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REPORT OF THE CHEMIST

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY,
Washington, D. C., September 15, 1925.

SIR: I beg to submit herewith the report of the work of the Bureau of Chemistry for the fiscal year ended June 30, 1925.

Respectfully,

C. A. BROWNE, *Chief.*

Hon. W. M. JARDINE,
Secretary of Agriculture.

The Bureau of Chemistry promotes agriculture and the industries that make use of agricultural products by scientific research in agricultural chemistry and by the application of the results of such research to the solution of the problems involved in the production, preservation, and profitable utilization of farm crops. It conducts biological investigations of food and drug products and studies the physiological effects of such products on the human organism. It develops methods for the manufacture of table sirups and sugar. It investigates chemical problems relating to the composition, manufacture, action, and application of insecticides and fungicides. It conducts experimental work in the utilization, for coloring, medicinal, and technical purposes, of raw materials grown or produced in the United States. It investigates and develops methods for the prevention of grain-dust, smut-dust, and other plant-dust explosions and fires, including fires in cotton gins and cotton-oil mills. It investigates and demonstrates improved processes for preparing, weighing, handling, transporting, and utilizing rosin and turpentine. It collaborates with other departments of the Government which ask the Secretary of Agriculture for assistance in chemical investigations.

The Bureau of Chemistry is charged with the enforcement of the tea inspection act, the naval stores act, and the food and drugs act, and is authorized to make the necessary investigations to regulate interstate and foreign commerce in the products covered by these laws.

THE CHEMISTRY OF CROPS

Fundamental studies of the factors affecting the composition of crops and crop plants were continued. Previous work has shown that the protein content of wheat can be materially increased by the application of fertilizer at certain stages of growth. The market value of wheat is increased by increasing the protein content. In developing methods for the practical application of fertilizer to wheat at various stages of growth it was found that by so spacing the rows as to permit the application of the fertilizer not only was the quality of the wheat improved but the quantity of the yield for a given area was not decreased. As the spacing of the rows made it possible to cultivate the soil between them, experiments were carried on to determine what effect such cultivation would have on both the quantity and quality of the crop. Many data have been acquired as the result of these experiments, but additional experimental work is necessary before final conclusions can be reached.

To ascertain whether or not the principles already worked out for wheat hold with rye, experiments were begun on the effect on yield and composition of the time of application of sodium nitrate fertilizer to rye. A start was made in a study of the absorption of phosphorus by wheat and rye.

Experiments on the effect of soil acidity on yield and quality of strawberries, potatoes, tomatoes, and corn have been undertaken. Studies were made also on the relation of soil

nitrogen to hydrogen-ion concentration. Because of the importance of iron in the diet, the possibility of increasing the iron content of green vegetables has been studied.

An experiment has been started to determine the effect of ammonium sulphate applied at different stages of growth, as compared with that of sodium nitrate, on the yield and composition of corn. In connection with this experiment, studies are being made on the quantity of available plant food removed from the soil in the immediate vicinity of the corn hills during thinning.

INVESTIGATION OF THE ODOROUS CONSTITUENTS OF THE COTTON PLANT

The results of the investigation to isolate and identify the odorous constituents of the cotton plant, undertaken in 1923 at the request of the Bureau of Entomology and completed this year, were communicated at a meeting of the National Academy of Sciences and subsequently published in the *Journal of the American Chemical Society* (vol. 47, pp. 1751 to 1774). As the cotton plant has a specific attraction for the boll weevil, it has been presumed that this was due to the emanation of some odorous substance which could be perceived by the insects at a considerable distance. It was thought that if any odorous substance could be identified, which by actual tests would be found attractive for the insects, it might be possible to produce it in sufficient quantities to permit of its use as a bait.

Among the numerous chemical substances found and identified in the distillate from the cotton plant, some of which had a fragrant odor, are ammonia and trimethylamine. These two basic substances were present in appreciable quantities in the distillate, but the ammonia largely predominated. Both were also found to be emanations from the living plant. Field tests have shown that trimethylamine possesses some attraction for the boll weevil, but much more extended experiments have still to be made by the entomologists in order to determine the practicability of its use as a bait under actual field conditions.

Large quantities of trimethylamine can be produced commercially at a comparatively low cost from waste sugar-beet molasses, for which some use has long been sought. Should trimethylamine prove to be an effective bait, this investigation may result not only in finding a means for reduc-

ing the great losses due to the deprivations of the boll weevil but also in providing a profitable outlet for a waste product of the beet-sugar factories.

PROTEIN RESEARCH

The nutritive value of the proteins in foodstuffs depends chiefly upon their content of the nutritionally essential amino acids. Proteins lacking in these amino acids are of little or no value for promoting the growth of young animals or for maintaining adult animals in a nutritively normal condition, when these proteins constitute the sole source of protein in the diet. Foods in which the protein is lacking in any of the essential amino acids should be supplemented with other protein foods which contain them. Progress was made in extending our knowledge of the composition of proteins from various sources. Little or no information on the percentage of cystine and tryptophane, which are essential amino acids, in the proteins of many of the most important foodstuffs was available. A paper on the tryptophane and cystine content of various proteins, based on extensive chemical research work in the bureau, gives for the first time the percentages of these amino acids in a large number of proteins.

A continuation of the studies on the proteins of wheat bran has shown that they differ in composition from those of the endosperm, which constitute the proteins of white flour. The bran proteins, in contrast to the wheat endosperm proteins, are characterized by having high percentages of the nutritionally essential amino acids. The bran albumin contains 4.76 per cent of tryptophane, the highest found in any plant protein hitherto reported; and the globulin is correspondingly high in the basic amino acids. These findings are of particular value, because the proteins of the wheat endosperm are deficient in these very amino acids. Approximately 22 per cent of the protein of the wheat kernel lies in the seed coats, or bran. This represents a vast quantity of protein in the total annual wheat crop. Feeding experiments to ascertain the availability to animals of the amino acids present are in progress. The results obtained thus far confirm the conclusions drawn from the chemical studies, that the bran proteins have a high food value. The value of wheat bran as a feed for animals has been long recognized by husbandrymen and practical feed-

ers of farm animals, but very little work has been done heretofore to determine the value of its proteins by carefully controlled scientific experiments.

It is planned to study the supplementary value of the bran proteins when fed with certain other proteins deficient in those amino acids which the bran contains in relatively large quantities.

Investigations previously reported have shown that the nutritive value of the proteins of the navy bean is limited by a form of indigestibility which can be remedied by cooking, and also that these proteins require the addition of cystine. Evidence obtained in the bureau goes to show that these proteins contain cystine in quantities which normally should be sufficient to meet the nutritional requirements of an animal for this amino acid. The defect of these proteins is then apparently not due to a deficiency of cystine but rather to a deficiency of *available* cystine. This may be explained by a possible combination between the cystine molecule in the protein with another amino acid or acids, which form a complex that is resistant to the action of the digestive enzymes. Feeding experiments to throw light on this question are in progress.

Notwithstanding the importance of rice as an article of human food, comparatively little work has been done on the rice proteins. During the year proteins were isolated from white rice—that is, rice from which the bran and germ have been removed—and from commercial rice bran, which contains both the bran and the germ, together with small quantities of endosperm. This bran contains nitrogen equivalent to 20.5 per cent protein. The various proteins which have been isolated are now being analyzed.

Progress has also been made in studies of the proteins of cottonseed, of timothy and orchard grass pollens, of sesame seed, of locust-tree bark, and of oysters, clams, and shrimp. Some physical constants of several proteins were determined.

VITAMINS IN FOODS

The extensive interest in vitamins, shown by the large number of letters asking for information on this subject, prompted the preparation of a pamphlet giving briefly and concisely information on the nature and properties of the five vitamins now generally recognized and the relative value of different foodstuffs as sources of vita-

mins. The effect of cooking and other processes used in the preparation of foods and of sunlight and irradiation upon vitamins is also discussed. The data thus presented have been compiled from the most recent sources of information. Hundreds of requests for the pamphlet have been received from all parts of the United States and also from foreign countries.

A paper on the effect of long-continued storage at low temperature on the vitamin A content of eggs gives the results of work completed on the subject. Modern improvements in industrial methods of preserving food products, such as refrigeration, dehydration, and canning have made it possible to keep foods in storage for relatively long periods. Many of our food products are subjected to such storage before they reach the consumer, and it is important to know what effect, if any, this treatment may have on their nutritive properties. The work described in this paper was undertaken to ascertain the effect of long-continued storage at low temperature on the vitamin A content of hens' eggs. The results of the feeding experiments show that no serious deterioration had taken place in the vitamin A content of eggs which had been held in storage in a frozen condition for nine years.

A paper on the vitamin A content of fresh eggs gives the relative vitamin A potency of egg-yolk oil and shows that eggs hold a very important place, if not the most important place, among the common food products as a source of vitamin A.

Work on the vitamin content of sugar-cane juice and of oysters, clams, and shrimps is under way.

SIRUP AND SUGAR INVESTIGATIONS

In response to the large number of requests for detailed information on the subject, a comprehensive bulletin on cane-sirup manufacture has been prepared for distribution during the 1925 sirup-making season. Owing to the desirability of extending the market for cane sirup, considerable attention has been given in the bulletin to a description of methods for producing sirup of uniform quality. The processes for making sirups of various types are also discussed, with a view to promoting the manufacture of the types best suited to different markets.

The bureau's work on sirup manufacture has been planned to give results of value to the entire industry. Inasmuch as the small sirup makers greatly outnumber the large pro-

ducers, the welfare of the small producer has hitherto been given particular attention. At the urgent request of Louisiana cane growers, however, an investigation has been undertaken recently for the purpose of developing an improved process for the production of better-quality sirup on a large scale. From an economic standpoint, some flexibility in the methods for utilizing a crop is frequently desirable. When the price of sugar is relatively low and the price of cane sirup high, as was the case in 1924, it is more profitable for cane growers to convert a portion of their crop into sirup. The method of making cane sirup now generally employed in Louisiana sirup factories, however, is that in which sulphur fumes and lime are used for clarifying the juice. This process gives the sirup a flavor which is very objectionable to many consumers.

A method for producing unsulphured sirup is therefore required in order to realize the greatest marketing possibilities. The work on clarification may also be expected to make possible eventually the production in Louisiana of a better-grade molasses as a by-product of sugar manufacture.

This work illustrates the application of chemical research and chemical technology to a practical problem, with the object of obtaining such flexibility in the manner of utilizing a crop as will permit better adaptation to changing economic conditions and markets, thereby yielding greater profit to the producer.

During the past year raw-sugar production has been investigated in Porto Rico. The longer manufacturing season there has made it possible to do more field work during the year, and the results obtained are directly applicable to the Louisiana cane-sugar industry. Certain reactions involved in the clarification of cane juice by liming, which is the customary factory treatment in commercial practice before crystallization of sugar, were studied. The control of this procedure is probably the most important single step in the recovery of sugar from cane juice. As a result of the experimental work, a method, based upon the determination of the hydrogen-ion concentration, and making possible more uniform control of liming, has been devised. A procedure has been developed whereby the liming of juice may be uniformly and automatically controlled by an electrometric method and a continuous recording potentiometer. This represents an important advance over existing practice.

Experiments were also conducted in Porto Rico on the efficient clarification in the factory of the juice from sugar cane of certain disease-resistant varieties. These results are of special value because of the prevalence of the mosaic disease of sugar cane in Louisiana and the steps that have been taken to introduce mosaic-resistant cane varieties there.

An investigation is in progress to determine the nature of the substances responsible for off-color cane and beet sugars and the manner in which these impurities are distributed in the crystals. Information of much value has been obtained, pointing to means which may be taken to reduce this trouble.

A study of the nature of the substances which accumulate during the Steffen process for desugarizing beet molasses and of the manner in which these substances cut down sugar yields is nearing completion. This investigation has involved a comparison with respect to viscosity and sugar solubility between molasses resulting from the Steffen process and molasses produced in factories which do not use a desugarization process. These results will be of value in connection with efforts to increase the yield of sugar from sugar beets, thereby increasing the value of an important crop.

Because of the importance of the plant colloids which are present in cane and beet juices and which play a large part in determining the yield and grade of sugar obtained, the study of these plant colloids has been continued. A number of practical testing methods, which will greatly facilitate the investigation of this subject, have been developed. Under the present status of scientific knowledge, the investigation of the colloids in the juice is the most promising line of work now available for developing improved methods to increase yields of sugar from sugar-producing plants.

A study was made of the substances which lower the quality of molasses, a valuable by-product, especially in white-sugar manufacture. These substances are largely colloidal and are responsible in a great degree for dark color and objectionable flavor. In edible molasses particularly, an improvement of the grade by the elimination of certain impurities will make a decided difference in the total financial return from growing sugar cane. The results obtained so far promise to assist greatly in devising measures to limit the production of inferior molasses.

Methods for determining hydrogen-ion concentration have been investigated for the purpose of developing an improved procedure for controlling the clarification of beet juice in the carbonation process.

Several scientific and semipopular articles describing the results of the year's work on sirup and sugar have been published.

FRUIT AND VEGETABLE UTILIZATION

The more profitable utilization of fruits and vegetables through the development of new or improved technical methods for manufacturing commercial commodities from surplus crops and culls continues to be from year to year one of the most effective ways in which the science of chemistry can serve the agricultural and manufacturing industries of the country.

The utilization of large quantities of what would have otherwise been waste oranges and lemons was continued in factories in California through the use of methods worked out in collaboration with the laboratory of this bureau established in Los Angeles for the purpose. One plant operated by citrus growers manufactured last year approximately 2,000,000 pounds of citric acid, using about 40,000 tons of cull lemons, which returned to the growers an average of \$12 per ton, with a total net return of about \$450,000. The net gain to the growers, however, was really larger than this, as heretofore the cull lemons were a liability on their hands, which had to be disposed of at a cost of at least \$1 per ton. In addition to citric acid, there are manufactured lemon juice, lemon oil, and pectin. Last year about 65,000 pounds of lemon oil, with a value of approximately \$70,000, together with 30,000 pounds of pectin, was produced at one plant.

From waste oranges are manufactured juice, marmalade, pectin, orange oil, and other products. One plant, which used last year 10,000 tons of oranges, put out, among other products, about 50,000 pounds of orange oil having a wholesale value of approximately \$100,000. One concern has even found a profitable outlet for orange pulp.

The disposal of orange pulp from which the juice had been extracted was once a distinct problem, costing about \$800 a month. A method was found for the preparation and disposal of orange pulp as feed for dairy cows, and now the profits from this source amount to from \$2,500 to \$3,000

a month. The average price last year for the wet pulp, containing 85 per cent of moisture, was \$3 per ton.

The preparation of several lots of pomegranate juice, undertaken for the pomegranate growers, has resulted in one or two projects for the utilization of surplus crops. The success or failure of these projects will be largely a matter of financing and business management. The surplus fruit is cheap and readily obtainable and the method of the preparation of the juice is satisfactory and inexpensive. Experiments on the production of pomegranate sirup and pomegranate concentrate are planned.

During the year a bulletin on the production of citrus pectin was issued and Department Circular 232, "By-Products from Citrus Fruits," was revised.

The proper standardization of various fruits depends upon practical methods for determining maturity and upon the extent of injury from frost, sunburn, molds, and the like. These can not be determined by observation alone. Progress was made in solving the problems involved in the standardization of raisins, and this work was discontinued at the end of the year. Laboratory work was done to find tests for sunburn and molds. Satisfactory stains were not found. A test depending upon the catalase activity of mold promises to solve the problem so far as mold is concerned. If raisins are placed in hydrogen peroxide, moldy fruits will at once begin to decompose the reagent, with an immediate evolution of oxygen. A little gas is produced along the stems of normal raisins, probably from the catalase of yeasts or molds fastened to them, but this evolution of gas is easily distinguished from that of moldy raisins.

As the result of cooperative laboratory work with the Bureau of Chemistry, the Raisin Growers' Association developed a device whereby raisins are stemmed, the stems and trash are separated by an air current, and the stemmed berries are collected in a can of definite volume. This can is mechanically shaken while the raisins are flowing into it, and when full it is weighed. The raisins vary in weight according to their grade. The apparatus also affords a means of weighing sand and trash mixed with the fruit. A device by which the approximate moisture content of raisins can be estimated in a few minutes has been designed. This is of no little importance to raisin buyers.

Department Bulletin 1250, "The Relation Between the Composition of California Cantaloupes and Their Commercial Maturity," published during the year, outlines the work done to develop maturity standards for cantaloupes and gives the tests for determining maturity. The soluble-solids test described is now applied commercially in determining when to pick cantaloupes for the market. The solids content of the juice of good melons is decidedly greater than that of the juice of less desirable melons. A test based on solids or specific gravity has the advantage of being practical for field operations, as it is easily made and does not require expensive apparatus. A Brix spindle reading, which gives the soluble solids, can be used as a measure of quality and maturity in cantaloupes, and suitable limits are suggested in the bulletin. The value of a proper test for the maturity for cantaloupes lies in the difficulty of placing California melons in eastern markets in a satisfactory condition unless they are picked at the right stage of maturity. If allowed to become too nearly ripe before being picked they will not keep in good condition until they reach consumers. If, on the other hand, they are picked too soon the flesh becomes shriveled and tough, and the melons lack color and odor and are disappointing in flavor.

One of the horticultural commissioners in a cantaloupe-producing section of California recently stated that "the establishment of the soluble-solids test for determining the maturity of cantaloupes has practically revolutionized the cantaloupe industry, and has been of inestimable value to the growers. Before this method was established the different interstate markets were demoralized by the continuous shipment of green cantaloupes, but this system has eliminated all question as to the maturity of our produce and has proved very economical and practical."

Likewise the maturity standard for oranges, mentioned in previous reports, has been practically applied in the picking of oranges, with great benefit to growers, shippers, and consumers. The standards for both oranges and cantaloupes as worked out in the Bureau of Chemistry have been made a part of the laws of California.

Requests for additional work on maturity tests have been received from associations of avocado, pomegranate, peach, and plum growers.

Progress was made during the year in a study designed to develop prac-

tical methods for detecting frosted oranges and lemons and for determining the extent of frost injury and how to utilize most profitably the fruit which in varying degrees has been injured. The result of this work, it is believed, will reduce materially the enormous losses that sometimes occur from the freezing of oranges and lemons.

In collaboration with the Bureau of Plant Industry, work has been continued in identifying citrus fruit of different strains by chemical means. This whole project is of great value to citrus growers as a means of improving both the quantity and quality of their fruit. It has already been shown that certain selected strains of lemons and oranges differ in chemical composition, and there is reason to believe that other strains may show like variations. A wide field of investigation which may yield important data on other fruits has thus been opened.

Investigations looking to improvements in the methods for the manufacture of sauerkraut and pickles were continued. Instructions for bringing pimentos and for pickling chayotes were issued. Information on standardization in sauerkraut production was furnished the Sauerkraut Packers' Association and the standards suggested were accepted by the association and also made the basis for a sauerkraut standard to guide food officials in the enforcement of food laws. Work was started on a bulletin dealing with the commercial production of sauerkraut.

Five editions of Farmers' Bulletin 1438, "Making Fermented Pickles," were issued. A second edition of the bulletin on how to make vinegar in the home and on the farm was printed.

Department Bulletin 1335, "Commercial Dehydration of Fruits and Vegetables," completed this year, gives the results of an investigation on improved methods for dehydrating various fruits and vegetables begun in 1918 and terminated last year. This work shows that when proper methods are used dehydrated products of superior quality can be made. Some of the fruits and vegetables upon which experimental work was done can be dehydrated in such a manner that practically all the flavor and color of the fresh product is retained.

COMPOSITION OF VEGETABLE OILS

Chemical researches to extend existing knowledge of the composition of vegetable oils, in order that they may be the more profitably utilized,

were continued. This work requires extended and painstaking laboratory experimentation in order that all the complex substances that make up the vegetable oils and their properties may be determined. At the present time the development of the vegetable-oil industry is retarded because of a lack of knowledge of the exact composition of many of the vegetable oils and of methods for isolating some of the constituents which have a marked effect on the economic utilization of the oils.

Further progress was made in an investigation of the constituents other than the glycerides of cottonseed oil. A so-called vegetable mucilage has been separated from the crude oil and found to be identical with that extracted from the cottonseed. The vegetable resin previously detected was separated and further studied. This was found to have some emulsifying power, which, however, was not nearly so great as that of the mucilage. Another constituent has been isolated from the settlings obtained when the crude oil is allowed to stand some time. It constituted about a third of these particular settlings. It has been found to be a high-melting glyceride, but its composition remains to be determined.

Further investigation of the action of direct sunlight on various oils has shown that, after exposure to direct sunlight, their unsaturated acids, freed from phytosterols, apparently affect photograph plates to the same extent as when mixed with the phytosterols. Much interest has been shown in this investigation by those engaged in studying the deterioration of paint films. Some of these investigators are applying and extending this study to meet their particular problems.

A study of the keeping quality of crude oils in contact with foots, as compared with the keeping quality of those freed from foots immediately after expression, is in progress. Some evidence has already been obtained that crude oils in contact with foots when stored in the dark, as is the practice at crude-oil mills, deteriorate more than those freed from foots, and also that portions of the same oils exposed to diffused light deteriorate much less in the same time. This work will be continued for another year in order to obtain complete data. Many refiners believe that thousands of dollars have been lost through inefficient handling of crude oils at the mills.

Manufacturers of refined corn oil are having difficulties in making a product that will remain clear, the corn oil after a time becoming slightly turbid. The cause of this turbidity was not known and the nature of the substance causing it has been a matter of controversy. The bureau has shown that the turbidity is due to a true wax, not to stearin or other substances as has been claimed. The nature of the wax will be studied further. Some corn-oil refiners have already succeeded in separating the wax from the oil.

The composition and chemical characteristics of authentic samples of California and Italian olive oils have been determined. This work has shown that olive oil contains notable quantities of stearic acid, thus settling a long-standing controversy regarding the absence or presence of stearic acid in olive oil. The Italian olive oil examined contains more than 1 per cent more of oleic acid and about 2 per cent more of saturated acids as glycerides than the California oil. This is the first time that the composition of olive oil has been investigated by modern methods.

INSECTICIDE INVESTIGATIONS

The bureau investigates chemical problems relating to the composition, manufacture, action, and application of insecticides and fungicides, with the object of developing better and cheaper chemical compounds for the more effective control of fungi and insects in order to reduce the enormous losses that occur in the growing of crops from these causes. This work is carried on largely in cooperation with the Bureaus of Entomology and Plant Industry.

Experimental work has developed as a substitute for carbon disulphide a grain fumigant which is free from the fire hazard. The necessity for this substitute arose from the fact that carbon disulphide is highly inflammable, making its use in box cars and elevators exceedingly dangerous. Fire insurance companies refuse to carry the risk on elevators, bins, and other property while it is being employed, and the railroads have prohibited its use for fumigating cars loaded with grain except at two designated isolated points. The cooperative work by the Bureaus of Chemistry and Entomology showed that a mixture of ethyl acetate and carbon tetrachloride is effective in killing destructive weevils in wheat in box

cars, grain elevators, and other tight inclosures. This fumigant is non-inflammable at fumigation temperatures, is noninjurious to those handling it, does not lower the germinating quality of seeds, does not injure the baking quality of flour from fumigated wheat, and costs less than 1 cent per bushel of fumigated wheat. It can be used effectively on wheat in elevators as well as in box cars.

In view of the rapid extension of fumigation with hydrocyanic acid to destroy insect pests, an investigation has been made in cooperation with the Federal Horticultural Board and the Bureau of Entomology to learn whether or not certain products so fumigated are rendered unfit for human consumption. The results, published in Department Bulletin No. 1307, show the quantities of hydrocyanic acid absorbed and retained by fumigated dried fruits, candy and candy-making materials, and cereals, meat, cheese, and dried milk, as well as the effect of storage and cooking on the hydrocyanic acid content.

A method for the rapid examination of foliage for spray residues from lead arsenate, developed in cooperation with the Maryland Agricultural Experiment Station, was published. This is of value in furnishing investigators with a rapid, easy, and sufficiently accurate method for studying the distribution of sprays and dusts and the efficiency of spreaders and stickers, and also for studying the effects of rain and other weather conditions on the retention of insecticides on foliage and the relation of the quantity of arsenic present to leaf injury.

A study on the mineral oil emulsions used as insecticides, now under way, is designed to determine the conditions under which emulsions may be prepared and the conditions which influence their stability. The results of an investigation into the cause of the sluggish reaction noted by manufacturers in the oxidation of white arsenic were published. The deterioration of nicotine dusts and of nicotine soap preparations used as insecticides has been investigated and the results have been published. A paper on the chemistry of dry lime-sulphur, barium sulphur compounds, and sodium sulphur compounds will soon be published in a joint bulletin by the Bureau of Chemistry and the Bureau of Entomology on the effectiveness of these sprays.

A systematic study of the effect of varying conditions, such as temperature, concentration, and time of di-

gestion, in the manufacture of calcium arsenate, which is extensively used as an insecticide, has been in progress during the year in order to discover why commercial calcium arsenate of the usual acceptable standard sometimes injures foliage. The development of a method for determining free calcium hydroxide in commercial calcium arsenate, published during the year, has been of great service in interpreting the results of this investigation.

A paper describing the preparation and properties of 16 arsenates of calcium, several of which are new, will be published at an early date. Not only will this information be of scientific value but it will give a better understanding of commercial arsenates of calcium and make possible their preparation in quantities large enough to permit a study of their relative values as insecticides.

PLANT-DUST EXPLOSIONS AND FIRES

The prevention of dust explosions and resultant fires in industrial plants is commanding the attention of investigators in every country in the world where manufacturing operations are carried on. The losses of life, foodstuffs, and property as a result of these dust explosions have indicated a need for the determination of their causes and the development of effective control measures.

The research work of the Bureau of Chemistry has been practically confined to the dust-explosion hazards in the grain-handling industry, which have caused extensive losses of life and property. It has not been possible to study the dust explosions in industries of all types. Records of approximately 270 dust explosions in plants in the United States and foreign countries have been obtained. In 66 of these explosions 444 lives were lost, and in 83 of them 780 people were injured. The total money loss in 132 explosions approximated \$32,917,000, an average of more than \$250,000 for every explosion. The Bureau of Chemistry is conducting special research investigations to determine the causes of these explosions and the circumstances favorable to their origin.

More than 21,000 establishments in various industries in the United States, manufacturing products with an annual value in excess of \$6,779,449,000, are subject to the dust-explosion hazard. The bureau investigations have shown also that extensive losses have been experienced from

dust explosions and fires in grain-threshing machines, particularly in the Pacific Northwest, and from cotton-gin fires in the Southwest.

Special studies have been made to determine the practical possibility of installing effective dust-collecting systems for the control of explosive dust created in the handling and storing of grain in terminal grain elevators. This work involved special engineering investigations to determine the points of suction application, type and design of hoods, apparent effect on grain weights, and other factors related to the weight readjustment of existing commercial practices.

Tests were conducted at a number of elevators in the East and Middle West, and many data, to be used in designing dust-collecting systems of this character, have been gathered. A bulletin, now in course of publication, gives the results of these investigations, together with recommendations for the installation of dust-control equipment for grain elevators. The bureau's work on this project was done in cooperation with a number of industrial agencies, such as the Terminal Elevator Grain Merchants Association, the National Fire Protection Association, and the Underwriters' Laboratories.

The encouraging laboratory results already obtained by the bureau indicated that the dust-explosion hazard during grinding operations can be practically eliminated by the use of inert gases. During the past fiscal year the activities on this project have consisted principally in the development of a large-scale testing unit at the Experimental Farm, at Arlington, which includes grinding, conveying, and elevating equipment similar to that used in operating practices. Carbon dioxide obtained from boiler flue gas, which is to be used as the inert gas, will be introduced into the grinding apparatus under actual operating conditions. It is hoped that this work will furnish enough additional data to enable the bureau engineers to design equipment practicable for industrial use. The dust-explosion losses from grinding grain and similar materials have been very great, resulting in extensive losses of life and property.

Static electricity, which has caused a great many dust explosions, may be generated in a number of ways. Methods for its elimination in industrial plants and in grain-threshing machinery have been considered in the bureau. Electrically grounded metallic combs, recommended for removing static

charges from belts, are not entirely satisfactory. The ground wire may be broken, thus increasing the hazard, and the combs are detrimental to the belt. Metallic combs can not remove induced charges from insulated substances. A Government-designed waterproof conducting belt coating, free from stickiness and of good wearing quality, which may be used without hindering the action of either belt or pulley, has proved thoroughly efficient in removing the charges of static electricity.

A study of the effect of prolonged heating on the ignition temperatures of several dusts has produced a more accurate method for the measurement of ignition temperatures. A preliminary survey was made to obtain data on the probable application of hot journal alarm systems, to be used in connection with a study of overheated bearings and their relation to fire and explosion. During the year 6 explosions were investigated—2 in flour-milling plants, 1 in a stock food plant, 1 in a grain elevator, 1 in a paper factory, and 1 in an aluminum factory.

Cooperation was continued with insurance underwriters, State commissions, and fire-prevention agencies in the application of measures for the prevention of cotton-gin fires. Department Circular 271, describing a new wiring system for grounding cotton gins, has been sent out to a large number of cotton ginners.

The bureau cooperated with the State fire marshal of Washington, with manufacturers of threshing machines, and with underwriters in the application of control measures for preventing explosions in threshers. The insurance rates on threshing machines equipped in accordance with bureau recommendations have been reduced.

The losses from thresher explosions and fires have been greatly reduced as a result of the work of the Bureau of Chemistry.

COLOR EXPERIMENTAL WORK

American manufacturers now produce vat dyes of brilliant color and lasting quality, as the result of processes developed by American chemists for making cheaply and of remarkable purity two dye intermediates formerly obtainable only in Germany. The process for making one of these essential intermediates, phthalic anhydride, worked out in the bureau, has been outlined in previous reports of the chemist. The vat dyes, because they are fast and durable, are especially

adapted for cotton goods, and their use is being rapidly increased. In 1914 no vat dyes were manufactured in the United States and 1,945,304 pounds were imported. In 1923 American manufacturers in the United States put out 1,766,383 pounds of vat dyes, and the country imported 1,207,554 pounds. In 1924 there was produced in this country 1,821,319 pounds, as against imports of 1,499,322 pounds. These statistics do not include indigo, which is also a vat dye.

All the phthalic anhydride now manufactured in the United States is made by the Bureau of Chemistry process. This essential intermediate has been sold in Europe, because both of its comparatively low cost and its exceptionally high purity. Approximately 2,300,000 pounds of phthalic anhydride was produced in this country in 1923, the last year for which statistics are available. The average price of phthalic anhydride manufactured in America has been about 29 cents per pound, and prices as low as 16 cents per pound have been quoted. Before the war the price of the product made in Germany was approximately 30 cents per pound, which to-day would be equivalent to about 53 cents. The product made by the American process is not only relatively lower in cost, it is also higher in purity.

In a recent article in a technical journal the chairman of the dye division of the American Chemical Society made the following statement regarding the contribution of this bureau to the development of the manufacture of vat dyes:

Thus we see that the manufacturers of vat dyes now have at their disposal cheap and pure products with which to build up the complex molecules characteristic of these coloring matters which give the brightest shades and the most permanent colors yet made. Every one knows that the permanency of color is an important item in every household. Who has forgotten the rapidly fading colors of 1916 and 1917? Who does not know the waste that these poor colors entailed in replacement costs for clothes and draperies? Who is not now familiar with the sunfast, no-fade clothes and materials? These are possible because of the vat dyes, and the American vat dyes are with us because of the development of cheap aluminum chloride and phthalic anhydride. And the latter is cheap because of the work of two chemists in the color laboratory of the Bureau of Chemistry of the Department of Agriculture. Thus, if one were inclined, it would be possible to figure out the saving to himself, to each family, to the Nation as a whole, brought about as the result of the work of the color laboratory, which was organized to help establish American independence in dyes. Not only has it done that, but, as shown above, it has caused a material saving and increased economy to each and every person who uses any cotton cloths—and who does not?

The total production of coal-tar dyes in the United States in 1924 was 68,679,000 pounds, which is a decline from the maximum output in 1923, due principally to decreased activity in the textile industry. The pre-war output of 1914 was only 6,619,729 pounds. Dyes of domestic manufacture now supply about 95 per cent of the consumption in the United States, and there was in 1924 an exportable surplus of certain dyes amounting to 16,000,000 pounds, according to reports by the United States Tariff Commission.

During the year progress was made in the work on the dyes used as biological stains by bacteriologists, biologists, physicians, and others engaged in health work to identify the microorganisms that produce disease. Without stains of known composition disease-producing bacteria can not certainly be identified. Before the war these stains could be obtained only from Germany. The work under way in the bureau is designed to gather all available data on the dyes used for this purpose and to develop specifications or standards for their manufacture to make it possible to insure the production of suitable dyes for staining. Because the volume of the business is small, commercial concerns can not well afford the basic research necessary to develop this phase of dye chemistry. Yet its development is essential in a country which aims to establish a complete dye industry and to be independent of foreign countries in this important field.

Work on the vapor-phase sulphonation of naphthalene has been completed. The chemistry of the process has been worked out and published. The problem now is merely one of mechanical construction for the best results. Progress was made in the study of hydrolysis of the sulphonic acids of naphthalene. The data from this study will aid in the production of the isomeric acids and possibly indicate new methods of isolation and purification. Means of establishing the identity of the methyl violet group of dyes have been worked out. The increasing use of members of this group in therapeutics makes this work of value also from the standpoint of medicine. In cooperation with the National Research Council, vapor pressures of the isomeric nitroanilines and of the mono- and di-methyl and ethyl anilines have been determined. It was found that all the nitroanilines decompose on heating at atmospheric pressure before they boil. This work

will be pursued with other intermediates, thus obtaining further data of importance in manufacturing processes.

CERTIFICATION OF FOOD COLORS

The growth of the certification of food colors has been rapid during the past year. This apparently is due not to any material increase in the use of food colors but to the fact that a larger proportion of the colors used in food are certified. Food manufacturers are coming more and more to demand that the dyes furnished them be certified. Only dyes that are known to be harmless and meet the required standard of purity are certified. During the year food colors were certified by 34 concerns, 9 of these being new certifiers. Eight batches of straight dyes and one batch of mixture were rejected. The work of passing on these dyes has been so systematized that notwithstanding a more than 18 per cent increase over the previous year, certification has been made, as a rule, in a shorter time than formerly. Table 1 indicates the quantity of dyes certified during the past three years.

TABLE 1.—Coal-tar food dyes certified, 1923-1925

	1923	1924	1925
Straight dyes (pounds).....	250,756	232,305	315,848
Repacks (pounds).....	20,216	26,956	39,013
Mixtures (pounds).....	239,614	281,148	284,060
Total batches examined.....	633	724	883
Firms.....	27	30	34
New firms.....	4	6	9

LEATHER, PAPER, AND FABRIC TECHNOLOGY

LEATHER AND TANNING MATERIALS

Raw materials for leather making are primarily agricultural products, and of the users of finished leather articles (harnesses, belts, shoes, boots, and the like) those engaged in agriculture form the largest class. Because of this dual relationship between the leather industry and agriculture, from the standpoints both of production of raw material and consumption of finished products, the Department of Agriculture naturally finds among its problems those of the leather industry. Long realizing that the domestic supplies of leather-making raw ma-

terials are inadequate and likely to be less plentiful in the future, the bureau has emphasized the importance of a conservative utilization of these materials, of making better leather, and of giving proper care to leather goods, which cost the people almost \$2,000,000,000 annually.

Recent investigations on the distribution of tannin in the American chestnut tree have shown that stumpwood, root wood, and root bark are relatively rich in tannin, some samples of root bark containing more than 30 per cent tannin and some of root wood more than 20 per cent. The usual chestnut wood of commerce has only from 7 to 9 per cent of tannin. It was also found that the edge zone of the heartwood is much richer in tannin than the central zone.

Aside from their scientific interest, these findings suggest consideration of the use of chestnut stumps and roots as a commercial source of tannin extract and indicate that from a given lot of chestnut timber a higher yield of tannin would be obtained from slabs than from the rest of the wood.

In attempting to find possible new sources of tannin, numerous plant products have been analyzed. Among these bear clover (*Chamaebatia foliosa*) was found to contain from 12 to 14 per cent of tannin. This shrub grows extensively over the Sierra Nevada mountains, where it is a fire menace. Data so far obtained on its tannin content and certain other factors regarding its growth and harvesting justify a further preliminary study of this material as a possible commercial source of tannin.

Pest and disease attacks upon cattle often result in a damaged hide for leather making. Tick marks and grubworm holes are well-known results. More recently several instances of defective leather from another cause, apparently unrecognized by the tanner, have been submitted to the department. The bureau, in cooperation with the Bureau of Animal Industry, has shown that this imperfection is the result of follicular mange contracted by the animal during life. This mange, although known for many years to exist among cattle, has not been considered sufficiently common to deserve attention. From recently submitted evidence and from data now being collected, however, it seems to be becoming more widespread and more serious to the leather industry than is generally appreciated. It deserves recognition as a real menace to our domestic supply of hides and skins.

In cooperation with the authorities handling the Alaskan fur-seal kill, a number of suggestions on handling and curing these skins were offered by the bureau. These suggestions, which were radical departures from existing practices, were put into effect with marked success and have now been adopted.

Educational work has been continued on the proper methods for skinning, curing, and marketing domestic hides and skins for leather making. Farmers' Bulletin 1055, "Country Hides and Skins," which was issued several years ago and has received the hearty indorsement of the leather industry, was recently selected by the Inter-American High Commission for translation into Spanish and distribution in South America.

In the South and Southwest the skins of goats and kids which are raised for family use are seldom marketed. Experiments are being conducted to develop methods for tanning these skins at home and through the aid of the department's demonstration agents to work up the resulting leather into small fancy leather articles, the sale of which should bring a good return.

A third reprint of Farmers' Bulletin 1183, "The Care of Leather," has been exhausted. Because of the widespread demand for the information in this publication, particularly that dealing with shoes, the subject matter has been divided. Two bulletins will be issued during the next fiscal year—one on the care of shoes and the other on the care of harness, belting, and other leather goods.

Recent developments in studies of the deterioration of leather have shown that leather bookbindings may deteriorate because of the corrosive action of the polluted atmosphere of large cities and other industrial centers, as well as from other causes already well recognized. The effect of different degrees of exposure to the atmosphere has been shown very strikingly by comparative analyses of various parts of bindings. The results of this work are being assembled and prepared for publication. By following up the lead furnished by these findings it may be possible to develop a treatment that will double or treble the life of leather bindings.

PAPER INVESTIGATIONS

The study of the physical properties of paper used for wrapping fruits and vegetables was continued. A large number of fruit-wrapping papers were

collected from citrus-fruit packers and shippers in Florida. Some of these papers are reported to lack the strength necessary to withstand service conditions. All the samples collected in Florida have been tested. The data on them, together with the results of tests previously made on many samples collected in various parts of the country, have been compiled. It is now possible to state definitely what physical properties papers for this purpose should possess in order to withstand service conditions. The results of this investigation, soon to be published, will aid packers and shippers to specify paper that will answer every purpose of a satisfactory fruit-wrapping paper and to purchase such paper at the lowest practical cost.

Undeveloped coated brown-print paper, used extensively in engineering and construction work for preparing negatives from original drawings on tracing cloth, deteriorates in strength very rapidly when stored under ordinary conditions. An investigation to determine to what extent the deteriorating effect on the paper of the commonly employed brown-print sensitizing materials is affected by temperature, and to determine under what temperature conditions the undeveloped coated paper may be preserved longest was completed. The results, which have been published, show that the undeveloped coated paper can be kept at 35° to 40° F. for at least five months without any deterioration in strength.

Progress was made during the year in the work to determine what physical properties map paper should have to withstand the rough handling to which it is sometimes subjected, to determine the relative value of carbon paper of different weights and kinds, and to determine the effect of temperature and humidity on the physical properties of paper. Work was done also on the preparation of specifications for paper for various uses in the Government service.

WATERPROOFING AND PRESERVING FARM FABRICS

Work on methods for preserving tobacco shade cloth was continued. Experimental work was done on the waterproofing of old weathered canvas not previously treated, on waterproof dressings for old automobile tops, and on fireproofing treatments. Information on these subjects, together with data on the protective effect of pigments against injury by sunlight and new waterproofing form-

ulas, are being incorporated in a revision of Farmers' Bulletin 1157.

IMPROVING THE PRODUCTION OF ROSIN AND TURPENTINE

Investigations on the production and properties and on the weighing, handling, grading, and uses of rosin and turpentine continued from previous years included work on the preparation and distribution of glass standards for rosin and of color standards for turpentine. Substantial progress was made in demonstrating new and improved processes for producing rosin and turpentine. Work was done on a new method for detecting steam-distilled wood turpentine in gum spirits of turpentine. The detection of mineral spirits by odor was investigated.

Attention was given to the trouble that varnish makers have had with certain rosins which tend to crystallize. Advice on how to overcome the difficulties has been given, but the exact cause of the tendency to crystallize, which seems to be most prevalent in rosin of the higher grades, has not yet been learned.

The color values of a large number of samples of wood rosin as regularly produced at southern wood-distillation plants have been determined. This rosin has a brilliant ruby red color entirely distinct from the color of ordinary gum rosin. This difference in color composition makes it difficult to grade wood rosin by the established standards. Under the standards set by the naval stores act all commercial wood rosin now being made must be graded as "D" or "E," not as "F," which was the grade usually assigned before the passage of the act. This new designation is not an indication that the quality of wood rosin has been lowered; it is simply the correct classification, under the naval stores act, of wood rosin as made for the past 15 years.

Preliminary studies of various coatings for the interior of sheet-iron drums have been made. Silicate of soda, or preferably a mixture of silicate and whiting, which will show when the entire surface has been covered, proved to be efficient in protecting the rosin from dissolving rust. Whitewash gave less protection than the silicate of soda; whiting alone gave no protection.

Color readings have been made on standard-type samples of very light-grade French rosin as a preliminary step toward establishing a standard

in this country for rosin of lighter color and higher grade than "X," the present top grade. It is believed that when certain improvements in production along the line of methods used in France are perfected and in general use, extra high-grade rosin will be made in this country to a much greater extent than at present.

The educational work among naval stores producers to explain and demonstrate new and improved methods, processes, equipment, plant layout, and construction in the manufacture of rosin and turpentine was carried on during the year with a large measure of success. The benefits from the use of the recording thermometer in operating a turpentine still were demonstrated, and as a result the number of installations of recording thermometers has greatly increased. The design and the method of installing recording thermometers on turpentine stills were improved, making the thermometers more sensitive and the temperature readings more accurate. Experiments were conducted at a number of stills to determine a better method of distilling scrape, the semi-hard, white, resinous material which accumulates on the chipped face of a turpentine tree. It was found that under well-regulated control of the still, with proper handling, an average yield of about 5 gallons of turpentine from each 300-pound barrel of scrape may be expected, and that 5 round barrels of rosin to each 50 gallons of turpentine obtained is an average yield.

Increased interest among operators in the methods of grading rosin and gauging turpentine was aroused. A number of disputes on grading and gauging between producers and buyers were settled. Mimeographed monographs on charging and discharging turpentine stills, on thermometers for stills, and on the operation of stills with and without recording thermometers were prepared and sent to all naval stores producers.

THE DEVELOPMENT OF METHODS OF ANALYSIS

The development of methods of analysis for the advancement of agricultural chemistry and of the chemistry of related industries has for many years been one of the important lines of work. This work can be done most economically and efficiently in cooperation with the scientific associations which are concerned with the science of chemistry. Chief among these cooperating bodies, in so far as

the work of this bureau is concerned, is the Association of Official Agricultural Chemists.

The objects of the Association of Official Agricultural Chemists, which is now 41 years old, are: (1) To insure uniformity and accuracy in the methods, results, and modes of statement of analysis of fertilizers, soils, cattle foods, dairy products, human foods, medicinal plants, drugs, and other materials connected with agricultural industry; (2) to afford opportunity for the discussion of matters of interest to agricultural chemists. The association is of limited international character in that its active membership includes analytical chemists connected with official institutions in the United States and Canada, engaged either in research work in agriculture or in the enforcement of laws applying to any of the products covered by the work of the association.

The methods of analysis of the association have long been recognized as the best available in the fields of activity occupying the attention of the association. They are widely used by agricultural, industrial, and research chemists. In control work the use of the association's methods is often mandatory.

From 1884 to 1894 the methods of analysis adopted by the association, together with the proceedings of the annual meetings, were published each year as a bulletin of the Division of Chemistry of this department. In 1895 the methods, brought up to date to include the changes sanctioned by the 1895 meeting, were printed as Division of Chemistry Bulletin 46. This bulletin was later revised to incorporate the changes subsequently made at the annual meetings up to 1899. The provisional methods for the analysis of foods, authorized by the 1901 meeting, were issued in 1902 as Bureau of Chemistry Bulletin 65. In 1907 the official and provisional methods as adopted by the association up to that time were printed as Bureau of Chemistry Bulletin 107, which was revised in 1908. A reprint of this revision was made in 1912. The methods were of such importance to the Bureau of Chemistry that from 1903 until 1912 circulars giving the official changes in the methods were issued as soon as possible after each annual meeting.

In 1920 the association itself published these methods of analysis, revised to November 1, 1919, in book form, under the title "Official and Tentative Methods of Analysis of the Association of Official Agricultural

Chemists," and during the present fiscal year the second, or 1925, edition of this book, containing the methods revised to July 1, 1924, has been issued. Various members of the bureau have taken an active part in this latest revision of the methods of analysis of the association and in other features of the association's work during the year.

WORK FOR OTHER DEPARTMENTS

The Bureau of Chemistry is called upon to do a great variety and a large volume of chemical work for other departments of the Federal Government. This work varies from an extended investigation for the Post Office Department, to determine whether or not a medicinal product will fulfill the claims of its promoter in relieving or curing certain diseases, to making a complete chemical analysis of a sample of food for the War Department to determine whether or not it is wholesome and meets the specifications under which purchased. Representatives of other departments frequently consult the specialists of the bureau regarding chemical problems that arise in their work. These consultations, which may be by correspondence, by telephone, or by personal interview, during a single year cover different phases of nearly every subject upon which the bureau works. The specialists of the bureau are frequently in a position to furnish other departments immediately with information which has a direct bearing on their problems and which could otherwise be obtained only at considerable cost for extended laboratory experimentation or original research.

As a result of the cooperative work with the Post Office Department designed to prevent the use of the mails for fraudulent purposes in the sale of medicinal preparations, fraud orders were issued by that department against eight concerns during 1925. The various preparations on which the fraud orders were based were sold as remedies or cures for a host of ills, including tuberculosis, diabetes, rheumatism, piles, impaired eyesight, catarrh, asthma, dropsy, anemia, nervousness, syphilis, impotence, Bright's disease, bladder weakness, prostatitis, hardening of the arteries, high blood pressure, varicocele, eczema, paralysis, and liver and kidney disorders. Some six other cases were closed when the concerns involved made affidavits to discontinue their use of the mails for the sale of their products. Other cases were closed either after court

contests or by agreement to discontinue the business. The necessary chemical and medical evidence was furnished in all these cases by the Bureau of Chemistry. Some of the cases involved extended investigations in order to develop the evidence necessary to prove the fraudulence of the practices involved.

Members of the technical staff of the bureau served on committees of the Federal Specifications Board and assisted in the preparation of specifications for the purchase of various products used by the Federal Government. Besides assisting in the preparation of specifications for the purchase of foods, drugs, stock feeds, chemicals, chemical apparatus, insecticides, leather and leather articles, paper and paper articles, and the like, the various laboratories of the bureau examined numerous samples of these products upon the requests of other departments to see that the products delivered by the contractors complied with the specifications under which they were purchased. Technical assistance was also rendered the General Supply Committee in determining the relative value of various articles submitted by bidders for contract supplies and also in examining samples taken from shipments of supplies delivered to the Government on contracts to see that they came up to the specifications and to the sample originally submitted with the bid. This work is confined to products on which members of the staff of the bureau specialize.

At the request of the Post Office Department, specifications were prepared for pocket-size commission cases for the use of post-office inspectors. The cases previously used have failed in a short time. The bureau's examinations showed them to be defective in construction.

At the request of the Chief Coordinator of the Federal Government, an investigation was made to determine the effect of storage for several years on the physical properties of certain wrapping papers. In acknowledging the report of this investigation, which involved the examination of about 50 samples, the chief coordinator said:

I wish to thank you for the complete and exhaustive tests you have made on the paper samples. The information contained in your report has been of material assistance in the handling of a problem which, without such information, would have been extremely difficult of solution. I can not, therefore, express too highly my appreciation of your cooperation and helpfulness and of the important service rendered in the interest of Federal economy.

Fifty-four samples of bookbinding leather samples were examined for the Government Printer. This work is resulting in a slow but gradual improvement in the quality of the bookbinding leather obtained by the Government Printing Office.

A cooperative investigation on anti-septic dyes was carried on with the Walter Reed Hospital laboratory. In cooperation with the Army Medical School a study was conducted on the efficiency of mercurochrome as compared with that of tincture of iodine against organisms found in war wounds.

In addition to the work mentioned, chemical work was done for the Army, the Navy, the Marine Corps, the Department of Commerce, the Interior Department, the General Supply Committee, the Commissioners of the District of Columbia, the Shipping Board, the Federal Trade Commission, the Panama Canal, the American consulate at Rome, the Government Printing Office, the Veterans' Bureau, the Treasury Department, and the Congressional Joint Committee on Printing.

ENFORCEMENT OF THE NAVAL STORES ACT

Active enforcement of the naval stores act of March 3, 1923, was started at the beginning of this year, when the first appropriation for the purpose became available. A naval stores classifier and a naval stores inspector were appointed and stationed at New York to inspect, classify, and grade rosin shipments to New York and other northeastern points, on which formal request for Federal inspection is made by the consignees, or on which it is deemed advisable to check the grading and take action under the naval stores act, and to collect samples of turpentine and turpentine substitutes which might be in violation of the act. A naval stores inspector was assigned to Cincinnati to cover the central field, and a naval stores classifier, with headquarters at Savannah, Ga., was appointed to reinspect, grade, and mark rosins originating in the South Atlantic producing territory, on which buyers request reinspection and marking under the naval stores act.

Two hundred and fifteen samples of turpentine and materials sold as such or in place of turpentine for similar uses were examined during the year. Thirty-five citations to hearings have been issued to concerns found to be violating the act.

Two surveys of rosin-grading conditions were made during the year. The first, made in the fall of 1924 and covering New York, Boston, Buffalo, and Cleveland, showed that the proportion of misgraded rosin was high. A conference of rosin shippers was held at the Bureau of Chemistry to discuss the situation revealed by this survey and to develop means for improving it. A second survey of grading conditions, made in June, 1925, in St. Louis, Chicago, and Milwaukee, revealed a decided improvement in rosin grading, although there is still need for further improvement.

Under the service features of the naval stores act, 82 lots of rosin, comprising a total of 9,946 round barrels and representing in the aggregate shipments of approximately 20,000 round barrels, have been inspected, graded, and marked to show Federal inspection, and United States grade certificates have been issued to cover them. Official analysis certificates were issued on two shipments of turpentine analyzed upon request. Samples representing two lots of rosin, amounting to 1,630 round barrels, were graded unofficially upon request and the results reported, but no certificates were issued.

The department has received the hearty cooperation of the naval stores industry during the first year of the enforcement of the naval stores act, and it is believed that there has been a marked improvement in labeling and grading rosin and turpentine, although many abuses remain to be corrected. As the industry has now had time to become familiar with the provisions of the act, a more exact compliance with its terms from this time on may be expected.

ENFORCEMENT OF THE TEA INSPECTION ACT

Tea is subject to both the tea inspection act and the Federal food and drugs act. A special act to regulate tea is necessary in order to control its

quality as well as its purity and to insure the correct labeling of imported tea. The act provides that all tea offered for entry into the United States must be inspected at the ports of entry. Only those teas which comply with the tea standards adopted by a board of tea experts, appointed by the Secretary of Agriculture, and otherwise meet the requirements of the act may be admitted.

During the last fiscal year 92,925,470 pounds of tea was examined at the various ports of entry. Of this tea 84,137 pounds, or approximately 0.09 per cent, was rejected. All of the rejections were for quality, except 5,666 pounds, which was rejected for being below the Government standard in purity.

The percentage of black tea imported during the year increased; the percentage of green tea imported decreased very noticeably; and the percentage of Oolong tea imported remained about the same. The largest increase in black teas was in the Ceylon variety. The percentage of India and Java black teas imported increased markedly, and the importation of Congou teas fell off more than 62 per cent. The only variety of green tea that did not show a decreased importation was the India green tea, which showed an increase.

The Canton Oolong, the tea which is consumed principally by the Chinese in this country, showed the most rejections, or 4.85 per cent. The varieties showing the next largest rejections were the Ceylon green and India black teas. These teas were not below the Government standard in quality but were damaged en route.

During the past fiscal year there was imported 92,925,470 pounds of tea, or 11.5 per cent less than was imported during the fiscal year 1923-24. Statistics of the Department of Commerce show that during the past fiscal year the United States exported 1,817,245 pounds of tea, nearly twice as much as was exported during the fiscal year 1923-24.

TABLE 2.—Statistical tea report

Port	Examined	Per cent of total examined	Passed	Rejected	Per cent rejected	Rejected for impurities	Rejected for quality
	<i>Pounds</i>		<i>Pounds</i>	<i>Pounds</i>		<i>Pounds</i>	<i>Pounds</i>
Boston.....	17,561,248	18.896	17,553,882	7,366	0.0419	-----	7,366
Chicago.....	2,691,550	2.896	2,691,104	446	.0161	-----	446
Honolulu.....	349,879	.377	349,879	-----	-----	-----	-----
Puget Sound.....	11,669,761	12.558	11,668,271	1,490	.0127	-----	1,490
New York.....	49,540,734	53.312	49,479,760	60,974	.1230	5,666	55,308
San Francisco.....	11,112,298	11.958	11,098,437	13,861	.1247	-----	13,861
Total.....	92,925,470	-----	92,841,333	84,137	-----	5,666	78,471

ENFORCEMENT OF THE FOOD AND DRUGS ACT

Although the Bureau of Chemistry regards the food and drugs act as a corrective rather than a punitive measure and believes that in general the education of the food and drug industry to comply with the law protects the public and legitimate industry more effectively than do regulatory actions, nevertheless in those cases where educational methods fail it is necessary to resort to action in the courts. During the fiscal year ended June 30, 1925, 910 seizures were made and 746 criminal prosecutions were instituted for violations of the food and drugs act.

As a result of combined educational and regulatory operations, marked progress has been made toward the correction of certain outstanding evils in the food and drug industry. In a regulatory law, however, it is never possible to foresee a time when vigilance may be relaxed for the reason that in every industry there are certain individuals who must be held under constant surveillance if they are to be expected to pursue a course wholly in conformity with the law. The protection of the consumer and the law-abiding manufacturer will undoubtedly require a continual maintenance of supervisory activities under the food and drugs act. Recognizing the vast extent of the industries, involving billions of dollars worth of food and drug materials annually, the bureau in its enforcement work has found it necessary to direct its major attention to staple products and to those which by reason of their peculiar susceptibility to adulteration or misbranding or their high market value offer particularly fertile fields for sophistication.

With the funds available it is always necessary to select the lines toward which regulatory work shall be particularly directed. This is accomplished under a project system of operation. As fast as a particular industry is brought into reasonable conformity with the law, the funds used for that purpose are diverted to the supervision of other industries, giving only such casual attention to the first industry as is necessary to make certain that there is no general recurrence of violation.

CANNED SALMON

Decided progress has been made in correcting the very bad situation

which existed in the salmon-canning industry prior to, during, and just after the World War. This progress has recently been made easier by the fact that the Government has been uniformly successful in contests of the prosecutions and seizure actions brought as a result of the canning of decomposed fish. A number of hard-fought contests have resulted ultimately in verdicts for the Government. This has demonstrated to those packers who are not disposed through an innate sense of decency to put up a sound and wholesome pack that it is incumbent upon them so to revise their method of operation as to insure an article which will comply with the law. In its campaign the bureau has had the whole-hearted support of the better element of the industry, which through pressure on offending members has assisted in the process of reform.

During the canning season of 1924 a power boat was chartered and a systematic effort was made to inspect canneries in operation in southeastern and central Alaska. Because of the remoteness of the field, the canneries operating in Bristol Bay could not be inspected, but as these canneries are principally engaged in packing red salmon, an article ordinarily handled with greater care than the cheaper grades, there has not been so much need for inspection in that section. Of 72 canneries inspected, 13 were found to be packing or to have in their possession fish in a stage of decomposition, rendering it unfit for food purposes. During the 1925 season the boat was again used. Although the 1925 season is not included in the fiscal year covered by this report, the results of the inspections made are given here for purposes of comparison. The plants of 71 packers were inspected; only 2 were found to be packing or holding questionable fish. In addition to the canneries inspected in Alaska, canneries in the Pacific Northwest were inspected during the packing seasons of 1924 and 1925. In 1924, 4 canneries out of 35 inspected were found to be doing a questionable business. In 1925, only 2 of the 30 canneries inspected were engaged in suspicious practices. During the last fiscal year 25 criminal prosecutions directed against 17 packers were terminated by the imposition of fines. These cases represented actions against packers who in former years had shipped decomposed salmon.

FROZEN ORANGES

During Christmas week, 1924, the orange groves of California were visited by a disastrous freeze. The effect of a serious frost on oranges which are nearly mature is not always immediately apparent. Within a week or two after a freeze, however, the fruit begins to break down as a result of injury to the tissues, and in a very short time the pulp becomes dry and pithy and more or less worthless, depending upon the extent of the frost damage. Frozen oranges harvested immediately after a freeze may show very little evidence of damage and might be reasonably palatable if eaten immediately. If packed and shipped to the eastern market, the drying process begins before the eastern consumer purchases the article. As there is no marked external evidence of the damage, the purchaser is defrauded by receiving a practically worthless article in return for the price of good oranges. At the same time the reputation of the fruit is seriously damaged in the minds of discriminating purchasers. Most of the orange growers of California recognize it to be not only to the interest of the consumer, but also to their own best interest, to harvest and ship only sound, unfrosted oranges. A few, who are more interested in immediate returns than in the future welfare of the business, have made a practice of harvesting oranges immediately after a frost and attempting to get them onto the market without regard to the fraud thus perpetrated upon the consumer.

Following the freeze of Christmas, 1924, it was recognized that it would be necessary to patrol these orange-growing sections, as in previous frost years, for the purpose of preventing the shipment of worthless fruit to the eastern market. In this patrol work authorities of California gave their enthusiastic support, and, as a result of the combined efforts, very little worthless fruit was shipped out of the State. In a large number of cases fruit which was about to be shipped was detected by the inspectors and upon advice to the shipper that it was of such character that action would have to be taken against it when it reached the eastern market, if shipped, the fruit was voluntarily withdrawn and put through the so-called water separator, for the purpose of removing oranges showing an excessive degree of frost damage, or diverted to legitimate technical uses.

BLUEBERRIES AND CHERRIES

During the 1924 canning season assistance was given the blueberry canners of Maine in selecting those berries which were sufficiently free from maggot contamination to be fit for canning. An apparatus for removing maggoty berries devised by members of the bureau during that season was very generally adopted during the 1925 season and very successfully used by the blueberry canners.

A similar problem arose in connection with the cherry-canning industry of New York, which by reason of worm infestation suffered a number of seizures of goods packed during the 1924 season. As a result of the agitation at that time a program of spraying was adopted by most growers during the present growing season, and a very much cleaner and more acceptable pack of cherries was made during the canning season of 1925.

SARDINES

Another industry which has shown a very material improvement is the sardine-packing industry of Maine. It has been the practice over a period of years to can sardines which have undergone a species of decomposition resulting in what is known as a "belly blown" condition. Canned fish of this type are classed as adulterated within the meaning of the food and drugs act. As a combined result of seizures of decomposed sardines and of extensive educational work among the packers over a number of years the pack of this season is more nearly free from this and other types of objectionable fish than in any past season during which supervision has been maintained.

OYSTERS

Investigations by the Public Health Service having indicated that typhoid cases in certain cities were caused by eating raw oysters, health and food officials gave much attention during the year to establishing an effective control of the sanitary conditions under which oysters are produced and handled.

The Bureau of Chemistry has authority over oysters under the Federal food and drugs act only when they have been shipped or offered for shipment in interstate commerce. Oysters which are polluted, whether such pollution may cause disease or not, can not be shipped within the jurisdiction of the act without violating the law.

The bureau, however, is neither authorized nor equipped to study the causes of disease. It is entirely conceivable that oysters produced in apparently unpolluted waters and handled in what seems to be the most approved sanitary manner may, through contact with a typhoid carrier or an individual in the early stages of typhoid, become a potent source of danger wholly undetected by the bureau's inspectors. Thus, where typhoid is concerned, the problem becomes one for the attention of health officials and epidemiologists rather than food inspectors.

By an act passed at the last session of Congress the sanitary control of the oyster and other shellfish industries was put under the supervision of the Public Health Service. Work relating to that control will be carried on in cooperation with State and municipal health authorities. A very satisfactory program of cooperation has been arranged between this bureau and the Public Health Service. The Public Health Service will report to the Bureau of Chemistry for appropriate action under the Federal food and drugs act interstate shipments of oysters which are adulterated as a result of having been produced or handled under unsanitary conditions. This bureau will continue its supervision of interstate shipments of oysters to insure compliance with the law in the matter of labeling and freedom from excess water.

BUTTER

Intensive sampling and examination of shipments of butter were undertaken by all of the field stations of the bureau during the months of maximum production and greatest traffic and again during several winter months, when the last lots in storage were being moved to distributing markets. A cooperative arrangement was effected also with trade bodies in some of the largest consuming markets, such as New York, Boston, Philadelphia, and Chicago, whereby dealers agreed to withhold from sale certain suspected shipments until examinations could be completed to establish the integrity of the product. This greatly facilitated the regulatory operations of the stations. During the year, 188 shipments which were not in compliance with the legal standard for butter or which were short in weight were seized, and 85 cases were developed for prosecution in the courts. This increase in the number of seizures effected over those reported

for 1924 does not indicate necessarily that there was a proportionately larger output of low-fat butter, but is thought to be due to perfected control measures and to the fact that the output of many creameries which had not been subjected to surveillance during former years was inspected.

EGGS

The condition of eggs shipped in the shell and in a frozen state was found to be a vast improvement over their condition in former years, thus indicating that the regulatory activities of the Federal and State authorities inaugurated some years ago, supplemented by the educational efforts of large receivers in terminal markets, have been successful in bringing about a marked reduction in the proportion of rots and spots included in shipments. Some of this improvement was probably due also to the cool weather prevailing during the summer of 1924, which had a decided influence in retarding the rate of spoilage between the points of origin and points where the products could be brought under proper refrigeration. During the year it was found necessary to invoke seizure proceedings on only 14 shipments of shell eggs and 5 shipments of frozen eggs and to inaugurate prosecution cases on 9 shipments of shell eggs.

PHARMACEUTICAL PREPARATIONS

The general survey of the more important pharmaceutical preparations, including hypodermic tablets and certain tinctures and fluidextracts, which was begun two years ago, has been continued according to the plan originally adopted. An effort has been made to obtain from each manufacturer a sufficient number of samples to be representative of his output. As many as 20, 30, or 40 samples from each manufacturer are taken if the extent of the business makes it feasible. When examination shows that a large proportion of the samples from any one manufacturer vary materially from their declared standards, the facts are referred to the courts for prosecution. In a few instances when a small proportion of the samples collected vary unduly from their declared standards, the attention of the manufacturers is called to the matter and court action becomes unnecessary. Practically all of the samples from several manufacturers complied closely with their declared standards.

Manufacturers have been kept advised of the bureau's program. This has resulted in the formation of con-

tact committees by the manufacturers' associations, through which helpful cooperation has been maintained. These committees have studied the factors involved in the manufacture of tablets as they apply to the accuracy of the finished product, and have made recommendations regarding the degree of accuracy which they regard as feasible to maintain. A proposed announcement containing this information has been sent to pharmaceutical manufacturers and trade journals. It is believed that the attention that has been given to this subject is resulting in increased accuracy of medicinal products. It is too soon to determine just what permanent improvement has been accomplished, but there can be little doubt that the medicaments manufactured in the future will, as a whole, be decidedly more accurate than those manufactured hitherto. This work will be continued until the quality of the goods on the American market is such as to render intensive investigation no longer necessary.

PROPRIETARY AND PACKAGE MEDICINES

During the year action has been continued on the products most prominently advertised to the public as kidney remedies, largely in pill form, until the market has now been fairly well covered. As a result practically all manufacturers of such preparations in any quantity have revised the labelings in compliance with law.

Attention has been given also to preparations represented as efficacious for appendicitis, diabetes, gallstones, tuberculosis, and similar serious disorders. Instances of flagrant misbranding are becoming increasingly rare as a result of the measures taken, aided by the support of public opinion, the attitude of the courts, and a better understanding on the part of the trade.

The labels of a number of misbranded veterinary remedies have been corrected.

Not the least important phase of this work consists in answering a steadily increasing number of inquiries from persons who submit their labels and formulas for criticism. These manufacturers are assisted by appropriate explanatory comment to a better understanding of the law as applied especially to their individual products. Such inquiries are being encouraged, and the proper handling of them is regarded as a valuable method of disseminating knowledge of the act's requirements, as well as of bringing labels into harmony with the law. Even though they receive no publicity, the results thus attained are regarded as important, since correction is accomplished without recourse to strictly regulatory measures.

PROSECUTIONS AND SEIZURES

The food and drug products involved in court actions instituted during the year are listed in Table 3.

TABLE 3.—Summary of prosecutions and seizures by Bureau of Chemistry during 1925

Product	Prosecutions	Seizures	Product	Prosecutions	Seizures
Alimentary paste.....	1	---	Flour.....	3	11
Apple butter.....	---	1	Fruit:	---	---
Baked products.....	4	---	Fresh.....	6	29
Baking powder.....	---	1	Canned.....	---	33
Beverages, sirups, and flavors.....	4	27	Dried.....	1	42
Chicken (canned).....	---	1	Jellies.....	20	37
Chocolate coating.....	4	---	Maple sugar.....	---	2
Coffee.....	3	6	Meal (corn).....	---	3
Colors.....	---	3	Milk (powdered).....	---	1
Confectionery.....	13	5	Nuts.....	1	27
Dairy products:	---	---	Oils.....	16	32
Butter.....	85	188	Oleomargarine.....	---	1
Buttermilk.....	1	1	Rice.....	---	3
Cheese.....	---	4	Sauce.....	---	1
Drugs:	---	---	Sirup (table).....	3	3
Crude drugs.....	3	8	Soups.....	---	1
Remedies.....	248	34	Spices and condiments.....	3	17
Eggs:	---	---	Tea.....	1	---
Shell.....	9	14	Vegetables:	---	---
Frozen.....	---	5	Canned.....	10	112
Feeds.....	131	78	Fresh.....	8	24
Fish:	---	---	Vinegar.....	1	2
Canned.....	104	106	Water.....	1	5
Shell.....	43	24			
Flavoring extracts.....	19	18		746	910

INSPECTION OF IMPORTED FOODS AND DRUGS

All consignments of foods and drugs offered for entry into the United States from foreign countries come within the jurisdiction of the Federal food and drugs act. The act provides that all consignments found to be adulterated or misbranded within its meaning or that are otherwise injurious to health are to be excluded from the country. Inspections are made, in so far as the limited personnel available will permit, of the foods and drugs offered for entry at the leading ports. As it is not practicable to inspect all consignments, attention is centered on those which there is reason to believe may be adulterated or misbranded.

COOPERATION WITH STATE AND CITY OFFICIALS

The Bureau of Chemistry in 1913, at the solicitation of State officials, created an office of cooperation, the function of which should consist mainly in acting as a clearing house for the exchange of information between State and city officials and the bureau.

After a period of 12 years, the bureau is thoroughly convinced of the wisdom of this policy, which has resulted not only in providing useful information of an official character to State and city food and drug officials but also in a distinct saving in the bureau's funds. This has been accomplished by the willingness on the part of local officials to assist directly in the work of the Federal officials. Particularly in districts where long and expensive travel is involved, the local officials have been able in many instances to perform the work as well as the bureau's inspectors could, thereby saving transportation and subsistence expenses.

STAFF CONTROL LABORATORIES

In order to develop basic information for the guidance of administrative officials in the enforcement of the food and drugs act, the bureau maintains staff laboratories in Washington. These laboratories make scientific investigations relating to the composition, manufacture, storage, preservation, and methods of handling food and drug products. They develop methods of analysis for detecting adulteration and misbranding and furnish information to be used in planning regulatory campaigns. They review cases developed by the field force when special technical questions are involved. They assist the field force in

planning and carrying out surveys and campaigns to bring about compliance with the food and drugs act. The results of their work are reflected in the progress made on the regulatory projects. Some of the main lines of work for 1925 in which they assisted have already been outlined; mention may be made of other investigations carried on by them during the year.

FOOD-CONTROL INVESTIGATIONS

A study was made of the Maine sardine industry for the purpose of getting definite information on the conditions under which sardines are packed, to find the cause of the deterioration of "feedy" fish, and to determine the significance of hydrogen sulphide in canned sardines. Results of the work indicate that decomposition of "feedy" fish is primarily not putrefactive but enzymic. The presence of hydrogen sulphide in canned sardines is indicative of decomposition. The results of a study on the canning of Atlantic coast soft clams will shortly be published. An investigation of the hard-clam packing industry was made and studies of the fill-of-can of tuna fish were completed.

Much work was done on canned fruits and vegetables, including the preparation of experimental packs of string beans and tomatoes, to determine the composition of the gas in the head space.

The details of a rapid and accurate method for the determination of fat in cacao products were established and the results published. Work was begun on methods for the determination of milk solids in cacao products, special attention being given to methods for estimating casein or milk proteins. A formula for making cocoa bread was published.

Results of the year's study on the composition of alimentary pastes and the raw material used in their manufacture were published. Work on the moisture content of flour was continued.

A study was begun of the changes in the fat characteristics of cheese brought about by the ripening processes. Methods for the determination of moisture in milk powder were studied, and data on jams, jellies, and preserves were collected. Reports on baking powder, cereals, eggs and egg products, and fruit and fruit products were made to the Association of Official Agricultural Chemists. Assistance was rendered in the development of a standard experimental baking method for hard wheat flours for the

purpose of unifying and standardizing experimental baking tests now in use and making possible a comparison of results obtained by different bakers.

METHODS OF ANALYSIS OF DRUGS

Methods of analyzing drugs, particularly the assay of certain alkaloidal drugs, have been studied. Apparatus for the improvement of the processes has been devised and described in technical journals. Some of the results obtained reported in journal articles include the effects of various factors in the assay of nux vomica, belladonna, and ipecac preparations. This work is to be continued, with special attention to the assay of hyoscyamus. Very delicate methods for the detection and identification of certain phenols have been devised and published.

MICROBIOLOGICAL INVESTIGATIONS

A study of the mold group *Aspergillus*, begun about 20 years ago and systematically followed throughout this period, has been completed for publication. Molds of this genus are exceedingly abundant in food, in feedingstuffs, in stored grain, in hay, and in fodder, and even occur as human and animal parasites. In spite of their importance and abundance, however, no critical study of the whole group existed in English and none had been published in any language for more than 20 years. Studies of sections of the group are to be found in publications from the microbiological laboratory and in French and German. The study of a collection of about 350 living cultures from many sections of America, from Europe, and from the Orient has been supplemented by the examination of herbaria, by the comparison of many specimens and cultures which were not kept in the living collection, and by a careful review of the literature. This made possible a systematic arrangement of the available information on the whole group and a reliable nomenclature of great sections of the group not hitherto well known. The results of this study, which will be published in book form, cover the morphology and physiology of these molds, their biochemical activities, their use in the industries as agents in the fermentation of tannins, in the fermentation of sugar to citric acid, and as sources of enzymes, and their appearance and significance in human and animal disease.

During the year an intensive study was made of the causes and conditions

incident to "spontaneous" heat production in masses of stored feeds and feedingstuffs.

A problem of spoilage in canned food, especially as it related to botulism, involved the examination of 3,000 cans of ripe olives in connection with poisoning cases during 1924 in Wyoming. No *B. botulinus* infected cans were found among these. Bacteriologically this survey showed that in spite of all efforts to attain sterilization the packers of olives have not succeeded in attaining 100 per cent sterility in their product. The dealer and consumer therefore should continue to take precautions to prevent the consumption of spoiling olives.

A peculiar type of decomposition in shrimp, involving extensive disintegration, was frequently found. An investigation is being made to determine at what point the pack of shrimp must be protected from the entrance of the microorganism that causes this decomposition.

An investigation was made of the cause of the fermentation in chocolate-coated candies that results in large losses from bursting. Work already done having indicated the probability that such fermentation might be due to yeasts of certain sugar-tolerant species, methods were developed which made it possible to isolate these organisms when present. Many yeasts were present in practically every lot of burst chocolates examined, but comparatively few bacteria or molds were found. Examination showed that some of the yeasts were capable of growth and fermentation in concentrations approximating those of the candies in question. The manufacture of experimental lots of candy, both infected and uninfected, made it possible to show that such sugar-tolerant yeasts were responsible for the losses.

In a study of the classification of the bacteria in food products, a paper was published describing the organisms in sweet corn, beginning with the field and following the product through to the packed can.

Enteric outbreaks not traceable to known organisms or to conditions definable closely enough to form the basis of preventive measures have been reported frequently. In the study of such an outbreak from cheese the bacteriologists of the bureau were able to isolate an organism not hitherto reported in America but capable of producing similar reactions in cats. This opens a new field in the explanation of bacterial food poisoning, which should eventually lead to the reduction of suffering of this type.

MICROCHEMICAL INVESTIGATIONS

The study on microscopical methods for the determination of shell in cacao products, started some years ago, has been continued. The study of acacia, citrus, fireweed, cotton, and tupelo honeys has been completed. One of the facts brought out by the alfalfa investigation is that honey of some varieties contains only a little of the pollen from the plants which are supposed to be the source of the nectar. Microscopic studies of several stock-feeds have been made. One of these was a locust meal which originated in South Africa and consisted of the dried powdered bodies of locusts. The character of white wheat middlings was studied.

The crystalline phase of candy fondant has been investigated to determine the size of the crystalline particles in fondant and correlate this finding with some of the organoleptic characteristics, such as graininess or staleness. The compilation of optical-crystallographic data for the International Critical Tables, under the supervision of the National Research Council, has been completed and will be published at an early date. A paper on the optical properties of some amino acids was published during the year.

PHARMACOLOGICAL INVESTIGATIONS

Great variations from the physiological potency recommended in the Pharmacopœia exist in certain "bio-assay" drugs. More than 300 samples of these drugs, widely used in medicine, including aconite, cannabis, digitalis, strophanthus, squill, ergot, epinephrine, and pituitary solution, were tested. They can not be assayed chemically, but must be tested by determining their physiological effects upon various animals. Only about one-fourth of the samples tested fell within the prescribed range. Some of the products tested were 200 to 300 per cent of the theoretical strength; others were more than 90 per cent deficient. These marked variations from the theoretical standard were found in the products of both large and small

manufacturers. Practically all of the large manufacturers now maintain bio-assay laboratories and test at least a part of the drugs of this class which they manufacture. It is believed that the work done by the bureau will result in a marked improvement in the uniformity of these drugs.

Experiments on the pharmacology of tin and on the effect of sulphur dioxide were continued. The toxicity of thallium sulphate to rats was studied for the purpose of assisting the Bureau of Biological Survey in developing the use of this substance for poisoning rats. Tests have indicated that the authentic American-grown cannabis crop is fully as active as authentic imported Indian cannabis.

PUBLICATIONS ISSUED

Six Department Bulletins, 2 Farmers' Bulletins, 1 revision of a Department Circular, 3 articles in the Journal of Agricultural Research, 3 food-inspection decisions, 1,250 notices of judgment, and 114 articles in scientific and technical journals were published during the year.

The Department Bulletins are: No. 1250, "Relation Between the Composition of California Cantaloupes and Their Commercial Maturity," by E. M. Chace, C. G. Church, and F. E. Denny; No. 1255, "Inheritance of Composition in Fruit Through Vegetative Propagation: Bud Variants of Eureka and Lisbon Lemons," by E. M. Chace, C. G. Church, and F. E. Denny; No. 1307, "Absorption and Retention of Hydrocyanic Acid by Fumigated Food Products: Part II," by E. L. Griffin and E. A. Back; No. 1312, "Loss of Nicotine from Nicotine Dusts During Storage," by C. C. McDonnell and H. B. Young; No. 1313, "Fumigation Against Grain Weevils with Various Volatile Organic Compounds," by I. E. Neifert, F. C. Cook, R. C. Roark, W. H. Tonkin, E. A. Back, and R. T. Cotton; and No. 1323, "Citrus Pectin," by H. D. Poore.

The Farmers' Bulletins are: No. 1438, "Making Fermented Pickles," by Edwin LeFevre; and No. 1452, "Painting on the Farm," by H. P. Holman.

