking quality of cereals and other products and the effect of bleaching on flour.

The composition of lead arsenate as well as the impurities contained by certain insecticides, notably commercial lead arsenates, and the injury to foliage caused by them will be further studied. The supposed damage to fruit trees from the accumulation of toxic salts in the soil, due to the use of excessive amounts of insecticides, will be investigated in cooperation with the Bureau of Entomology. The study of arsenic and other poisons in fabrics, wall papers, and other household articles will be continued, as will also the arsenic content of certain fruits and foods. The effect of toxic gases on different species of plants, and also the resistance of certain plants to copper, arsenic, and other smelter wastes will continue to be investigated, and field observations on certain regions in the vicinity of smelters will be made.

It is also proposed to make an examination of the atmosphere of schools, public buildings, railroad cars, etc., to determine the effect of polluted air on the comfort and health of the occupants, and in connection therewith of the method of manufacture and practical value of disinfectants.

SUGAR LABORATORY.

The plans of work for the fiscal year 1910 are in large part a continuation of the investigations already described, in so far as they have not been finished, and may be outlined as follows:

(1) Analyses of authentic samples of honey coming from various countries.

(2) A completion of the analysis of samples of maple sirup and sugar already collected, and field work during the coming season, to elucidate some of the points so far brought out by the analyses.

(3) As the time allows, it is the intention to investigate sorghum sirup and molasses with much thoroughness, collecting samples of pure products and determining their characteristics and chemical composition so as to distinguish the pure from the adulterated article.

(4) A study will be made of the chemical composition of cane sirup and molasses, both made by vacuum and open-kettle processes.

(5) A study of methods of determining the per cent of sugar in the beet.

(6) A study of the methods of analysis used for determining sugar in various factory products.

(7) A continuation of the general work on chemical methods employed in the analysis of sugars and carbohydrates.

(8) A continuation of the work on the effect of environment on sugar-containing plants.

DAIRY LABORATORY.

Besides the routine work, the plans of investigation of the Dairy Laboratory are as follows:

(1) The study of the process of condensing milk to determine the practical limit of condensation consistent with a good mechanical condition.

(2) The study of the composition of cows' milk produced in the States of Washington and Oregon, as compared with that produced in other sections of the country.

(3) Work on the perfecting of analytical methods, and the checking of analyses received from the branch laboratories.

LEATHER AND PAPER LABORATORY.

The testing of paper, leather, and turpentine for other Departments which request such tests will be continued with especial reference to the qualities that determine value in service. Experiments on the quality of papers to be used for various special purposes will be conducted, and investigations of new paper-making materials and paper-making processes will be made. Under the Food and Drugs Act turpentine will be examined, and the proper methods of differentiating commercial turpentine will be studied. Work will be continued on the production and utilization of the products of the destructive distillation of wood, and also on the study of native American tanning materials.

CONTRACTS LABORATORY.

The work of the Contracts Laboratory for the fiscal year 1910 is planned along the same lines as that of the year preceding, as much time as possible being given to the study of paints and paint materials, especially the examination of linseed oil and service tests of paints made in cooperation with the American Society for Testing Materials, which work will probably be continued during the fiscal year 1911. It is also proposed to continue the study of methods for the analysis of alloys, and in cooperation with the Treasury Department and the technological branch of the Geological Survey to make a study of the inflammability of denatured alcohol and of methods for the storage of the same.

The preparation and improvement of specifications for the purchase of materials for the Executive Departments and independent establishments of the Government will be undertaken in so far as the very rapidly increasing amount of work requested by other branches of the Government, which keeps the laboratory force fully occupied with routine work during the greater part of the year, will allow. The increasing number of requests from the General Supply Committee, the Isthmian Canal Commission, and the Bureau of Engraving and Printing for the examination of supplies are the principal items which will augment the routine work of the ensuing year.

MICROCHEMICAL LABORATORY.

In addition to the regular routine work in collaboration with the other laboratories of the Bureau, the following microscopical investigations are to be continued by the Microchemical Laboratory: (1) Examination of cold-storage, liquid, and desiccated eggs; (2) analytical methods for the identification of alkaloids; (3) histological studies of small fruits, drugs, and mustards.

FOOD RESEARCH LABORATORY.

The proposed work of the Food Research Laboratory for the fiscal year 1910 will consist chiefly of the study of poultry and eggs. Cer-

tain of the industrial problems relating to the handling of these products will be studied (1) in the field by investigations conducted in the packing houses during transportation as well as in the warehouses and after the produce has reached the hands of the commission merchant or the retailer; and (2) in the laboratory, where by anatomical, histological, bacteriological, and chemical study the elucidation of the problems will be sought by scientific means. The results so acquired will then be applied practically in the industry for the betterment of the produce on the market, and the data collected will form a contribution to the scientific knowledge of putridity and decomposition.

SPECIAL INVESTIGATIONS.

ANIMAL PHYSIOLOGICAL CHEMISTRY.

The work as planned is a continuation of the work now in progress and falls into two divisions: (1) Metabolism experiments and related food work, and (2) the study of enzymes, especially their relation to ordinary and special analytical methods.

VEGETABLE PHYSIOLOGICAL CHEMISTRY.

For 1910 and 1911 it is intended to continue the lines of work in course of progress and to take up more in detail the following:

(a) The study of the influence of climate, soil, etc., on the composition, character, and value of the final product in the case of wheat grown under different conditions, a study of the baking value of the flour being made, and likewise, in the case of durum wheats, of its value for macaroni production. An investigation of the baking value of flours will be undertaken in collaboration with the yeast-culture expert of the Bureau, bread being made with pure yeast of different varieties. This will not only be a study of the flour, but of the quality of the yeast as well.

(b) The study of the food value of the high phosphorus-containing portion of wheat.

BACTERIOLOGICAL CHEMISTRY.

The projects for the year 1910 include a continuation of the work already begun on the contamination of shellfish from sewage-polluted sources; the examination of dairy products, such as milk, cream, ice cream, condensed and evaporated milk, milk powders, and infant foods; the testing of the germicidal and antiseptic value of various chemical substances recommended for use in destroying germ life; the testing of the sterility of dressings, ligatures, gauzes, bandages, etc., used in medical and surgical practice; and the bacteriological examination of waters from various sources, consisting largely of bottled mineral waters. New lines of investigation will consist of the examination of desiccated, liquid, and frozen eggs and egg compounds, used largely by bakers and confectioners; the examination of edible gelatin, macaroni, manufactured and natural ice; a study of the flora of dried fruits prepared or kept under insanitary conditions; a consideration of the bacterial content of raw vegetables, such as watercress, lettuce, celery, etc.; and the part played by the "typhoid

fly" in the transmission of disease-producing organisms. A systematic effort is made at all times to inspect as many localities as possible where food materials are prepared, handled, or stored, in order to note the sanitary condition of such establishments and to observe commercial practices.

ENOLOGICAL CHEMISTRY.

The plans for the work of the fiscal years 1910 and 1911 are in large part a continuation of investigations now under way:

(1) The study of the character and composition of the grape crop as delivered to the wineries and fruit-juice factories of the Lake Erie district, including, in so far as possible, the entire northern grape belt of Ohio, Pennsylvania, and New York.

(2) The collection, organoleptic testing, and chemical examination of the native wines made in the district mentioned.

(3) The preparation of native wines from pure must of the grapes grown in this same district.

(4) A similar line of studies and chemical examinations of apples grown in the northern fruit belt of the United States, and the by-products therefrom.

(5) The study of pure yeast races.

(6) The experiments on the technic of wine making, including an investigation of all the fundamental questions of cellar practice in the fermenting, maturing, aging, and preserving of wines.

