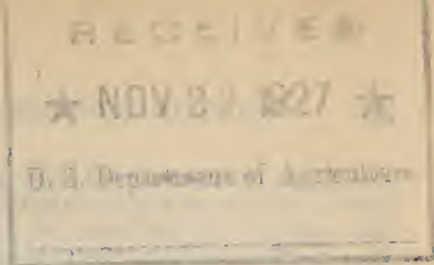


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1926/27

## REPORT OF THE CHIEF OF THE BUREAU OF CHEMISTRY

UNITED STATES DEPARTMENT OF AGRICULTURE,  
BUREAU OF CHEMISTRY,  
Washington, D. C., June 30, 1927.

SIR: I beg to submit herewith the report of the work of the Bureau of Chemistry for the fiscal year ended June 30, 1927.

Respectfully,

C. A. BROWNE, *Chief.*

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

### INTRODUCTION

The present report of the Chief of the Bureau of Chemistry is the last to be submitted for this bureau as an independent departmental organization. It is therefore appropriate at this time to make some reference to the early development of the chemical work of the department and to the indications for future progress in this field.

In the act of Congress for 1862 for establishing a Department of Agriculture, it was enacted, in section 4, "That the Commissioner of Agriculture," in addition to the appointment of a chief clerk and other employees, "shall, as Congress may from time to time provide, employ other persons, for such time as their services may be needed, including chemists, botanists, entomologists, and other persons skilled in the natural sciences pertaining to agriculture."

In the first report of the Commissioner of Agriculture to President Lincoln, Isaac Newton called attention to the importance of chemistry to agriculture. As a basis for this opinion he referred in the following words to the action of the Board of Agriculture of Great Britain, appointed by Prime Minister Pitt in 1793: "More than all, the board was instrumental in employing Sir Humphrey Davy to make those experiments which are not only an honor to intellect, but which established agricultural chemistry as a department of science and of inestimable value."

In accordance with his view of the primary importance of chemistry to agriculture, Commissioner Newton appointed as the first scientific employee of the newly created department the distinguished chemist Charles M. Wetherill, already well known for his investigations upon the chemistry of agricultural products. Doctor Wetherill's report as chemist of the department for January 1, 1863 (Department Report, 1863, pp. 508-540), the first and only scientific report to be submitted during the first year of the department's activities, marks the inception of chemical research in the department. It describes investigations along several important lines, such as the composition of American grapes, a chemical study of sorghum, sorghum sirup and sorghum sugar, and analyses of sugar-cane products. After Doctor Wetherill's resignation in 1863 chemical investigations were initiated by his successor, Henry Erni, upon soils, fertilizers, sugar beets, and fermentation. Thomas Antisell, who became chemist of the department in 1866, started investigations upon marls, greensands, and phosphates in 1867, upon tanning materials and sweet potatoes in 1868, and upon peanuts, meat extracts, and foods in 1869. In his report for 1869 Doctor Antisell called attention to the extensive adulteration of fertilizers and feedstuffs and to the need of controlling the purity of these products by chemical supervision. The future chemical regulatory activities of the department

are here foreshadowed for the first time. It is seen that, notwithstanding the serious distractions of the Civil War period and the very limited provisions for scientific research, a broad foundation was laid before 1870 along many lines for the future chemical work of the department.

After Doctor Antisell's resignation, chemical investigations were begun by Ryland T. Brown in 1871 upon cassina and in 1872 upon the agricultural value of sewage. William McMurtrie, the next chemist of the department, initiated investigations upon cereals in 1873, upon insecticides in 1874, upon sugar corn in 1875, upon bat guano in 1876, and upon the chemistry of mildew and rot in 1877. Peter Collier, chemist of the department from 1878 to 1883, in addition to various items previously mentioned, made chemical examinations of waters, baking powders, tea and coffee substitutes, butter and oleomargarine, veterinary medicines, grasses, and numerous other products employed or produced by agriculture. Doctor Collier made also extensive investigations upon the production of sirup and sugar from corn and sorghum. His work upon sorghum is the most extensive chemical investigation of this crop which has ever been performed.

In 1883 Doctor Wiley was appointed chemist of the department, and the impress which he gave to the chemical work of the Department of Agriculture and to agricultural chemistry, during the 29 years of his Governmental service, has been of a lasting character. The chemistry division of the department, when Doctor Wiley assumed its direction, was located in two small rooms in the basement of the old agricultural building and had a personnel of only 3, which number had expanded at the time of his resignation in 1912 to over 500.

In 1883 the first bulletin of the chemical division of the Department of Agriculture was issued. This related to the composition of American wheat and corn and was the precursor of a long series of bulletins dealing with the chemistry and technology of American food products. The best known of this series was the important Bulletin 13 upon foods and food adulterants, of 1,417 pages, dealing with the chemical composition, technology, and adulteration of dairy products, spices, fermented beverages, lard, baking powders, sugar, molasses, confections, honey, tea, coffee, cocoa, canned vegetables, cereals, and pre-

served meats. The publication of the 10 parts of Bulletin 13 extended over a period of 15 years, from 1887 to 1902. The wide attention called to the practice of food adulteration by the various parts of this bulletin was an important factor in the movement which led to the final passage of the Federal food and drugs act in 1906.

The division of chemistry was created a bureau of the department in 1901 and it was to the Bureau of Chemistry that Congress assigned the execution of the Federal food and drugs act. These new regulatory activities, which were a direct consequence of long, extensive research, led to the establishment of numerous branch laboratories of the Bureau of Chemistry, in different cities of the United States. The regulatory work of the bureau was still further enlarged by its being intrusted in part with the execution of the Federal insecticide act of 1910, which was also a result of the previous research work of the bureau upon the chemical composition and adulteration of insecticides, germicides, and fungicides.

Coincident with these investigations upon foods, insecticides, etc., the Division, and afterwards the Bureau, of Chemistry performed a large amount of work in collaboration with the Association of Official Agricultural Chemists upon the improvement of methods for the chemical analysis of agricultural products. The results of this work are contained in the Proceedings of the Association of Official Agricultural Chemists (the first 29 volumes of which were published as bulletins of the Division, or Bureau, of Chemistry) and in numerous bulletins upon methods of analysis. The contacts between the chemists of the department and of the various State institutions secured by the meetings of the Association of Official Agricultural Chemists have been of the greatest value in promoting the advancement of agricultural chemistry along both research and regulatory lines.

The chemistry division of the Department of Agriculture was not only the first Federal agency to investigate the chemistry and technology of soils, fertilizers, cattle feeds, insecticides, and the various food products derived from cereals, sugar crops, fruits, vegetables, meats, fish, poultry, and milk, but it was the earliest to make chemical studies upon forestry products, naval stores, paper, leather, tanning materials, dyestuffs, paints, varnishes, denatured alcohol, and many

other materials of industrial importance. The department's division of chemistry, as originally conceived and developed, was the agency in which all the chemical work of the Government should be performed, but with the rapid expansion of scientific work in other bureaus of the various Federal departments this plan became too extensive for practical continuance. The relation of chemistry to agriculture and industry in both America and Europe had been gradually changing from that of an independent to that of a cooperating science. As stated in my report for 1924, "An increasing need for chemists was felt in every branch of governmental service, with the result that chemical work on contract supplies, soils, road materials, forestry products, dairy products, meat products, and other commodities, which had been initiated by the Bureau of Chemistry was gradually taken over by Federal agencies that were specifically charged with the investigation of these materials."

Coincident with this general realignment of chemical activities in Federal and State institutions, another movement had been slowly gathering headway—the complete separation of research and regulatory work. These two lines of activity were recognized in European countries to be so different in purpose and method that their complete segregation under different administrative offices, with different laboratories and personnel, was effected a half century ago. Research and regulatory work demand the attention of officials of entirely different qualifications. The regulatory chemist, because of the detriment of delayed decisions to industry and commerce, is obliged to form his conclusions quickly, although in some cases these decisions may be wrong. The research chemist, on the other hand, must form his conclusions with more deliberation because of the necessity of verifying his work by all the possible checks at his disposal. The regulatory chemist, owing to the demands of law enforcement, limits his attention to the small percentage of products which constitute infractions of certain State or Federal enactments and ignores the vastly larger percentage of products which meet the requirements of those acts. The research chemist, on the other hand, is concerned more with the rendering of service to industries whose products are of the latter class.

On account of the interferences of the regulatory work with the research activities of the agricultural experi-

ment stations, many of the latter have either transferred all their law-enforcement work to State officials or have established independent laboratories, where the two lines of work can be conducted with less interference. A few experiment-station directors, however, are still of the opinion that some connection of the station with regulatory work upon fertilizers, cattle feeds, human foods, insecticides, etc., is advisable, not only for the benefit of the agricultural contacts, but because of the unfortunate degeneration of the regulatory work in some States where it has lost contact with research and scientific control.

The movement of separating the chemical research and regulatory work of the Bureau of Chemistry was longer deferred than elsewhere on account of the extremely close connection which has existed between these two branches of the service, and perhaps also because of the recognized efficiency with which each line of work was directed. Previous to 1906, when the Federal food and drugs act was passed, the work of the Bureau of Chemistry was exclusively along research lines, and it was upon the basis of such research that chemical methods were developed for the detection of adulteration, that the prevalence of sophistication in foods, drugs, insecticides, and naval stores was ascertained, and that laws were finally passed for correcting these abuses. After the passage of the various regulatory acts that were entrusted to the Bureau of Chemistry for execution, parallel lines of research and law-enforcement work were initiated that have been in many ways mutually beneficial. Chemical research has enabled the regulatory branch of the service to assist manufacturers in meeting the requirements of law enforcement; the regulatory service, on the other hand, has assisted chemical research by its suggestion of urgent practical problems, with the avoidance of lines of investigation that were too academic or visionary. It is hoped that with the separation of the research and regulatory activities of the Bureau of Chemistry under separate administrative offices the advantages of the old system of close collaboration between the chemists engaged in these two lines of work may so far as possible be maintained.

It can not be denied that with the enormous extension of the regulatory work of the Bureau of Chemistry since 1906 in the enforcement of the Federal food and drugs act, the insecticide act, the tea inspection act, and the

naval stores act, the expansion of its former research activities has greatly suffered. This has been due to the inability to obtain proper financial support for much-needed investigations in competition with the very urgent need of funds for the inspection and police work. The amount of the appropriations expended by the Bureau of Chemistry for regulatory work during the last fiscal year was \$1,111,385, while that expended for research was only \$380,221. The only possible inference to be drawn from these figures is that the quantity (but not the quality) of the research work of the Bureau of Chemistry has been overshadowed by the development of its regulatory operations.

The chemical researches of the Bureau of Chemistry upon the utilization of agricultural wastes; upon the prevention of losses of agricultural products from deterioration and from the effects of fires and other destructive agencies; upon improvements in the chemical technology of foods and other agricultural products; upon the development of better methods of agricultural chemical analysis; and upon fundamental investigations concerning the carbohydrates, proteins, fats, waxes, essential oils, tannins, glucosides, organic acids, and other constituents of agricultural products, should be greatly amplified and extended. It is hoped that these research activities of the former Bureau of Chemistry, which form the branch of "chemical and technological research" in the newly constituted Bureau of Chemistry and Soils, may undergo a new period of enlargement and growth commensurate with the importance of such investigations to agricultural science and with a continuance of the same spirit and aims which have made the name of the Bureau of Chemistry universally known for its long splendid record of service and accomplishment.

#### RESEARCH

In line with the purpose for which the Bureau of Chemistry was created, research in agricultural chemistry was continued during the fiscal year, with the following outstanding results.

#### CROP CHEMISTRY

Research was directed toward the improvement in quality of wheat and rye, special attention being given to the relation of the spacing of rows to yield and composition of grain. The influ-

ence of soil acidity on the yield and composition of lettuce and other green vegetables was also studied. The principles governing absorption by plants of potassium and phosphorus were investigated by growing seedlings in solutions of compounds of these elements.

Studies were made of the chemical changes in tomato seedlings during their growth, with transplanting, in the greenhouse before transfer to the field. Some of the plants were set out in tiles which had been buried in the ground and filled with soil of different reactions from the fields at Welcome, Md., where a similar study was conducted two years ago, in order to find out whether or not the influence of soil reaction on growth would be the same under different surroundings.

An electrical-measuring equipment has been installed to facilitate the determination of soil reaction, formerly done colorimetrically only. Extensive trials of the quinhydrone-electrode method of making these determinations have given results that agree with those obtained by the colorimetric method. Henceforth these two methods will be used in parallel.

#### FRUIT AND VEGETABLE CHEMISTRY

Since its establishment in 1913, the laboratory at Los Angeles, Calif., has worked out methods for the utilization of cull and surplus fruits, for the detection and elimination of frosted citrus fruit, and for the determination of maturity of citrus fruits, cantaloupes, and pomegranates. It has also aided materially in establishing standard grades for raisins.

#### BY-PRODUCTS

During the last year, a device for the mechanical production of lemon oil was developed, and studies on the composition of California citrus oils were continued. The by-product work has included also the production of pomegranate juice and jelly and has been extended to include problems in the bottling and canning of cider. As a result of this work, both pomegranate juice and jelly are on the California market and bid fair to become standard products throughout the country.

#### MATURITY STANDARD

A maturity standard for pomegranates was developed and submitted to the Pomegranate Growers Association.

with the result that it is now a part of the California standardization law. This standard limits the acidity to 1.85 per cent of anhydrous citric acid and the color of the juice as equal to or exceeding 20 red+1 yellow on the Lovibond scale.

#### FROSTED FRUIT

Opportunity for further work on the problem of setting satisfactory standards for the control of the shipment of frosted fruit was afforded by the disastrous freeze in Florida last January. A branch laboratory was established at Orlando and many of the methods which had previously been developed were tested under Florida conditions. Among the most satisfactory tests that have been developed for keeping frozen fruit from the market is one depending upon the volume of juice yielded by partially damaged oranges.

#### COLORING FRUIT

Prior to 1923 work was done on the problem of coloring mature oranges and lemons. In that year a method using ethylene was perfected and patented. Because of the importance of the effect of this process on the composition of fruit and vegetables data were accumulated, which indicated that the process brought about little or no change in the edible portion of the fruit. Since that time the coloring effect of ethylene has been tried on other products, including avocados, bananas, dates, persimmons, and tomatoes. Although the data are meager, they do not indicate a material change in composition except in persimmons, the tannin in which seems to be rendered insoluble or decomposed.

The method for coloring citrus fruit by means of ethylene has been generally adopted in California and Florida. The process requires a temperature of from 65° to 80° F., so that during the winter months it is often necessary to raise the temperature of the fruit. This is usually done by kerosene stoves, the combustion gases of which are themselves coloring agents, which makes the use of ethylene unnecessary. However, in many places the stoves are used only to raise the temperature, and they are extinguished at night. Using ethylene instead of stoves at night eliminates the fire risk of a kerosene stove and the need for a watchman. Studies of the application of the process to coloring other fruits and vegetables are being continued.

#### INHERITANCE THROUGH VEGETATIVE PROPAGATION

The inheritance of composition from one generation of fruit to the next through vegetative propagation is being further studied. The data on the variants of the Washington navel orange are being compiled and the report is in course of publication. The investigations are being continued with the Eureka and Lisbon lemons. Some work has also been done on the composition of the California loquat.

#### COMPOSITION OF COTTON PLANT

In collaboration with the Bureau of Plant Industry, a study of the composition of the leaves of the cotton plant has been undertaken to discover, if possible, the reason for thrips attacks on cotton plants that have been insufficiently irrigated.

#### SULPHURED FRUIT

In cooperation with the Dried Fruit Association of California, an attempt is being made to reduce the quantity of sulphur dioxide remaining in dried apricots, peaches, and pears. It is hoped, as a result of these investigations, not only to reduce greatly the quantity of sulphur dioxide used to preserve the fruit, but possibly to eliminate its use entirely. Preliminary studies indicate that the combination of sulphur dioxide with the constituents of the fruit is unstable, especially the combinations with the coloring matter. The effects of heat, of pressure, and of vacuum on the sulphur-dioxide fixation have been studied. It is hoped that the foundations have been laid for materially changing the details of the process. Already it has been found that inactivation of the peroxidase of the fruit is correlated more closely with heat than with sulphur treatment. Bromine, chlorine, nitric oxide, and carbon dioxide impregnations have not been found suitable substitutes for sulphur dioxide.

#### PICKLES

For many years the bureau has conducted investigations, with a view to improving methods of converting vegetables into pickles.

During the last year the effect of certain salts that occur in natural waters on the fermentation and curing of cucumbers was determined. Brines containing calcium sulphate, calcium carbonate, magnesium chloride, cal-

cium chloride, ferrous sulphate, and sodium nitrate all had an unfavorable effect, calcium sulphate and calcium carbonate apparently having the least unfavorable influence. Calcium chloride materially retarded the curing process and sodium nitrate made the pickles unfit for use. The iron salt, even when present in comparatively small proportions, had a darkening effect. These experiments showed that (1) the less salt, other than sodium chloride, a brine contains, the better the pickles will be, (2) under experimental conditions at least 60 days are required for the thorough curing of cucumbers, and (3) under experimental conditions a 40° brine will not prevent for very long the spoilage of pickles held at temperatures as high as 25° to 30° C. (77° to 86° F.).

The flavor of dill pickles to which only dill weed had been added was superior to that of pickles to which mixed spices and vinegar, as well as dill, had been added. Apparently, however, the vinegar, by increasing the acidity, aided in preserving the product. In one experimental lot, to which nothing but 2 per cent of cerulose was added, a yeast fermentation rather than a lactic fermentation was soon evident.

#### SAUERKRAUT

The control of the organisms involved in the preparation of sauerkraut was studied. The results have been incorporated in a manuscript to be published as a technical bulletin of the department.

#### PRODUCTION OF ORGANIC CHEMICALS BY FERMENTATION

A series of experiments with about 175 varieties of molds resulted in the discovery of one strain which, when grown on solutions of glucose, will produce only gluconic acid. Gluconic acid has been in the past one of the rarer chemicals and it is hoped that, following the development of a method for its production at a price which will allow it to compete with citric, tartaric, and other organic acids, some industrial use may be found for it. It has been suggested that it may be used as a beverage acid or may possibly replace lactic acid in the plumping of hides and the dyeing of silks. The investigation on this process has taken the form of determining the optimum conditions for the fermentation of glucose, and yields of gluconic acid as high as 70 per cent

of theory have been obtained. This subject is of great theoretical as well as practical interest, as it is believed that the production of organic chemicals by the fermenting action of molds will be one of the great industrial developments of the next few years. Figures obtained in this investigation may possibly serve as signposts for future work in this field.

#### FARM AND INDUSTRIAL WASTE UTILIZATION

At the experimental plant erected at Arlington, Va., in 1920, for the purpose of solving basic problems of the dye industry, and of conducting other technological researches, various methods of utilizing farm and industrial wastes have been tried out during the last few years. The outstanding results in this field for the fiscal year just ended are the development of a new metal cleaner and a new paint thinner from industrial wastes and progress in discovering some means of utilizing certain farm wastes.

#### INDUSTRIAL WASTES

p-Cymene, a waste by-product in the manufacture of paper pulp, the production of which is estimated at more than a million gallons annually, has proved to be a good thinner for paints, varnishes, and lacquers, and also to lend itself to the preparation of a black resinous compound insoluble in acid, alkali, and alcohol, having excellent insulating properties. o-Dichlorobenzene, a by-product in the manufacture of chlorobenzene, was shown to be an excellent cleanser for metals. A study of the formation of 2-3 dichloro-anthraquinone by the condensation of o-dichlorobenzene and phthalic anhydride by means of the Friedel-Craft synthesis has been carried out on a semiplant scale, and certain optimum conditions for this reaction determined. This work has not yet been completed; methods for the purification of the 2-3 dichloro-anthraquinone prior to its further utilization are still being investigated.

#### FARM WASTES

The chemical problem involved in the utilization of short-fiber cellulose is in general the same for all farm wastes. In an effort to work out a solution with a distinct bearing on all such wastes, peanut hulls, which are easily obtained from factories where the kernels are utilized, were selected.



A series of experiments have produced a cellulose pulp which promises well as a raw material for rayon, except that it is high in ash. Efforts to reduce the ash content have resulted in the degradation of the alpha cellulose. The problem then is to discover some method of removing ash that will have no bad effect on the alpha-cellulose content of the pulp. An attempt is now under way to extract the soluble materials in peanut shells, determine their composition, and work out some fermentation method for transforming them into a useful substance.

#### LIGNIN

The investigations initiated by the bureau in 1920 upon the utilization of corncobs and other agricultural wastes for the production of the chemical furfural are now being applied commercially, and the bureau is studying the technical utilization of corncobs, cornstalks, straw, and other agricultural wastes in other ways. An important constituent of these products, now almost entirely wasted, is lignin, which makes up from 20 to 30 per cent of the dry material. The bureau has succeeded in converting lignin into varnishes, dyestuffs, and various aromatic chemicals that give great promise of commercial utilization. Lignin may be called the greatest of all unutilized agricultural wastes and it occupies with respect to industrial possibilities the position held by coal tar a century ago. An article upon lignin from corncobs (*Jour. Amer. Chem. Soc.* 49, 2037) has been published, and other contributions upon the subject are in course of preparation.

#### GOSSYPOL

A research fellowship, established by the Interstate Cottonseed Crushers Association, is devoted to an investigation which is being conducted in the laboratories of the bureau upon gossypol—a poisonous phenolic constituent of cottonseed. The presence of gossypol in cottonseed meal has resulted occasionally in the death of farm animals which have ingested too large a quantity of this substance. The results thus far obtained under this fellowship have thrown new light upon the chemical constitution of gossypol. When this phase of the problem has been solved experiments will be made upon the application of the information to the detoxification of cottonseed products.

#### FOOD AND TECHNICAL MICROBIOLOGY

Work on the monograph on the fungus genus *Penicillium* is in progress. The discussion of the genus, preparation of species descriptions for known forms and also for forms recognized only in the literature, the bibliography, and special line illustrations have been completed.

Physicians from New York to Georgia and west to Nebraska have been assisted in cases where human disease due to fungi was suspected. The first catalogue of the American Type Culture Collection (for 1927) indicates the successful maintenance of about 200 viable cultures of fungi which are now accessible to universities, physicians, and plant pathologists.

Studies to determine the cause of the bursting of chocolate-covered cream candies were conducted, in an effort to assist the confectioners to cut down the loss suffered each year from this cause. It was found that the activities of sugar-tolerant yeasts cause this bursting. A paper reporting the results appeared in *Industrial and Engineering Chemistry*, volume 19, page 353 (March, 1927), and was reprinted in the *Manufacturing Confectioner* for May, 1927.

#### SIRUP AND SUGAR

Nearly all the results of the bureau's work on carbohydrates done during this fiscal year have been reported in articles submitted for publication in various trade journals. These results may be summarized as follows.

#### NEW BLENDING SIRUP

Investigation of the production of unsulphured cane sirup of good quality from low-purity cane juice, in conjunction with cane-sugar manufacture, was continued. A good blending sirup was produced, and it is believed that the quality of this sirup can be further improved. In preparing it a method of filtration with diatomaceous earth and treatment with decolorizing carbon was followed. A quantity of blended sirup of good quality made from low-purity cane juice and low-purity refinery sirup was prepared and distributed by a cooperating cane-sugar producer.

#### CANE CREAM

The work on cane cream mentioned in last year's report was continued. Production of cane cream was undertaken on an industrial scale in coop-

eration with a cane-sugar producer in Louisiana. Several hundred cases were made, and commercial distribution was arranged in cooperation with a cane-sirup company for the purpose of learning the reaction of the consuming public toward this new product. Cane cream has a semisolid consistency, and from a physical standpoint consists of a mixture of sirup and microscopic sugar crystals. It is intended to be used as a spread on bread, sandwiches, griddle cakes, waffles, etc.

The development of new products from sugar cane tends to diversify its utilization and affords a greater flexibility in meeting variable market conditions, a matter of prime importance to the sugar-cane industry of the continental United States. This investigation illustrates the manner in which chemical technology can be applied for the purpose of facilitating the marketing of agricultural products, to the material profit of the producer.

#### CARAMELIZATION OF SUGAR

Investigation of the cause of the low caramelization point of some commercial sugars has revealed the fact that there are a number of impurities which may be responsible, even when present in minute quantities. Among them are phosphates, compounds of iron, oxidation products of carbohydrates, other organic impurities, and possibly colloidal substances in the sugar. No one of these is the sole cause, so far as is known at present. Amino acids and related compounds, if present, also increase caramelization, but investigation by means of a test developed during this work showed that amino acids are usually eliminated during the process of purification of the juice and crystallization of the sugar.

#### CONTROL OF LIMING

The work started last year for the purpose of devising a means of automatic control of the liming of cane juice in the production of raw cane sugar was practically completed. In cooperation with a raw cane-sugar factory, an experimental installation was operated during the season of 1926. This installation included apparatus for measuring electrometrically and recording continuously the pH values of the juice, and also accessory equipment to control automatically the addition of lime so as to maintain any desired constant pH value. Satisfactory results were obtained, and the

working out of a few details is all that is required for the practical functioning of this method of control. Accurate control of the addition of lime overcomes the deleterious effects of an uneven reaction in the clarification of cane juice. It results in a greater elimination of impurities, increased rate of crystallization, and an additional recovery of sugar and an improvement in its quality. These are important considerations if maximum production and high quality are to be maintained.

#### CLARIFICATION OF CANE JUICE

An investigation was made of the various factors which influence the efficiency of the defecation of cane juice by the use of lime. In order to determine its relation to elimination of colloids, rate of settling of flocculated material, lime salts formed in the defecated juice, etc., special attention was given to the pH value at which the juice is limed. These factors were also considered in relation to the phosphate content of cane juice. Both small-scale and factory tests were made in which phosphate in appropriate form was added to juice deficient therein, and the beneficial effects due to greater elimination of colloidal material were measured by appropriate methods, including the dye test and ultrafiltration. In cooperation with the Porto Rico Agricultural Experiment Station, a series of experiments was made with juice from cane harvested from experimental plots from the same field on which fertilizers in various combinations had been applied. Some information was thus obtained which indicated the effect of different fertilizer constituents on the tonnage of cane and purity of juice, and likewise the effect of phosphate fertilizers from the standpoint of increasing the phosphate content of the juice as well as affecting the tonnage and sucrose content of the cane. This is of significance in view of the important part played by the natural phosphates of the juice in clarifying it by the use of lime as a step preliminary to the crystallization of sugar. Valuable information was also obtained on the quantity and type of colloids present in so-called refractory juices, such as those obtained from burned cane or cane that has deteriorated after being cut. It is believed that these data can be applied to overcoming the difficulty encountered in clarifying refractory juices.

Another investigation resulted in determining the proper conditions for adding lime to the mud obtained in the defecation of cane juice in order that this mud may be filtered readily without the formation of excessive lime salts or deflocculation of the mud. It was found that the treatment of the mud with lime is frequently not properly controlled. Some of the flocculated material is often peptized and placed in colloidal solution by this treatment, with the result that the colloid content of the filtered juice is actually increased, thus nullifying part of the beneficial results of previous defecation. In such cases the percentage of lime compounds in the juice is increased and they are present to a great extent in objectionable colloidal form, with resulting increase in viscosity of the juice. Data were obtained also regarding the relative advantages of single and double defecation, in order to compare the two methods from the standpoint of colloid elimination and formation of lime salts in defecated juice.

#### COLLOIDS IN PLANT JUICES

In preparing cane and beet juices for recovery of sugar by crystallization as in the customary procedure, nonsugar substances in the colloidal state interfere greatly with crystallization of the sugar, and removal of this material from the juice to the greatest extent possible is a critical step in the process of sugar production. It is therefore important that suitable methods be available for measuring, at least approximately, the quantity of colloids present in the original juice and at later stages of the process, in order to ascertain the extent of colloid removal and to serve as a guide to the improvement of the process. By improving a method used in soil-colloid investigations, it became possible for the first time to estimate the approximate quantity of colloids in sugar-plant juices under industrial conditions. This method, termed the "dye test," depends upon the use of the positively charged dye "night blue" to neutralize electrically the negatively charged colloids of the juice or sugar liquors. By the aid of this method, together with ultrafiltration, it has been found that the colloidal material in both cane and beet juices varies materially, depending upon such important factors as soil conditions and the variety and maturity of the sugar cane or sugar beets, as well as upon

any deterioration between the time of harvesting and extraction of juice from the sugar plants. Ultrafiltration by means of standardized collodion membranes has revealed important differences in the character, as well as in the quantity, of the colloids in sugar-plant juices. This explains why some juices are clarified with greater difficulty than others, and suggests the direction in which a remedy for this condition may be sought. It has been found also that the dye value is an accurate index of the refining quality of raw cane sugar (aside from the influence of salts), thus demonstrating the fact that these differences in refining quality are due to nonsugar contaminants in colloidal form. The dye test may be used to predict the behavior of raw cane sugar in the refinery, and when correlated with observations in the raw-sugar factory will indicate means for improving the quality of raw sugar.

A method was devised whereby the clarification of starch conversion liquors in the production of corn sirup and particularly corn sugar may be improved. It was found that, contrary to the rule with cane and beet juices, the colloids in acid cornstarch-conversion liquor bear a positive electric charge. They may therefore be removed by mutual flocculation by adding an appropriate colloidal material which bears a negative electric charge when present in the liquor. It was found that this could be accomplished by the use, for instance, of certain aluminum compounds, such as sodium or calcium aluminates, or the natural clay bentonite. Experiments with bentonite showed that the elimination of colloids could be increased greatly over that obtained by the usual treatment of the acid-conversion liquor with sodium carbonate.

#### DECOLORIZING CARBONS

Further investigation was made of the action of bone char and other decolorizing carbons on sugar-plant colloids. In the case of raw cane sugar it was found that, under the usual operating conditions, carbon showed preferential adsorption of the so-called "irreversible" colloids as compared with those of "reversible" type. As it is the colloids of the irreversible type that are eliminated to the greatest extent by simple methods of juice purification, such as lime defecation, the importance of this observation is apparent. This means that,

in order that decolorizing carbons may be used with the greatest efficiency, irreversible colloids should be eliminated as thoroughly as possible in the preliminary clarification of the juice, so that the action of the carbon may be restricted as much as possible to the removal of reversible colloids, for which it is probably the most effective agent available.

In cooperation with one of the beet-sugar companies, investigation was made of the use of vegetable decolorizing carbons in beet-sugar production. Investigation was also started for the purpose of applying means for automatic electrometric control of second carbonation in the beet-sugar process, with the view of increasing the elimination of nonsugars at that point. This is to be operated by means of a potentiometer which continuously records the pH value and automatically controls the flow of carbon-dioxide gas.

#### STARCH

An investigation of the properties of various types of starch and their adaptation to industrial purposes was started, particular attention being given to effective utilization of typical starch-producing plants. Starch-making equipment on a semi-industrial scale has been installed.

#### VEGETABLE OILS

For the first time the character and quantity of the fatty acids present chiefly as mixed glycerides in the oil from the upland cottonseed, which constitutes the bulk of domestic production, have been determined. Fatty acids of the same kind were found, but in different proportions from those isolated several years ago from the oil of sea-island cottonseed. The findings, published in the *Journal of Oil and Fat Industries*, volume 4, page 131 (April, 1927), demonstrate conclusively the presence of stearic and arachidic acids in cottonseed oil, thus bringing to a close a long-standing controversy. The knowledge of the kind and quantity of the fatty acids in the form of glycerides that comprise the neutral oil is a step toward placing the cottonseed-oil industry on a scientific basis.

The composition of olive oil has been a subject of controversy in various countries for some time. It was not known whether arachidic acid was present, nor were the proportions of palmitic and stearic acids in oils from different sources known. The compo-

sition of olive oil from widely different regions therefore has been determined in the laboratory. The results of this extensive investigation, published in the *Journal of Oil and Fat Industries*, volume 4, page 63 (February, 1927), showed that arachidic acid was a minor but regular constituent of California, Italian, Spanish, and Tunisian olive oils. The samples of California and Italian oils were found to be very much alike in composition.

Methods for determining peanut oil in mixture with olive oil are being examined. This research was begun because large quantities of salad and cooking oil are now prepared in France by mixing 25 per cent of olive oil with 75 per cent of peanut oil. The possibility of this mixture being exported to the United States as pure olive oil makes it necessary to devise a method for detecting with greater accuracy this form of adulteration.

Work is in progress on the fat from the seeds of the *Ancoba echinatus* (Gorli) grown in Costa Rica. Like chaulmoogra and related oils used widely in the treatment of leprosy, this fat contains also a large quantity of chaulmoogric acid. The *Ancoba* is a tropical plant which produces seed two years after planting, as against the many years which the other species, being trees, require for fruiting, and could be readily grown on a commercial scale in the American tropics. If the ethyl esters prepared from the *Ancoba* fat prove to be as effective as those from the other related oils in the treatment of leprosy, such cultivation might prove warranted.

The material issued in 1919 as Department Bulletin 769 was entirely revised, brought up to date, and published as Department Bulletin 1475, *Production and Utilization of Fats, Fatty Oils, and Waxes in the United States*.

#### PROTEINS

The importance of a knowledge of the chemical composition of proteins in judging the value of feeds and feeding stuffs, as well as that of food for man, was pointed out in the Report of the Chemist for 1925. The research on proteins and vitamins conducted during this fiscal year is in large measure a continuation of that reported during the last few years.

#### VITAMINS IN SHELLFISH

Feeding experiments to determine the vitamin content of oysters and clams showed that both are good

sources of vitamins A and D. Oysters were found to be good sources of vitamin B, but clams, both hard and soft shell, were practically devoid of this vitamin. Vitamin A is a specific xerophthalmia (eye disease) curing and preventing vitamin; vitamin D is concerned with the metabolism of calcium and phosphorus; and vitamin B prevents and cures beriberi, a disease prevalent in the Orient.

#### GLUTELIN IN FLOUR

A new method for the separation of glutelin from wheat gluten, based on the observation that glutelin is precipitated from an alkaline solution by a very little ammonium sulphate, was published in the *Journal of Biological Chemistry*, volume 73, page 321 (May, 1927).

Heretofore wheat glutelin (like gliadin) has been generally considered as an individual protein. By means of the new method of preparation, it was possible to separate two glutelin fractions differing in properties and in chemical composition. These results will be of interest in connection with the study of the gluten or baking strength of wheat flour, as much of the work on this subject has been connected with the glutelin and gliadin constituents of wheat flour.

#### RELATION OF POLLEN PROTEIN TO HAY FEVER

The results of the collaborative study on the specificity of the albumin and proteose fractions of the pollen of certain plants toward hay-fever patients are given in the *Southern Medical Journal*, volume 20, page 257 (April, 1927). Four protein fractions were isolated from timothy pollen. A cutaneous sensitiveness to two or more of these fractions was shown by 63 per cent of vernal hay-fever subjects. Twenty-one per cent were sensitive to the proteose A fraction only and 15 per cent to the albumin fraction only. The glutelin fraction is of negligible importance. Proteose and albumin have been isolated also from ragweed pollen. Autumnal hay-fever patients exhibit cutaneous sensitiveness to one or both of these pollen proteins.

#### GLOBULINS

The study on the immunological relationships of the  $\alpha$  and  $\beta$  globulins of several proteins, conducted during the last five or six years in collaboration with the University of Chicago, was

completed, and the results were published in the *Journal of Infectious Diseases*, volume 40, page 326 (February, 1927). The delicate anaphylaxis tests on guinea pigs showed differences, as well as points of similarity, between the proteins studied that were in perfect agreement with those brought out by chemical analysis, thus confirming the work done in the laboratory on the  $\alpha$  and  $\beta$  globulins of many seeds from which they have been separated.

#### FEEDY FISH

A biochemical investigation on the immature herring (used in sardine packing) to determine the cause of the decomposition of feedy fish, which makes them unacceptable for food purposes, was conducted. The results showed that the flesh of feedy fish is invaded by bacteria and by the trypsin of the pyloric ceca, but the visible evidence of decomposition—the softening of the abdominal wall—is due almost solely to the action of the trypsin, which is greater in quantity or more active than that in the ceca of non-feedy fish and readily escapes from the delicate and highly congested tubules, quickly penetrating to the adjacent tissues of the ventral wall.

#### INSECTICIDES AND FUNGICIDES

Several branches of the Department of Agriculture are engaged in the campaign against the depredations of insect pests and against the fungous diseases which annually cause severe losses on American farms. This bureau, in collaboration with the Bureaus of Entomology and Plant Industry, has directed much attention during the last fiscal year to studying the composition of insecticides and fungicides now in use and to developing new materials to answer the purpose more effectively or more cheaply.

#### INSECTICIDES

A method for the rapid field determination of sulphur on foliage and fruit treated with sulphur preparations was devised and will be published shortly.

A long series of experiments, involving many dialyses, to determine the composition of colloidal calcium arsenate and the best method of preparing it was completed. The results are being prepared for publication.

The general investigation of the chemistry of calcium arsenate, which has been under way for several years,

was concluded. Papers describing the preparation and chemical and physical properties of 12 crystalline arsenates of calcium, several of which are new, are being made ready for publication. Calcium arsenate is the most effective poison at present known for use against the cotton boll weevil, whose depredations cost the American cotton planter nearly \$200,000,000 yearly. It is expected that more effective control of this insect may be had by the use of one or more of these new calcium arsenates.

Investigation failed to produce any satisfactory short routine method for determining the fineness of particles in commercial dust insecticides, such as lead arsenate. The method of settling in water gives a good idea of the size and relative proportions of the various particles present, but only at the expense of much time and effort.

The chemical composition and insecticidal value of plants, plant constituents, and synthetic chemicals were investigated, with a view to finding substitutes for insect flowers and developing new insecticides. Attempts were made to determine whether or not compounds corresponding to the active constituents of plants and other materials and having insecticidal action can be made synthetically.

The work on the oil and the crystalline alkaloid, delphinine, from the seed of stavesacre (a species of larkspur) is described in a paper entitled "Isolation of the oil and alkaloids of stavesacre seed," accepted for publication in the *Journal of the American Pharmaceutical Association*. The results of the investigations on the pyridine derivatives—the dipiperidyls, the dipyridyls, and "neo-nicotine"—will be described in a forthcoming series of papers. These experiments give promise of the manufacture of a synthetic nicotine substitute at \$1 a pound. The present price of nicotine is \$3.50 a pound.

#### FUMIGANTS

Some 2,200 laboratory fumigation tests with more than 300 organic compounds were made on grain weevils. As the result of these and of a number of fumigation tests in box cars loaded with wheat, and in boxes, chests, and a fumigating chamber, several highly promising fumigants have been developed. One of the most promising is a mixture of 3 volumes of ethylene dichloride with 1 volume of carbon tetrachloride, which may be used satisfactorily in a commercial

fumigating chamber of the kind used by warehousemen. This mixture is noninflammable and cheap, has a pleasant odor, and, although effective in killing insects infesting carpets, clothing, upholstered furniture, etc., is relatively nontoxic to man. Tests with this new fumigant are described in the *Journal of Economic Entomology*, volume 20, page 636 (August, 1927).

The rate of vaporization of carbon disulphide and the development of an apparatus for its rapid volatilization are described in Department of Agriculture Circular No. 7.

Cooperative experiments with the Federal Horticultural Board on the penetration of hydrocyanic-acid gas generated from liquid hydrogen cyanide into the centers of bales of cotton showed that when introduced in liquid form hydrocyanic acid does not volatilize fast enough to penetrate the cotton. Penetration was obtained when the hydrocyanic acid was volatilized before it was introduced into the chamber. Along the Mexican border and at certain ports in the United States baled cotton is fumigated with hydrocyanic-acid gas in order that living specimens of the destructive pink bollworm may not be brought into this country in imported cotton.

#### OIL EMULSIONS

Oil emulsions are very effective and are extensively employed in controlling certain injurious insects. It is important that they be stable. When an oil emulsion breaks it separates into its components, oil and water, and vegetation is seriously injured by the application of a nonemulsified oil.

Studies showed that oil emulsions in which the drops of oil are large are much more toxic to aphids than those in which the drops are small. The oil in the small-drop emulsions does not adhere to vegetation as readily as that in the other type. The presence or absence of soap or cresol does not affect the toxicity of the emulsion. The results of this investigation are published in the *Journal of Agricultural Research*, volume 38, page 727 (April 15, 1927).

Rosin soaps when used with a little fish-oil soap formed very stable emulsions, but when used alone the emulsions broke rapidly.

#### TOXICITY OF COPPER CARBONATES

Copper carbonate is widely used as a preventive of smut in grain. Tests

were conducted in an effort to increase the fungicidal efficacy of copper carbonate, which is now widely used as a preventive of smut in grain. Attempts to prepare in the laboratory copper carbonate with more than 20 or 22 per cent CO<sub>2</sub>, which most of the common commercial basic carbonates contain, were unsuccessful. It is believed that the variation in toxicity of the different carbonates on the market is due to the fineness or other physical properties of the dusts rather than to the chemical composition.

#### ATTRACTANTS AND REPELLENTS

Prior to the work done in the bureau to obtain satisfactory attractants and repellents for flies which infest animals, strongly odorous materials, such as pyridine, bone oil, fish oil, and nitrobenzene, were recommended as fly repellents. The investigational work in the bureau has shown that copper carbonate, an inodorous compound, is more effective in repelling flies from baits than any of the highly odorous materials tested. The effectiveness of pine-tar oil as a repellent dressing for wounds of domestic animals has been demonstrated. Large manufacturers of proprietary screw-worm fly killers and repellents are now using pine-tar oils as the basis of their preparations, instead of coal-tar phenols, as before. The results of this investigation have been published (Dept. Bul. 1472, March, 1927; and *Industrial and Engineering Chemistry*, vol. 19, p. 942, August, 1927).

#### BIBLIOGRAPHIES

Information concerning insecticides is widely scattered not only in entomological and agricultural journals, but also in the chemical, technological, patent, medical, pharmaceutical, and veterinary literature. No one abstract journal covers all this literature. In order to bring to the attention of entomologists and others interested in insect control promising new or little-known insecticides, a series of bibliographies has been inaugurated. The first of this series, entitled "Chemistry Bibliography No. 1, Chloropicrin," brings together all published information on chloropicrin, a "war gas," now receiving much attention as a fumigant. A supplement, bringing the references up to January, 1927, was issued later in the year.

The series of quarterly reviews giving abstracts of United States patents relating to insecticides and fungicides

has been continued. This patent review has met with a cordial welcome from entomologists, and requests to be placed on the mailing list of the review have also come from insecticide manufacturers and chemical and biological research institutions. A paper calling attention to this quarterly review and emphasizing the value of the patent literature to economic entomologists was published in the *Journal of Economic Entomology*, volume 20, page 640 (August, 1927).

#### LEATHER AND TANNING

Among the important raw products of agriculture are hides and tanning materials, which, in turn, are converted into finished products indispensable to the proper development of our agricultural industries. The conservation of these raw and finished products is, therefore, a major field of research by this bureau. Work has been continued on the study and advocacy of correct methods of producing raw materials, on the development of new sources of such materials, and on the realization of longer-lasting leathers, by improved manufacturing processes, by more judicious selection of leather goods for the service intended, and by the exercise of proper care through the application of treatments to counteract undue deterioration.

#### CHROME-IRON TANNING

Research on the utilization of ferrochrome alloy as a raw material in mineral tanning has been brought to the point where large-scale tanning experiments with one of the progressive tanners of the country are under way. This industrial-scale work promises to confirm the conclusions drawn from laboratory experiments that either a straight chrome tannage or a joint chrome-iron tannage can be obtained with certain preparations made from ferrochrome, and also that the joint chrome-iron tannage yields a leather of a pleasing natural color at a lower cost than do the present-day chrome tannages.

#### NEW TANNING MATERIALS

Investigation of farm and forest products and wastes as possible new and needed sources of tannin has been continued. Among the materials examined which may deserve further consideration as sources of tannin are four barks from Mexico (*Lysiloma divaricata*, *Pithecolobium dulce*, *P.*

*lanceolatum*, and *Albizia occidentalis*), showing from 22 to 29 per cent tannin; four samples of American spruce bark, showing from 10 to 20 per cent tannin; and several samples of mixed oak leaves, showing from 10 to 14 per cent tannin. Analyses of several other materials, including palmetto roots, English walnut shells, and black laurel bark, indicate that these materials offer little promise as a source of tannin.

The roots of *Badan* (*Saxifraga crassifolia*), a wild Siberian plant, are receiving much attention in Russia as a possible new commercial source of tannin. As these roots may be imported for the use of American tanners and because of the interest shown by the American trade in this material, a sample of the roots was obtained through the office of Foreign Plant Introduction, and examined. The roots contained 28.6 per cent tannin, a tannin content very promising for commercial development.

#### BOOKBINDING LEATHERS

As part of the program of work on more serviceable leathers, progress has been made during the last year in determining the causes of deterioration of leather and, in cooperation with the United States Government Printing Office, in interesting tanners in making bookbinding leathers of more durable tannage and better quality. Work has been continued on devising dressings to counteract the injurious effects of both the original acidity of the leather and that acquired through exposure to an atmosphere polluted with sulphur dioxide. Some of these dressings are being tried under actual library service in the New York City Public Library and in the United States Government Printing Office. The work so far done on bookbinding leathers warrants the conviction that the rational application of suitable dressings will greatly prolong the usefulness of leather-bound books and thus materially reduce the expense of leather binding.

Following the publication of the results of the study of the deterioration of bookbinding leathers by polluted atmosphere, described in last year's report, the library of the Royal Archives of Great Britain submitted a number of small pieces of leather taken from books dating from 1480 to about 1880 that had been kept in a pure atmosphere. Examination of these speci-

mens showed the highest acidity to be 0.53 per cent and in 6 out of 10 cases the acidity was zero. These findings confirm the conclusion reached last year that atmosphere polluted with sulphur dioxide is one of the major causes of the deterioration of leather.

#### SELECTION AND CARE OF SHOES

How to get the most out of a pair of shoes is a question of decided interest to everyone. Suggestions and information on this matter are given in Farmers' Bulletin 1523, Leather Shoes, Selection and Care. The general application by wearers of shoes of the information in this bulletin would reduce their shoe bills at least 25 per cent, which would make a saving to them of more than \$350,000,000 annually.

#### HIDES AND FOLLICULAR MANGE

The inferiority of leather made from hides of cattle with follicular mange having been shown, efforts were made to assist hide dealers and tanners in recognizing the condition before the hide is unhaired or immediately thereafter, in order that such hides may be separated and processed in the most suitable manner. The Bureau of Animal Industry, in cooperation with this bureau, instructed its field men to inspect livestock for mange and reports progress in its recognition. There seems to be no way to counteract the effect of follicular mange at the finished-leather stage. The disease must be prevented entirely or it must be cured before the animal is killed if its effects are not to show on the finished leather.

#### SUGARS IN TANNING MATERIALS

The sugar-yielding constituents of the various tanning materials play a major part in tanning leather. Much work has been done on their determination. Progress has been made in determining the total sugar in a number of the more important tanning materials and the influence of yeast on infusions of these materials.

#### MOISTURE IN LEATHER

Further work has been done on methods for determining moisture, one of the important constituents to be considered in any fundamental work on leather. Drying in a current of moisture-free air probably gives the most accurate results of any of the



methods studied, but no entirely satisfactory procedure for making this important determination has been developed thus far.

## PAPER

### RELATIVE HUMIDITY

Moisture materially affects the weight, strength, and durability of paper. The results of an extensive investigation to ascertain the effect of atmospheric humidity on the moisture content of paper of many kinds have been prepared for publication. These results, which are of interest not only to those who manufacture, sell, or use paper, but also to those engaged in testing it, show that the moisture content of paper is appreciably higher at 50 and 65 per cent relative humidity at 70° F. when these conditions are approached from a high humidity (80 per cent) than when they are approached from a low humidity (35 per cent). This may explain, in part at least, the fact that folding endurance results on a given sample sometimes differ widely when it is tested at different times and places, although the test strips are always conditioned at the same relative humidity and temperature.

### PAPER FOR TEA PACKING

As the value of a tea is largely determined by its characteristic flavor, it is important to pack teas so that their characteristic flavors will be retained. It has been shown that bags made of parchment paper are much more resistant to the passage of both air and moisture than ordinary manila bags and that the flavor of the tea packed in such bags is retained much longer than when packed in ordinary manila bags.

## FARM FABRICS

### TOBACCO SHADE CLOTH

The research on increasing the durability of tobacco shade cloth has progressed favorably. Shade cloth treated with preservatives and untreated cloth for comparison have been exposed over tobacco near Windsor, Conn., for two-year and one-year periods. At the end of one year the yellow cloth (treated with lead chromate) showed a 5 per cent loss in tensile strength, the black cloth (treated with petroleum asphalt and lampblack) showed a 14 per cent loss, and the untreated cloth a 47 per

cent loss. At the end of two years the tensile strength of the lead-chromate-treated cloth was decidedly greater than that of either of the others at the end of one year. Apparently, therefore, the lead-chromate treatment is superior to the other, so far as the preservative effect is concerned. Observation by an official of the Connecticut Agricultural Experiment Station showed that the color of the treated cloth has no effect on the growth or on the quality of the tobacco. The details of this work are given in an article entitled "Preserving Tobacco Shade Cloth," published in *Textile World*, volume 71, No. 19 (May 7, 1927). General application of the research work so far done would save tobacco growers about \$1,000,000 annually. The investigation has reached the stage where commercial development of the processes is the next step.

## GENERAL

Assistance and suggestions for waterproofing treatments and treatments to prevent the destruction of cellulose by microorganisms have been given to other Government bureaus and to manufacturers.

## NAVAL STORES

### TECHNOLOGICAL WORK IN THE FIELD

**Gum cleaning.**—The presence of large quantities of bark, chips, sand, and fine dirt in crude gum is one of the most serious obstacles in making rosin. These foreign materials not only make for great waste, but the fine dirt remaining in the rosin lowers its grade and causes much annoyance and loss to users. During the last season extended experiments with a gum-cleaning plant of the French type were carried on with the cooperation of one of the producers of southwestern Georgia. These experiments did not solve the difficult problem of thoroughly cleaning American gum. They showed that this type of equipment, while adapted to the cleaner gum of France, is not suitable for handling American gum, which is not only dirtier but also more viscous than French gum. Although several improvements in the equipment were made before the season closed, entirely satisfactory results were not obtained. The experiments in gum cleaning, however, have afforded valuable experience and have indicated the direction in

which further improvement must be made. They have also stimulated the interest of producers to a remarkable degree.

**Steam still.**—A simple but efficient steam still was designed for a progressive naval-stores producer of Mississippi who appealed to the bureau for assistance. Under the direction of the Government engineer and technologist an old-type fire still was converted into a steam still and put into successful operation. The results indicate that a steam still of this type is the most practical and least expensive kind for general use throughout the naval-stores industry and will produce the maximum yield of spirits of turpentine and highest grades of rosin. On the basis of this work the producer is converting a second fire still into a steam still.

**General field work.**—Work among producers to bring about better stilling procedure, so as to decrease losses and make higher grades of rosin, has met with great success. Technological studies at each still visited have enabled the bureau to improve the working at that place by devising better procedure to fit the needs of the place in question. The better procedures have been such as lead to the production of higher grades of rosin through an exact regulation of the still fire, the prevention of loss of turpentine through better condensing conditions, covered separators, painted and covered storage tanks, the elimination of losses from dirt by more careful straining and through cleaner gum, and the reduction of cost of operation through better coordination of the work. A simplified procedure for following and controlling a distillation, based upon the proportion of spirits of turpentine and water in the distillate throughout the distillation, was worked out and written up as a guide for stillers. Its general application would give producers many thousands of dollars more income through the production of better grades of rosin. This procedure is being rapidly adopted by producers.

#### LABORATORY STUDIES

**Rosin from cup-cleaning gum.**—Much so-called B-grade rosin made from gum recovered in cleaning turpentine cups or made with crude equipment was found to be partially decomposed and partly converted into pitch, owing either to the presence of a great deal of dirt in the raw material or to ex-

cessively high heating during distillation. Such a product can not be sold under the naval stores act as rosin. From examination of a number of samples of this product it has been possible to tell producers how to guard against such decomposition, which renders the product unsatisfactory for many purposes and which therefore brings the producer less money.

**Rosin fires.**—In heating rosin in large kettles it may flash or even burn under certain conditions if fire is brought near it. Preliminary investigations conducted in response to an appeal from users of rosin indicate that gum rosin will flash in the Cleveland open cup at about 410° F. and will burn at about 465° F. It was found, however, that if the rosin contains a small percentage of residual mineral oil, as it sometimes does when it has been reclaimed from dross by dissolving in mineral oil or naphtha and subsequently distilling off the solvent, it may flash at as low as 220° F. and burn at about 415° F. Knowledge of these facts are of service to rosin users in enabling them to buy suitable rosin of low fire hazard, and in showing that extra precautions must be observed in heating reclaimed rosin to high temperatures.

**Viscosity of rosin.**—Investigations, in cooperation with producers, users, and the American Society for Testing Materials, on the development of simple methods for determining the softening point of rosin, and on the degree of viscosity or fluidity at a given temperature have been continued. Knowledge thus gained is essential in avoiding serious difficulties and losses when rosin is used for certain purposes. The work has shown that none of the methods commonly used is entirely satisfactory. Two new methods, one of which was originated in the bureau, are promising, and work is being continued on them.

**Opaque rosin.**—Opaque rosin is objectionable to the user and a loss to the producer. The question has arisen as to how much water opaque rosin contains. An investigation has shown that opacity may result from the presence of as little as 0.2 per cent of moisture, although usually opaque rosin contains much more. As the water content increases the rosin gradually becomes translucent, then opaque, and finally powdery. Three per cent of water will give rosin a white, opaque appearance. A sample of powdery, opaque rosin was found to contain approximately 20 per cent of moisture.

**Constituents of turpentine.**—Progress has been made in the investigations to identify the constituents of the several kinds of spirits of turpentine, including refined turpentine recovered as a by-product in making paper pulp from resinous woods by the sulphate process. Such turpentine is readily distinguished from other turpentines by the odor, and it contains small percentages of sulphur compounds. Contrary to previous opinion, however, the indications are that the strong odor is not due entirely to the sulphur compounds present. Assistance in purifying and refining sulphate-wood turpentine has been given to those engaged in recovering and marketing it. It is necessary under the naval stores act, and also for technical and financial reasons, to distinguish between the several kinds of turpentine, especially to identify mixtures. The aim of these investigations is to make such recognition more certain than it now is.

**Turpentine types.**—Spirits of turpentine is sold in the primary markets as "water white," "standard," "one shade," and "two shades" in color. Proposed permanent types for these grades have been prepared during the year in a form similar to the rosin standards, have met with the practically unanimous approval of the trade, and are proving of very definite service.

#### COOPERATION WITH FIRMS AND INDIVIDUALS

Many problems of the industry are first brought to the bureau's attention by business firms in trouble. In order that the industry and the general public might be better served, cooperation has been extended during the year to many individuals and manufacturing concerns in solving problems arising in the manufacture, transportation, handling, and use of naval stores. This has involved the analytical examination of several hundred samples of naval stores of various types and of products made from them. The information thus obtained has and will enable the bureau promptly to help others also, when they are in need.

#### AMERICAN ROSIN STANDARDS APPROVED BY FRENCH TRADE

Until recently the naval-stores trade of France has had no definite and permanent standards for rosin.

Through cooperation with French leaders, the French trade has now adopted as official for French rosin the color values and nomenclature of the United States standards from B to WW inclusive. Steps are being taken to bring into agreement the paler shades, i. e., the American X and the French Y grades. This is the initial step in an effort to make rosin standards universal, and is a long step forward in putting the naval-stores business of the world on a uniform basis.

#### STATISTICS

A statistical report issued in December, 1926, covered the industrial consumption during the calendar year 1925 of turpentine, rosin, and mineral oil thinners, showed the stocks of turpentine and rosin at the ports and distributing points and in the hands of consumers on the last day of the 1925 naval-stores season, and gave the production statistics on both gum and wood turpentine and rosin during the 1925 season, stocks at the stills as of March 31, 1926, and export and import data for the 12 months corresponding to the producing season. A report on the number of new turpentine cups sold to be hung in the turpentine forests for the 1927 season was also published. These statistics serve to keep producers and users of naval stores informed on trade conditions.

#### COLORS

Research on coal-tar dyes begun many years ago in connection with the enforcement of the food and drugs act has been greatly expanded. As pointed out in previous reports, many dyes are studied in the laboratory at Arlington, Va., with a view to developing new ones and improving on present methods of manufacture.

During the fiscal year progress in working out analytical methods for pyronines and neutral red was reported. Satisfactory procedures for the analysis of ethyl eosin and the sudans were found. An iodimetric method for methylene blue and a method for the detection of subsidiary dyes in methylene blue were perfected.

Data on the solubility in water and in alcohol of 54 biological stains were obtained and published.

The continuation of the sulphonation studies on basic fuchsins has made possible the manufacture of acid fuchsins of excellent staining characteristics.

### PLANT DUST EXPLOSIONS AND FARM FIRES

The research this year to determine the causes of dust explosions in industrial plants and to develop methods for their control and prevention has been confined almost entirely to grain-handling and milling plants. The investigations on the project, however, have indicated that extensive losses of life and property have occurred in practically all lines of industry where combustible dusts are produced during manufacturing operations. This bureau is the only scientific Government bureau studying the dust-explosion problem in industrial plants, and it has frequently been called upon to render assistance to the chemical-engineering industries where new processes have introduced additional hazards. The bureau recognizes the necessity of extending this work to include industrial plants and chemical-engineering industries of all types, as well as the importance of providing facilities for large-scale explosibility testing.

#### INERT GASES

The value of inert gases, such as boiler-flue gas, for the prevention of dust explosions and fires in milling and conveying systems was determined under practical operating conditions in the experimental plant at Arlington, Va. The damping effect of various percentages of inert gases and the effect of various densities in the dust cloud were ascertained and demonstrations before representatives of a large number of industrial companies and organizations interested in dust-explosion prevention were held. As a result of this research and demonstration, several companies have installed inert-gas equipment and others are planning to do so.

#### CONTROL OF STATIC ELECTRICITY

Past investigations having shown the danger of static electricity as a source of ignition of a dust cloud, attention was directed to the development of a nonstatic leather-belt dressing. Although charges of static electricity were eliminated under laboratory conditions of testing, difficulties, such as stretching of the belt and lowering the coefficient of friction and flexibility of the leather, were experienced during actual working conditions. A mixture having as a base tallow and castor oil thinned with pine oil was satisfactory in the laboratory but in actual

practice caused stretching of the leather. Other dressings were tested, the most successful so far being a mixture of fish glue, glycerin, an emulsified sulphonated oil, and lampblack. As this mixture has some objectionable qualities as a coating for a new belt, experiments are now under way to produce a composition having a flexible shellac base.

#### IGNITION TEMPERATURE DETERMINATIONS

In developing methods for the prevention of dust explosions it is important to know the ignition or burning temperature of the various dusts. Accordingly, the ignition temperatures of the following dusts were determined: Cocoa, pyrethrum flowers, cloves, tobacco, wheat smut, wheat elevator, corn elevator, oat hulls, wood pulp, wood flour, lignone, leather, fertilizer, cornstarch, hard wheat flour, paper dust, and cellulose prepared from filter paper. These temperatures range from  $237^{\circ} \pm 5^{\circ}$  C. for cocoa to  $350^{\circ} \pm 5^{\circ}$  C. for cellulose, in the order given. For the dusts containing cellulose the higher the content of cellulose the higher the ignition temperature.

#### EFFECT OF OXYGEN DILUTION

As a result of the industrial interest in the use of inert gases for explosion control, laboratory work was carried on to determine the oxygen dilution necessary to prevent the propagation of flame in certain dust clouds, such as cork, pyrethrum flowers, and ground oat hulls. Special experimental apparatus was designed to determine the limits of concentration for explosive dust clouds.

#### DUST TESTING

During the year explosibility tests were conducted on a number of samples of dust submitted to the bureau by manufacturers, insurance companies, and other agencies. As a result of these tests, assistance was given in the adoption of measures for the reduction or elimination of the dust-explosion hazard in the industry concerned.

#### DUST-EXPLOSION HAZARDS COMMITTEE

The dust-explosion hazards committee, under the leadership of the bureau, met in New York, N. Y., on January 10 and in Chicago, Ill., on May 10. During the year the regulations for sugar and cocoa pulverizing sys-

tems were combined into one set of regulations and important revisions in the pulverized fuel regulations were made. The Department of Agriculture has accepted joint sponsorship with the National Fire Protection Association for the preparation of codes for the prevention of dust explosions in the dusty industries and the codes already prepared have been accepted and approved by the American engineering standards committee.

During the year the dust-explosion work of the bureau was presented at a large number of meetings and conventions. Special assistance was given the National Association of Fire Fighters in the adoption of methods for the prevention of explosions during fire fighting, to assure protection to the lives of firemen in connection with the control of fires in industrial plants.

#### COOPERATION WITH STATE OFFICIALS

A definite plan of cooperation with the State officials directly concerned with industrial-accident prevention was arranged. Under this plan the bureau engineers will assist the State officials in the investigation of dust explosions and make available the experience of the bureau in the adoption of precautionary measures.

#### FARM FIRE PROTECTION

The annual fire loss in the United States is about \$570,000,000, and it has been estimated that approximately \$150,000,000 of this amount is due to losses on farms and in rural communities. These figures do not take into consideration the losses caused by deterioration and spoilage of farm products which have a relation to spontaneous combustion, now recognized as one of the principal causes of farm fires. It has been estimated that 3,500 lives are lost annually as a result of fires on farms and in rural communities.

The farm fire protection committee of the National Fire Protection Association, in which the bureau has the leadership, held two meetings during the year, one at Columbus, Ohio, on February 15, and the other at Chicago, Ill., on May 9. The committee, which includes representatives of a number of national organizations, is making a study of the causes of farm fires and is cooperating with the Department of Agriculture in the development of methods of control and prevention. The bureau cooperated

with the agricultural committee of the national fire waste council of the Chamber of Commerce of the United States in a special campaign to reduce fire losses, with special attention to agricultural communities.

#### METHODS OF ANALYSIS

In the course of the many examinations it is required to make, the bureau is constantly improving upon old methods of analysis and devising new ones. As pointed out in the Report of the Chemist for 1925 (p. 13), much of this work is done in collaboration with the Association of Official Agricultural Chemists.

Some of the methods developed during the last fiscal year are reported in other paragraphs of this report. Others are a method for the quantitative determination of ether in medicinal products, a calcium-chloride method for separating alcohol and ether, a method for the estimation of caffeine, aspirin, and cinchophen in admixture (to be published in *Industrial and Engineering Chemistry*), and a method for the detection of yohimbine in the presence of strychnine. A special fractional distillation outfit was constructed for the fractionation of both steam-distilled wood turpentine and gum turpentine, in an effort to devise a method for the determination of the composition of spirits of turpentine, with special reference to the minor constituents.

The importance of the application of the optical-immersion method to the identification of crystalline substances has been demonstrated. It is particularly useful in the identification of alkaloids and other organic compounds and is applicable to a large variety of crystalline substances. As this method can often be conducted much more quickly than chemical determinations, it is of special value in supplementing the usual chemical methods. The method calls for the petrographic microscope. Certain conditions having been complied with, the indices of refraction characteristic of the crystalline material are determined, reference ultimately being made to tables of refractive indices of substances of known chemical composition for the purpose of establishing the identity of the material. When the material under examination is crystalline, only small quantities are available, and quick and accurate results are sought, the optical immersion method is specially valuable.

### COLLABORATION WITH OTHER BUREAUS AND DEPARTMENTS

As in past years, the bureau conducted a great deal of analytical and investigational work for other branches of the Government service.

One of the chief lines of this work was that done for the Post Office Department as part of the enforcement of the fraud order law, an act which, among other things, may debar the use of the United States mails to anyone found guilty of abstracting money from the public through the mails by means of false and fraudulent claims and representations. As a result of the examination of samples in the bureau, 79 cases were brought under this law. Among the preparations which called for the issuance of fraud orders were a powder that, according to its manufacturer had only to be sprinkled in the shoes to cure many diseases; a preparation advertised as a cure for tuberculosis, pneumonia, and other pulmonary disorders, but found on analysis to contain no ingredient which alone or in combination would effect such a cure; and an alleged cure for all ailments of the eye—a dry wine containing 0.25 per cent of zinc sulphate. Many preparations for which false therapeutic claims were made were voluntarily withdrawn from the market without recourse to fraud-order action. The manufacturers realized the fraudulent nature of their business in view of what had happened to others and discontinued the use of the mails for selling their preparations.

Many samples of drugs and narcotics were examined for other departments and bureaus. Some 70 samples of biological stains were analyzed for the Commission on Standardization of Biological Stains and analytical data on about 40 stains were supplied to the Army Medical Museum.

Hundreds of samples of foodstuffs were tested for five other departments, for the General Supply Committee, the Commissioners of the District of Columbia, the Panama Canal Commission, the Shipping Board, the Federal Trade Commission, and various bureaus of the Department of Agriculture.

All the tea bought by the Navy, the Marine Corps, the Veterans' Bureau, the Department of Justice, the General Supply Committee, and the District of Columbia was examined by representa-

tives of the bureau. The bureau's tea examiners appraised all tea containers for the United States Customs Service.

Two hundred and thirty-five samples of special arsenicals, fluorides, silico-fluorides, and cyanides were analyzed for the Bureau of Entomology and 70 samples of disinfectants were tested for other branches of the Federal service.

Cattle foods were analyzed for the Forest Service, the Bureaus of Agricultural Economics, Animal Industry, and Plant Industry of this department, for other departments, and for the Panama Canal Commission.

Assistance was given the Federal Specifications Board in preparing specifications for bag and other leathers and for paper. Bookbinding leathers were examined for the Government Printing Office, and the acid content of several samples of paper thought to have deteriorated during storage was tested for that institution. Many kinds of paper were tested for other offices of this department and for the District of Columbia.

Jute twine and turpentine were tested for the General Supply Committee.

### REGULATORY WORK

In 1907 the Bureau of Chemistry was charged with the enforcement of the Federal food and drugs act; in 1920 the enforcement of the tea act was transferred from the Treasury Department to the Bureau of Chemistry; and three years later the enforcement of the naval stores act, passed in 1923, devolved upon the bureau. The enforcement of these three acts entails a certain amount of analytical and investigational work, in addition to the inspectional and administrative work involved. The outstanding results of these activities, both inspectional and investigational, during the last year follow.

### FOOD AND DRUGS ACT

A brief history of the Federal food and drugs act and the details of the plan of its operation were given in the Report of the Chief of the Bureau of Chemistry for 1926. The same plan of operation was followed this year.

Table 1 lists the food and drug products involved in court actions during the fiscal year just ended.

TABLE 1.—Summary of prosecutions and seizures under the food and drugs act during 1927

Product	Prosecutions	Seizures	Total
Alimentary paste.....		25	25
Baked products.....	8	1	9
Beverage ingredients (malted milk, sirup).....	1	6	7
Beverages.....		2	2
Cereals.....		1	1
Chocolate coating.....		2	2
Cocoa.....		1	1
Coconuts.....		1	1
Coffee.....	1	3	4
Confectionery.....		3	3
Dairy products:			
Butter.....	24	79	103
Milk (powdered).....		1	1
Drugs:			
Crude drugs.....	2	5	7
Remedies.....	97	63	160
Eggs:			
Shell.....	5	17	22
Frozen.....		7	7
Feeds.....	41	98	139
Fish.....		34	34
Flavoring extracts.....		4	4
Flour.....		2	2
Fruit:			
Canned.....		15	15
Dried.....	4	40	44
Fresh.....	2	165	167
Frozen.....		1	1
Ice cream cones.....		1	1
Jams, jellies, and preserves.....		8	8
Nuts.....		19	19
Oils.....	3	1	4
Oleomargarine.....		3	3
Olives.....		1	1
Pickles.....		1	1
Sauerkraut.....		1	1
Shellfish.....	51	23	74
Shrimp.....		1	1
Sirup.....		1	1
Spices.....	5	9	14
Vegetables:			
Canned.....	9	39	48
Fresh.....	3	6	9
Vinegar.....		1	1
Water.....	2	4	6
Total.....	258	695	953

The number of seizures and prosecutions instituted by the Department of Agriculture under the Federal food and drugs act is in no way set forth as an index, or even as an indication, of the amount of work done by the Bureau of Chemistry in the enforcement of this act. It would be a reflection on the efficiency of the bureau if the ratio of seizures and prosecutions to the number of samples collected from year to year did not diminish progressively. It is safe to say that to-day the greater proportion of the samples collected by Federal inspectors show no violation of the law, or, if they do, the violations are minor and usually can quickly be corrected by correspondence or other informal means. A list such as that

given in Table 1, however, serves the purpose of acquainting the public with general conditions in the food and drug industries.

## DOMESTIC FOODS

In glancing over Table 1 even the casual observer will probably pause to wonder why the department found it necessary to seize 25 shipments of such an apparently harmless substance as alimentary paste, or why 50 seizures of grapefruit and 75 seizures of oranges were made. Unusual activity in any given direction is sometimes caused by the failure of manufacturers to observe new rulings of the department, but more often it is due to a change in natural conditions over which the department has no control.

On January 15, 1926, the Bureau of Chemistry issued an announcement to manufacturers, shippers, and importers of alimentary pastes, warning them that pastes of every description containing color added to simulate egg paste were in violation of the Federal food and drugs act, even though the presence of the added color was declared on the label. This pronouncement was not issued as a surprise to the trade, but reaffirmed a similar announcement made in 1915. It was made to combat the deception which results from the sale of artificially colored paste for egg paste, and to meet the ever-increasing traffic in egg paste of all types. A very liberal period was allowed manufacturers and dealers to adjust their manufacturing processes and to dispose of the stocks on hand at the time the announcement was issued. In spite of the three-month period of grace, however, many shippers either failed to dispose of their stocks or deliberately made misbranded shipments in the face of the definite prohibition by the department. The seizure of 142 shipments of citrus fruit, principally oranges and grapefruit, was the result of natural causes. The cold wave which spread over almost the entire citrus belt of Florida in January caused the freezing of much of the citrus fruit then ripe or ripening on the tree. Frosted fruit is usually very dry and lacking in juice when it reaches the consumer. Department announcements were issued immediately after this freeze to warn citrus growers and shippers of the worthlessness of dry or frozen fruit and to remind them of the department's intention and duty to take regulatory action against any shipments

found to be dried beyond an announced tolerance. Notwithstanding these warnings, as well as those of the inspectors and chemists who were constantly in the field during this period, and the unfortunate experiences of other shippers in previous years, an effort was made by the less scrupulous shippers to place this unfit fruit on the market. The result of their unlawful attempts is shown by the number of oranges, grapefruit, and tangerines seized. Most of these shipments were carload lots, and by the time an effort could be made to salvage the fruit it was either decomposed or of such little value that salvaging was impracticable. Many of these shipments could be apprehended only with the excellent cooperation of State and municipal officials, without whose assistance the department would often have been helpless.

The large number of seizures of butter and feeds noted in Table 1 is not unusual. These are standard commodities shipped in vast quantities from every section in the country during every month of the year. Both are open to gross abuse by manufacturers. Butter has been defined by Congress by special act, but many manufacturers still ship a product that is either low in butterfat or short in weight. Much of the illegality can be charged to the new creameries springing up each year, which disclaim any intention of violating the law or are unfamiliar with the details of the business in which they are engaged. The food and drugs act applies to feeds for animals as well as to food for human beings. Feeds are purchased by dealers and feeders on a protein basis, and any decrease in protein from that specified on the label constitutes a fraud against the purchaser.

The Boston station gave particular attention this year to the blueberry industry in Maine for the purpose of continuing the maggot-control work of previous years and to obtain cooperation with canners in rejecting raw materials unsuitable for canning. The industry since the beginning of this campaign has shown a splendid spirit of cooperation, and the last report indicates that various modifications of the Howard-Stephenson type of washer are in use in most of the factories and working efficiently. The work of the last few years has produced very gratifying results. The industry has passed through a period of transition. Instead of the desire

to pack everything brought in from the field, the packers now realize the folly of this procedure and of their own accord are taking advantage of every scientific development to place a high-grade product on the market.

Past reports have discussed at some length the bureau's work on sardines and salmon. Neither of these industries to-day requires the close personal attention of the staff laboratories or the field stations.

In the past a Government representative has been in Maine during the entire sardine-packing season, making sanitary surveys, examining fish at the canneries, and assisting the packers in every way possible to pack a higher-grade product. It is not reasonable, however, to expect the department to keep up this supervision indefinitely, especially as the packers by their own efforts are trying to make the industry a credit to the State. Members of the Boston station remained in the sardine-packing area throughout the entire summer of 1926. This will probably be the last time the department will take such active charge of the work, unless conditions make it essential to have an inspector in the neighborhood at all times. In the future inspectors will make the rounds of the factories as frequently as time permits.

The 1926 pack showed fewer decomposed fish than ever before, according to reports from the various packers. The inspection of fish at the factories is an advantage to both the Government and the packer. Because it results in the packing of a better grade of sardines, the packer may safely pack high-grade goods without fear that his competitor can pack an inferior product, thereby destroying his market. Most, if not all, of the packers have welcomed Federal inspection and have heartily cooperated. As Maine sardines are sold for the same price, regardless of the quality of the individual packs, there has been a great incentive for packers to use fish of an inferior grade which can be obtained from the boats at a much lower price than the better grades. If one unscrupulous packer adopts all the short cuts that are presented to him, such as packing inferior fish and reducing his price, all the other packers must fall in line and adopt the same practices or suffer a financial loss. This careful plant inspection has obviated the necessity for intensive sampling by the Government after shipment.



For the last four years the bureau regularly has sent an inspection party into southeastern Alaska to visit salmon canneries, primarily to determine if possible which canneries are likely to ship bad fish at the end of the season. This plan has worked efficiently, but, in spite of a great improvement, an extremely large quantity of partly decomposed fish was shipped during 1926. The bureau found it necessary to seize thousands of cases of salmon packed by some of the largest and supposedly most reputable organizations on the Pacific coast. Obviously the industry has not yet reached that permanent reformation for which the bureau had hoped and which was indicated by the great improvement of the year before. Most of the salmon seized last year, however, came from the regions farther north than the inspectors have ever traveled. This may be a coincidence only, and no attempt is made to explain the presence of the large quantity of decomposed fish on the market by this fact. In concluding their report of the trip, the inspectors stated that, although a marked improvement was noted in central and southeastern Alaska, owing to the bureau's control work, as a general rule it is possible to visit few of the canneries more than once during the season and often the canner knows just when the inspector will reach his cannery. This, of course, gives ample time to clean up and dispose of questionable fish which might otherwise be placed in cans.

As usual, it was necessary to pay particular attention to egg products of various types. At stated intervals warehouses known to hold frozen eggs were surveyed, with a view to the seizure of all lots of decomposed or partially decomposed eggs. More than 6,000 cans of eggs were seized by the Government and in addition a half million pounds were embargoed by State and city officials as the result of a joint survey by State, city, and Federal officials in a half-dozen mid-western cities.

The practice of shipping so-called incubator eggs in interstate commerce is a growing source of annoyance to food-control officials. One hatchery in Pennsylvania, with an egg capacity of 500,000, was found to be removing unhatchable eggs after they had been in the incubator for as many as 7 to 10 days. These were recandled and those showing clear were shipped to New York or other large cities.

## DOMESTIC DRUGS

The department's campaign against misbranded patent or proprietary medicines has continued without interruption. This work calls for the consideration of every label, carton, and circular used in connection with the sale of these products, and in no field of manufacture and sale is the advertising so prolific as in the patent-medicine business. Most of the new products encountered were falsely and fraudulently labeled and required either correspondence or personal interview for correction. In a great many cases seizure action and prosecution have been necessary.

One of the outstanding features of the work on drug products was the completion of an investigation begun several years ago which covered all pharmaceutical preparations found on the market. During this last year a high proportion of all the pharmaceutical samples collected in the inspection districts were either grossly deficient or contained an excess of the active medicinal ingredient. Owing to the variations in the individual tablets, caused by imperfect mixing of the ingredients, and to the natural deterioration of some of the ingredients, a notable example of which is nitroglycerin, the preparation of uniform pharmaceutical preparations is exceedingly difficult. The use of adequate control measures in manufacture, however, should keep from the market pharmaceutical products showing wide discrepancies from the label declaration.

Ampuls, preparations intended for hypodermic injection, and distributed in glass containers or ampuls, supposed to be in condition for instant use, were also investigated. It having been discovered that pharmaceutical tablets often vary widely from the declared strength, a survey of the ampuls on the market to determine whether or not the same variations existed was inaugurated. Some of them showed negligible variations, but a great many showed amazing deficiencies or a corresponding excess of the active ingredient. Little more than the laying of a foundation could be done this year. One hundred and thirty-one samples were analyzed, and as rapidly as possible the results were tabulated, and the appropriate pressure was exerted on the manufacturers whose products were found unsatisfactory.

Attention has been directed also to antiseptics and such preparations as acidophilus and Bulgaricus tablets and cultures. Nearly 50 per cent of the samples of products sold as mouth washes, nasal sprays, etc., and labeled as antiseptic or germicidal solutions, examined were wholly ineffective as either an antiseptic or a germicide. As a matter of fact, some of the samples contained viable bacteria. Within the last year or so the market has been flooded with so-called acidophilus and Bulgaricus preparations. The output of 21 manufacturers of these substances was analyzed during the summer of 1926. The result of this short investigation led the bureau to conclude that most of these products are useless. To be exact, 77, or 90 per cent, contained few or no active organisms, and those that did show acidophilus or Bulgaricus organisms contained them in such small amounts that it would be necessary to consume unheard of quantities to derive any benefit. The trade has been warned with respect to the general uselessness of these preparations, and notified of the Government's intention to rid the market of misbranded, deteriorated, contaminated, or otherwise illegal pharmaceutical preparations.

Early in 1926 several deaths were attributed to the use of impure anesthetics, ethylene being the agent used. The bureau was promptly notified and immediately began an investigation into the quality of anesthetics on the market. Several hundred samples were collected and analyzed and a great many seizures were consummated. At the present time the manufacturers themselves are engaged in a comprehensive investigation as to the cause of the deterioration of ether. The deterioration of ethylene was found to be due to lack of control in the manufacturing process.

#### IMPORTED FOODS AND DRUGS

The Federal food and drugs act provides for inspection of all imported foods and drugs at the time the shipments are offered for entry, when they are examined by collectors of customs or appraisers of merchandise in connection with the requirements of the tariff act. It provides also for the exclusion of all adulterated or misbranded foods and drugs. All such goods are not excluded, however, for while they are still in customs custody or under bond the privilege is granted of relabeling those that are not gross-

ly misbranded and of resorting or reconditioning those not intentionally adulterated. If such relabeling or reconditioning brings the goods within the requirements of the law, they are allowed entry; if not, they must be exported. Although inspection is made of all goods and the invoices covering them, samples are not taken of all shipments, but only of those suspected of being adulterated or misbranded. Past experience with products of similar nature and a knowledge of the practices of shippers make possible the control of many imported foods and drugs by means of a relatively small number of samples.

Practically all fields are covered generally, but certain fields are made the subject of special study from year to year. The following received particular attention during the fiscal year just ended.

**Cocoa beans.**—The high price of cocoa beans from Africa, the largest source of supply, has probably induced shippers to send forward many shipments of border-line or excessively moldy or wormy beans. As a result, not a few shipments have been detained and exportation required or special use permitted, which would eliminate their employment in making cocoa powder or other chocolate products. Similar action was taken on many shipments from Haiti. To devise some method of improving the quality of cocoa beans imported from the Gold Coast of Africa, a bureau representative visited the cocoa-bean plantations there, inspecting the product from the time it was harvested until it was loaded onto the ocean-going boats. Based on his recommendations, various requirements are now being made of the native growers and shippers, which, it is believed, will greatly reduce the number of shipments of cocoa beans detained at the port of New York because of excessive mold.

**Figs.**—Owing to the campaign against figs which have become moldy or show evidences of the action of larvæ or worms, a somewhat steady improvement has taken place in the quality of figs shipped to the United States. A special warning issued early in the year that every attention must be given to such improvement produced particularly noticeable results. A lower tolerance on objectionable figs has been issued, to take effect the coming season.

**Nuts.**—As a result of special attention through several years, a marked decrease was noted this year in the

number of shipments objectionable because of worms or mold, a common condition not long ago. Greater care in drying and in shipment of chestnuts has cut down the number of objectionable importations. Less than 5 per cent of the shipments of walnuts and filberts were detained. The percentage of Brazil nuts and cashew nuts detained because of moldy or wormy conditions was about 15 per cent. Shipments of almonds showed little deterioration from these causes.

**Medicinal preparations.**—Many shipments of medicinal preparations are detained because of false therapeutic statements. The number of shipments of products considered to be grossly misbranded, in that they were represented as treatments for such serious diseases as cancer, tuberculosis, influenza, and diabetes, when in fact there was no basis for the statement, was unusually large. Some of these products were preliminary shipments from a firm specially organized to exploit the product in question. Other shipments would have followed but for the action taken.

#### FOOD STANDARDS

The food standards committee, formerly known as the joint committee on definitions and standards, is composed of three representatives from the United States Department of Agriculture, three from the Association of American Dairy, Food, and Drug Officials, and three from the Association of Official Agricultural Chemists. Two meetings only were held during the year.

A definition and standard were adopted for cultured skim milk, cultured buttermilk, and a new definition was adopted for rice. The definition for sweetened condensed milk was revised in order that the requirements for milk entering into its composition might correspond to those for milk as defined. The definitions and standards for alimentary pastes and macaroni products, including noodles, were revised and adopted.

Several hearings and conferences were held upon the subjects of cultured skim milk, so-called process cheese, cream meal, a product of corn, and so-called smoked salt.

Schedules were prepared for the consideration of the committee on purified middlings (farina) and semolina, and on a series of strained tomato products. After discussion, action upon the proposed definition and standard for ice cream was deferred.

Since the last report a number of the definitions and standards adopted by the department, upon the recommendations of this committee, have been adopted by State food-control officials. Their general acceptance of these standards is resulting in greater uniformity in regulation of the sale of food products throughout the country.

#### CERTIFICATION OF COAL-TAR COLORS

The extensive chemical and physiological tests to which all dyes offered for inclusion on the list of certified colors are subjected were concluded on a new green dye, offered as St. Louis green and finally accepted as fast green FCF. Feeding and toxicological experiments on this dye and on light green SF yellowish and Guinea green B, the two green dyes previously certified, showed that in general the fast green FCF and the light green SF yellowish are about on a par and are superior to Guinea green B by one-half.

A report on the results obtained in the spectrophotometric study of the effect of the permitted coal-tar colors upon the hemoglobin of the blood has been prepared for publication. It was shown that these dyes, when mixed with defibrinated blood of cattle, cause the conversion of oxyhemoglobin to "reduced hemoglobin," a normal reaction. No evidence of methemoglobin, a danger signal, following the use of any dye on the permitted list could be detected.

Table 2 shows the quantities of food colors certified during the year, as compared with the quantities certified during the preceding four years.

TABLE 2.—*Coal-tar food dyes certified, 1923-1927*

Year	Straight dyes	Repacks	Mixtures	Batches	Number of firms	
					Total	New
	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>No.</i>		
1923...	250,756.0	20,216.00	239,614.00	633	27	4
1924...	232,305.0	26,956.00	286,148.00	724	30	6
1925...	315,848.0	39,013.79	254,060.00	883	34	9
1926...	311,434.5	32,234.00	304,040.22	1,075	38	14
1927...	277,044.0	28,844.13	374,804.28	1,172	52	10

The falling off in the total quantity of straight dyes certified has been more than offset by an increase in the quantity of mixtures and in the number of batches submitted for analysis.

Seven batches of straight dye, one repacked straight dye, one repacked mixture, and 26 mixtures were rejected.

Miscellaneous Circular 52, which gives the procedure for the certification of coal-tar food colors, has been revised and will be issued shortly as Service and Regulatory Announcements, Food and Drug No. 3.

#### FOOD-CONTROL INVESTIGATIONS

The enforcement of the food and drugs act each year calls for new and improved methods of analysis and examination to keep abreast of the new forms of adulteration which appear from time to time and to make it possible more efficiently to carry out the terms of the law. During the past fiscal year particular attention was given in the laboratory to the following products.

##### CEREAL PRODUCTS

Comparative analyses of farina and semolina indicated that farina has a higher water-soluble-nitrogen content precipitable by 40 per cent alcohol and lower ash, lipid, and protein contents than semolina. Ratios of lipoids, ash, and protein to water-soluble nitrogen precipitable by 40 per cent alcohol may be of value in differentiating between the two products.

Increasing the "prepanary" fermentation period of strong gluten doughs, containing 3 per cent yeast and 3 per cent sugar, from one hour to one and three-fourths hours produced loaves having more elastic crumb, and in other respects equal to, if not superior to, those made with the shorter fermentation time.

Baking tests were made with different flours using a "fixed type" of procedure in which, with the exception of absorption, the flours were the only variables. The same flours were also baked using the ordinary procedure in which the formula is about the only constant. The former method showed more strikingly the baking qualities of the flours.

It was demonstrated that if raisins are first soaked in malt extract they will not char when exposed to the direct heat of the oven in baking a raisin loaf. This practice is used by commercial bakers.

In the analyses of whole wheat and graham flours certain data to be used in differentiating between wheat meal and a scalped product were obtained.

The ratios of  $\frac{\text{starch}}{\text{bran}}$  and  $\frac{\text{CaO}}{\text{MgO}}$  seemed to indicate differences that might be considered diagnostic.

Commercial rye flours from Washington (D. C.) bakeries contained approximately the same amount of moisture as wheat flour.

A note on the influence of peptic digestion in the determination of total carbohydrates in cereal products was published in the Journal of the Association of Official Agricultural Chemists, volume 9, page 482 (November 15, 1926). It was found that permitting pepsin to act upon cereals prior to treatment with diastase greatly facilitates the conversion of starch.

The investigation of malted milk showed that no lipolysis occurs when a malt-flour infusion is permitted to act on neutral butterfat or dried whole milk. It was concluded also that with proper control of conditions with respect to temperature and hydrogen-ion concentration, a malt-flour infusion will cause digestion of milk protein. Regarding the preparation of malt-flour infusion itself, it was shown that: (1) A malt-flour infusion prepared at 65° C. has a hydrogen-ion concentration of about 5.7 and an acidity as lactic of approximately 0.14 per cent; (2) the mashing temperature does not materially affect the hydrogen-ion concentration; (3) the highest sugar degree is obtained at 55°; (4) the temperature of 55° does not permit of complete starch conversion in four hours, although by increasing it to 65° C. for one hour a maximum sugar degree is yielded.

##### CHEESE

The study of the effect of aging of cheese on the fat constants was completed. The results showed that the Reichert-Meissl number of the fat of Italian Pecorino cheese was lower and the Polenske number higher than those of the fat of cows' milk cheese and that aging produced a lowering of the Reichert-Meissl number. The Reichert-Meissl number of the fat of Roquefort cheese made from goats' milk was found to be abnormally low and the Polenske number higher as compared with the Reichert-Meissl and Polenske numbers of the fat from the goats' milk itself, but very little change took place upon aging with respect to these fat constants.

Satisfactory methods for the determination of added citric and tartaric acids as emulsifiers in process cheese were outlined.

## JELLY ROLLS

Experiments on the use of pure jellies in making jelly rolls demonstrated that the so-called "bakers imitation jellies" are not necessary in the manufacture of that product.

## SEA FOOD

During the last year the possibility was studied of determining accurately small quantities of acetic acid that might be present in canned marine products by distilling with xylene under vacuum from liquor acidified with phosphoric acid. This method did not prove as satisfactory as the less complicated methods in common use.

## CANNED GOODS

Experiments on a pack of blanched and of unblanched string beans showed that in some cases it is possible to get a full can when using unblanched beans. This work, taken in connection with that previously done on unblanched beans, indicates that some unblanched beans will increase in cut-out weight over put-in, and that others will decrease, owing probably to differences in maturity, growing conditions, or variety.

Experiments to determine the effect of freezing and thawing on canned peas showed that, after being frozen, the skin of the peas is much tougher than the skin of the peas in similar cans held at room temperature. No other effects were noted in these experiments, which were, however, too limited to permit final conclusions.

## CACAO PRODUCTS

A method for the estimation of milk protein in milk cacao products was devised and published in *Industrial and Engineering Chemistry*, volume 19, page 501 (April, 1927). Incidental to this study, a paper on the determination of casein in milk was published in the *Journal of the Association of Official Agricultural Chemists*, volume 10, page 259 (May, 1927).

## FRUIT ACIDS

A paper on the application of the Stahre reaction to the accurate determination of citric acid published in the *Journal of the Association of Official Agricultural Chemists*, volume 10, page 264 (May 15, 1927), sets forth the conditions required for obtaining maximum yields of pentabrom acetone from citric acid. It shows that under

proper conditions as little as 4.5 milligrams of citric acid in the aliquot under examination yields acceptable results.

The further study of methods for the determination of fruit acids disclosed the fact that for very small quantities of tartaric acid (5 milligrams) the Kling method is not always reliable. It is believed that for determining such small quantities, the second precipitation should stand overnight in order to complete the reaction. Determinations of malic acid by the official method (Dunbar-Bacon procedure) are not satisfactory for small quantities of the acid and work for perfecting the method is now under way.

## BEVERAGE AND FLAVOR INVESTIGATIONS

Because of the enormous increase in the distribution of bottled cocoa and cocoa-milk beverages preserved with hydrogen peroxide, accurate and dependable methods for the determination of minute quantities of this chemical in such food products have been worked out and described to State officials and its efficiency as a preservative in such beverages investigated. Federal and many State officials hold that hydrogen peroxide is not a proper ingredient of beverages. Hydrogen peroxide persists for a long time in such beverages and prevents bacterial activity as long as determinable quantities remain. The results of these studies are reported in two papers, entitled "Persistence of hydrogen peroxide in cocoa-milk beverages" and "Efficiency of hydrogen peroxide in preserving cocoa-milk beverages," to be printed in a trade journal. Through the studies on cocoa-milk beverages it was found that the powdered milk used was a serious source of contamination of the beverage. Consequently, samples of powdered milk from 39 manufacturers throughout the country have been procured and examined. The bacterial content of these samples varied from a few hundred to millions per gram. The organisms included nonspore-forming bacteria, resistant spores, and yeasts.

Manufacturers of imitation-maple flavors maintain that their products are not imitations because no one has ever manufactured genuine maple flavor. To show that such a flavor can be made, a laboratory process was developed for concentrating the flavor in maple sap or maple sirup to such a

degree that when from 2 to 4 ounces of it is added to a gallon of sugar sirup of suitable density a reconstituted maple sirup is produced which has the same composition and properties as ordinary maple sirup. A public service patent for a flavor to be manufactured by this process from maple sap, maple sirup, or maple sugar has been applied for.

The practice of adding imitation maple flavor to figs has been uncovered. Suitable action to correct this practice, or to insure proper labeling, is under way.

Samples of known origin of Michigan cherry juices and cherries have been analyzed and the results sent to the field force of the bureau and to State officials, as an aid in interpreting the results obtained in the examination of commercial samples of cherry products alleged to contain cherry juice.

The examination of 60 barrels of "cold-pack" strawberries and 25 barrels of "cold-pack" cherries was completed. The content of fruit juice in the samples was accurately determined by obtaining refractive indices of the fresh fruits and of the fruit sirups after storage. The results were sent to Federal and State food officials throughout the country.

Commercial drug products alleged to be radioactive reach the laboratory in many different states of physical condition, some as ores, some as clear liquids and opalescent liquids, and others as pills, pastes, etc. Methods for preparing these various kinds of samples for analysis of radium content have been developed and reported for publication.

#### DRUG-CONTROL INVESTIGATIONS

In cooperation with the Bureau of Home Economics, an extensive survey of cod-liver oils and cod-liver oil preparations found on the market was undertaken. Many products purporting to contain, in concentrated form, the active principles of cod-liver oil are offered for sale. Nearly all such preparations examined were either nearly or entirely lacking in vitamins. The truthful labeling of such products, not only as to composition but as to therapeutic representations, has received attention. Most of the oils so far examined, both domestic and imported, have been found to be of good quality. A close check is being maintained on imported cod-liver oils, for both human and animal use.

Results of a number of investigations on drug methods were published. These include researches on automatic devices for extracting plant material, the detection of diethylphthalate (an alcohol denaturant) in drug products, errors in the determination of alkaloids in the presence of soaps, suitability of chloroform for extracting alkaloids, the extraction of santonin in *santonica*, the stability of various alkaloids, such as atropine and hyoscyamine, during analysis, and methods for the examination of ipecac. Methods of examination of ginger and its various preparations, based on a study of its constituents, have been developed, also methods for determining cinchophen and podophyllum.

#### PHARMACOLOGICAL INVESTIGATIONS

The official bioassay standards specified in United States Pharmacopœia, X, were distributed to 21 firms and analysts in this country and to official investigators in England, Canada, Belgium, and Spain. During the year 65 samples of drugs and 106 importations of crude ergot were assayed. Two articles upon the assay of ergot were published. It was found that samples of crude ergot coming directly from Spain or Portugal were usually as strong as, or stronger than, the physiological requirements outlined in the Pharmacopœia, whereas those from Russia were usually below this standard physiological activity.

Experiments with the method of assaying mydriatics developed in the bureau have been extended to cover other mydriatics. The method has also been adapted to the quantitative assay of miotics. Information is now available upon atropine, hyoscyamine, hyoscyne, homatropine, cocaine, pilocarpine, and physostigmine.

In connection with a case brought under the Federal food and drugs act, apples were seized on the ground that they contained excessive spray residue. Chemical analysis showed the presence of 0.05 grain of arsenic per pound, which corresponds to 0.25 grain of lead arsenate per pound. Peelings of these apples were fed to rabbits over a period of about seven days, after which the rabbits were killed and their tissues examined. Marked hyperemia and submucosal hemorrhages in the stomach walls, and congestion of the cortical and medullary layers of the kidneys were produced. Arsenic was found throughout the body; lead was localized in the bones. This case was

tried before a judge and jury, and verdict returned for the Government.

Experiments in which di-lead arsenate was fed to rabbits brought out the interesting fact that lead and arsenic may be transmitted through the mother's milk to nurslings.

An article on so-called habituation to arsenic, published in the *Journal of Pharmacology and Experimental Therapeutics* (vol. 28, p. 351, September, 1926), gives the results of a series of experiments which showed that there is no probability that any noteworthy systemic or gastrointestinal habituation to arsenic will be developed.

The study of the effects on health of food contaminated with tin was continued. Pumpkin and asparagus containing varying quantities of dissolved tin were fed to a "poison squad" of volunteers from the Bureau of Chemistry. Only small quantities of tin, or none, were found in the urines voided during the experimental period.

The histological examination of tissues of animals fed sulphur dioxide indicates that large doses cause definite injury and that small doses may cause some damage.

From the studies conducted this year it appears that the minimum lethal dose of gossypol, injected intraperitoneally into rats, is 25 milligrams per kilogram for acute death and 15 milligrams per kilogram for chronic toxicity.

The results of a three-year series of collaborative experiments with the Bureau of Biological Survey on the production of red-squill powders for use as rat poisons have been prepared for publication. This work suggests that white squill is not toxic to rats but that red squill is. The most toxic red-squill powders are usually those that have been dried at 80° C. Death from red squill is due to selective central respiratory paralysis. After extensive independent commercial study, a manufacturer in Ohio is now equipped to use about 1 ton of squill bulbs a day in the preparation of rat poison.

The use of thallium to eradicate various rodents, such as Zuni prairie dogs, coyotes, and porcupines is increasing. As the minimum lethal dose of this substance to white rats has been found to be 25 milligrams per kilogram, the possible danger to human beings in its use has been pointed out. It is as toxic as strychnine, and from five to ten times as toxic as

arsenious oxide when employed as a rat poison.

In collaboration with the Bureau of Biological Survey, some 20 substances that were believed to be of value as attractants or repellents to rats have been tested. Naphthalene was the only one which offered much hope. The work indicated that there is a possibility of developing a commercially feasible rat repellent containing naphthalene.

#### MICROBIOLOGICAL INVESTIGATIONS

To detect spoilage and to develop effective means of preserving foods bacteriological studies must be made. Special attention was given to canned goods, cheese, and fish.

#### CANNED FOODS

Because of difficulties in interpreting the bacteriological cause of spoilage in many samples of canned foods examined in the laboratory, a field laboratory was set up where bacteriological experiments were conducted with a view to ascertaining the types of organisms responsible for decomposition. During the summer string beans, corn, and Lima beans were studied throughout the entire process of canning. The results on string beans showed that the most important source of organisms was the raw bean as it came from the field. Beans growing on the upper portions of the vine contained more organisms than those growing next to or on the soil. From 500,000 to 3,000,000 organisms were found on the lower parts of the vine and approximately twice as many organisms were present on beans from the upper portions of the same vine.

Experimental packs of string beans, corn, and Lima beans were put up during the canning season with a view to causing flat sour decomposition under varying conditions. Examination of these goods has shown that the only typical flat sours produced were from cans held eight hours in the sealed cans before processing.

#### PREVENTION OF SUGAR DETERIORATION

The proposal to use certain volatile substances to prevent the deterioration of raw sugar was investigated. It was found that formaldehyde, acetone, chloroform, and carbon bisulphide destroyed the mold inoculated into the sugar under the experimental

conditions, and that toluene and carbon tetrachloride failed to kill fungi. This indicates the possibility of preventing sugar deterioration under certain conditions by such means.

#### CHEESE STARTER

A striking example of the increased activity of a microorganism growing in close association with another species was found in the cheese starter used in the manufacture of Swiss cheese in certain regions. This consisted of a mycoderma associated with *Lactobacillus bulgaricus*. Investigation of the relation between these organisms showed that the acid production of the *L. bulgaricus* was approximately doubled by its association with the mycoderma. This mycoderma appears to be identical with Dombrowski's *Mycoderma lactis* alpha used in Finland for the manufacture of various milk products.

#### FISH

A large number of bacterial cultures from Scotch cured herring and other salted and preserved fish products were studied in pure culture with a view to identification. In the Scandinavian canned-fish products, which are sealed in cans without processing, the bacterial flora uniformly consists of streptococci, lactobacilli, aerobic spore-forming bacilli, and anaerobic spore-forming bacilli of the putrefactive type. The significance of these organisms has not yet been determined. The bacterial flora of Alaskan and Scotch salt herring consists of a multiplicity of forms, with aerobic and anaerobic spore-forming bacilli and streptococci predominating. The cultural reactions of a large number of these organisms have been studied, but, so far, no information has been obtained regarding the significance of any particular group. Whether or not any of these bacterial groups play a part in the normal curing or in the spoilage of this product can be determined only by the preparation of experimental packs in the field. The work on this problem has now reached the point where field work is indicated.

Some study has been made of the kind of culture media best suited for use in this work. Of particular interest is a group of so-called halophilic bacteria which are constantly present in the brine of Scotch and Alaskan salt herring. These organisms will grow only in the presence of at least

5 per cent salt and have been found to grow readily in the media containing 20 per cent salt. Following a study of the cultural reactions usually considered for the identification of an organism, an attempt was made to substitute for sodium chloride other chlorides and other sodium salts. Regardless of the reaction of these media and regardless of whether the salt added was computed on the molecular basis or on a percentage basis, growth of the halophilic bacteria occurred only on media containing sodium chloride, sodium sulphate, or sodium acetate, although very slight growth occurred on media containing lithium chloride. The reason for the support of such growth by sodium chloride, sodium acetate, and sodium sulphate, but not by the other salts used, is obscure. There is some indication that the sodium ion is necessary for growth of these bacteria, but that it must be in combination with some anion which is not antagonistic to the growth of microorganisms.

#### FOOD POISONING

Most of the samples of food suspected of causing food poisoning submitted during the year proved negative. These included bran, olives, home-canned string beans, and miscellaneous food products charged with causing enteric outbreaks. In one case the organism of dysentery was found. In a cheese-poisoning case the streptococcus previously reported as a cause of food poisoning was again isolated.

#### REDUCING SUGAR IN FRUIT JUICES

The possibility of reducing the sugar in fruit juices by the use of properly selected microorganisms was studied. Out of some 150 organisms several were selected as being capable of reducing all the sugar, under properly controlled conditions for growth.

#### MICROCHEMICAL INVESTIGATIONS

Microchemical methods of examination can sometimes be used more effectively than straight chemical methods in detecting adulteration and misbranding of foods and drugs. Often such methods are invaluable as supplements to the chemical methods. Since the passage of the food and drugs act many microchemical methods have been perfected in the bureau and the standards of comparison for



many products drawn up. The following received special attention during the fiscal year just ended.

#### CACAO PRODUCTS

Methods for making authentic cacao-product standards were described. The standard chocolate liquor containing 6 per cent of cacao shell was studied critically and the size of shell fragments in 25 samples of commercial cacao products was determined. Tests made with the euscope, suggested as a possible improvement upon the direct-vision microscope for determining shell, led to the conclusion that results by the direct-vision method are more reliable. The claim that a factor derived from standards containing small quantities of cacao shell would be higher than a factor derived from 100 per cent shell was disproved.

#### HONEY

The pollen content of various honeys was studied in an effort to determine, by means of count, a numerical expression for the proportion of the different kinds of pollen present. Results indicate that in many of the honeys named primarily on the basis of color, consistence, and flavor the proportions of the different kinds of pollen vary widely. One sample of a honey found to be poisonous contained a small quantity of Ericaceous pollen. Honey from the nectar of Ericaceous plants has long been regarded as poisonous.

#### DRUGS

The extent to which glandular materials are being exploited calls for improved methods for their microscopical detection and identification. Progress has been made on this difficult problem in animal histology.

#### FEEDING STUFFS

What are the smallest percentages of ingredients of feeding stuffs that can be detected by microscopical examination? To answer this question, mixtures of wheat middlings, linseed meal, and alfalfa meal in various proportions were examined. It was found that capable analysts can detect these products in 1 per cent quantities.

#### COOPERATION WITH STATE AND CITY OFFICIALS

At the close of the fiscal year the Department of Agriculture was co-

operating with each of the 48 States in the enforcement of at least one act. All but one of the States have food laws comparable to the Federal food and drugs act. In two or three States the existing laws are not enforced, owing either to lack of appropriations or to the inadequacy of their provisions.

The Federal department has extended its contacts to departments that enforce laws on dairy products and commercial feeding stuffs. The opportunity for contact with State officials has been increased by the enactment of a model dairy law in New Mexico, by citrus-fruit legislation in Texas, and by numerous State acts dealing with the labeling of dangerous poisons for household use, similar to the law passed by the last session of Congress covering interstate shipments and assigned for enforcement to this department.

The year just passed has demonstrated perhaps more clearly than any preceding year the value of cooperation with State officials. The department has been called on to face some situations of peculiar difficulty, such as the control of canneries and canner products and the control of shell eggs. It would have been impossible for the department alone to have coped with these situations as satisfactorily as was the case, particularly in the large egg-producing States and in those States where the canning industry is extensive. The fact that the services of State and city departments are frequently given without any possibility of recompense from this department in a material way is a tribute to the character of the men who are in official positions and an evidence of their whole-hearted acceptance of the cardinal principles of coordinated efforts.

#### TEA ACT

Table 3 shows the kinds and quantities of tea passed and rejected during the fiscal year ending June 30, 1927. All of the tea rejected, which amounted to 0.1 per cent, was rejected because it fell below the Government standard established under the tea act of March 2, 1897, in quality. During the last fiscal year no teas were rejected for being substandard in purity.

TABLE 3.—*Kinds and quantities of tea passéd and rejected during the fiscal year ended June 30, 1927*

Variety or port of entry	Examined	Passed	Re-jected for quality
	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
Formosa Oolong.....	9,792,293	9,792,243	50
Foochow Oolong.....	29,564	29,564	-----
Congou.....	2,605,857	2,605,807	50
India.....	19,355,784	19,288,720	67,064
Ceylon.....	25,255,879	25,245,374	10,505
Blended Ceylon and India.....	600,439	600,439	-----
Java.....	9,054,747	9,051,416	3,331
Sumatra.....	868,792	868,792	-----
Ceylon Green.....	330,206	330,206	-----
Ping Suey Green.....	8,306,149	8,301,449	4,700
Country Green.....	960,124	960,124	-----
Japan.....	17,091,294	17,091,118	176
Japan Dust.....	1,817,896	1,817,895	-----
Capers.....	669	669	-----
Scented Orange Pe- koe.....	23,262	23,262	-----
Scented Canton.....	580,443	580,443	-----
Canton Oolong.....	274,566	259,734	14,832
Jasmine.....	12,885	12,885	-----
India Green.....	628,668	628,668	-----
African.....	5,882	5,882	-----
Formosa Black.....	180	180	-----
Total.....	97,595,579	97,494,871	100,708
Boston.....	19,701,406	19,697,489	3,917
Chicago (9 months).....	2,306,941	2,306,941	-----
Honolulu.....	342,075	342,075	-----
Puget Sound.....	11,817,192	11,816,942	250
New York.....	53,074,737	52,991,334	83,403
San Francisco.....	10,353,228	10,340,090	13,138
Total.....	97,595,579	97,494,871	100,708

The importations of the fiscal year fell below those of the preceding year by nearly 1,000,000 pounds. During the last fiscal year the importation of Congou tea was less by about 4,000,000 pounds than it was during the preceding fiscal year. This severe falling off in the black-tea importations from China is no doubt due to the civil war in that country, as many of the best black-tea districts are in the territory over which the northern and southern Chinese armies are fighting. The importations of India black teas during the year increased by more than 2,700,000 pounds over those of the preceding year. This increase no doubt was brought about by the extensive advertising campaign now being conducted by the Indian Tea Association in this country. This campaign is also probably the cause of the doubling of the quantity of India green tea imported during the year. As compared with the preceding fiscal year, there has been a falling off in the importation of Japan green teas to the extent of nearly 2,000,000 pounds, but this has been more than taken care of by an

increased importation of over 3,000,000 pounds of Ping Suey green teas from China.

The general shifting during many years from a green-tea drinking nation to a black-tea drinking nation suddenly stopped this year—that is, if the kind of tea imported is a true index of what is consumed. The importation of green tea increased about 2 per cent and that of black tea decreased about 2 per cent, whereas the importation of semifermented or oolong tea about held its own.

The Boston station examined approximately 20 per cent of the total quantity, which is about 2 per cent more of the total amount than was examined in 1926. New York examined about 1 per cent less than in 1926, and the Puget Sound and San Francisco stations examined practically the same quantity as during the preceding year. On April 1, 1927, the office of the tea examiner at Chicago was discontinued because of the falling off in examinations there. All samples formerly examined in Chicago are now sent to Boston, which probably accounts for the increase in examinations at that port.

Only about one-tenth of the total quantity of teas rejected by the tea examiners were appealed to the tea board and only one protest, amounting to 4,700 pounds, was sustained. In the case of the other appeals taken from the findings of the tea examiners the importers were overruled.

#### INVESTIGATION OF TYPES OF TEA CONTAINERS

Tea packers and tea-container manufacturers, with whom the bureau has been cooperating in the investigation, continue to be actively interested in the study of the effects of different types of containers on the keeping of tea, and indirectly other food products, begun in September, 1925.

Although no results have yet been made public, it has been possible to give packers of tea and other food products information to meet their special needs. The investigation as a whole will probably be completed during the fall of 1927, when the results will be made public.

#### NAVAL STORES ACT

##### ENFORCEMENT

During the year inspectors operating under the naval stores act collected 133 formal and 57 informal samples

of turpentine and 16 formal and 28 informal samples of mineral spirits that were thought to have been advertised or sold in violation of the law. In only one instance was there an apparent disposition to continue this violation once it had been brought to the attention of the offending shippers. Steps have been taken to prosecute the concern involved. Apparently the sale of turpentine adulterated with mineral oil has decreased greatly in the territory covered by the bureau's naval-stores-inspection force. Through the efforts of the bureau also the use of steam-distilled wood turpentine for adulterating gum turpentine seems to have been discontinued. The fraudulent practice of reselling turpentine in original barrels on the basis of the gross gauged capacity of the barrel without allowance for the "outage" has been combated.

Formal samples from 25 lots of misgraded rosin were examined. In addition, approximately 3,000 barrels of rosin, representing 161 lots covering shipments of some 20,000 barrels to the larger north-central and eastern consuming points, were sampled and graded at distributing yards and consumers' plants. Only two citations were issued on account of serious misgrading, most of the grading being done within the limit of allowable error. These results indicate that the bureau's efforts to convince rosin producers and inspectors of the need for greater care and accuracy in grading have borne fruit.

Turpentine prepared as a by-product in the sulphate process of manufacturing paper pulp has a distinct, and sometimes disagreeable, odor. As the production and importation of this turpentine is increasing, and as no provision was made for it under the naval stores act, a hearing to consider a standard for "sulphate wood turpentine" has been called by the Secretary of Agriculture. This product is sometimes sold as steam-distilled wood turpentine, but is quite distinct from it.

#### SERVICE

Under the service features of the naval stores act, 32 samples of turpentine were analyzed upon request. Government certificates of analysis were issued on 14 of these samples, as they were the only ones taken directly from the original containers by Federal inspectors. The department has furnished regular rosin-inspection

service to naval-stores producers in Mississippi, Louisiana, and Texas.

During the year, 105,742 barrels of rosin were graded by department inspectors, 103,214 barrels at the turpentine stills in Louisiana, Mississippi, and Texas, and 2,528 barrels in northern consuming centers. It is estimated that under the regulatory and service features of the naval stores act combined, the department's representatives have graded or checked the grading of close to 8 per cent of all the rosin produced in the United States.

#### SESQUICENTENNIAL EXPOSITION

In connection with the participation of the department in the Sesquicentennial Exposition at Philadelphia the Bureau of Chemistry installed an exhibit which illustrated various phases of its research and regulatory activities. This exhibit was beneficial both in bringing the work of the bureau to the attention of the public and in establishing new agricultural and industrial contacts. A gold medal and diploma were awarded to the bureau by the exposition authorities for the various exhibits which it installed.

#### PUBLICATIONS ISSUED

The following publications were issued during the year: Report of the Chief of the Bureau of Chemistry for 1926; 18 Service and Regulatory Announcement Supplements, containing 900 Notices of Judgment (Nos. 14101 to 15000); 14 Food Inspection Decisions—No. 198, Wine Vinegar, Grape Vinegar, and Malt Vinegar; No. 199, Gluten Flour, Self-Raising, "Diabetic" Food, and Canned Pea Grades; No. 200, Milk and its Products; No. 201, Glucose, Mixing Glucose, Confectioner's Glucose; No. 202, Dutch Process Chocolate (Alkalized Chocolate) and Dutch Process Cocoa (Alkalized Cocoa); No. 203, Fruits and Vegetables; No. 204, Flour; No. 205, Meats and the Principal Meat Products; No. 206, Alimentary Pastes; No. 207, Sweetened Condensed Milk; No. 208, Rice; No. 209, Colors in Food; No. 210, Cultured Buttermilk; and No. 211, Adulteration of Oysters; Miscellaneous Circular No. 22, Supplement 3, Amendment to Regulations for the Enforcement of the Naval Stores Act; Department Bulletin No. 1475, Production and Utilization of Fats, Fatty Oils, and Waxes in the United States; Farmers'

Bulletin No. 1523, Leather Shoes, Selection and Care; 2 articles in the Journal of Agricultural Research—Toxicity of Dipyridyls and Certain Other Organic Compounds as Contact Insecticides; and Relation of Size of Oil Drops to Toxicity of Petroleum-Oil Emulsions to Aphids; and 123

articles in various trade and scientific journals. In addition the following short circulars were mimeographed for a limited distribution: Fast Green F C F; Investigations on Spices; Information Sheet on Feeds and Feeding Stuffs; Candy-making Bibliography; Chloropierin Bibliography.



