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[From Annual Reports of the Department of Agriculture for 1913.]

REPORT OF THE CHEMIST.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY,
Washington, D. C., November 24, 1913.

SIR: I have the honor to submit herewith a brief report on the work of the Bureau of Chemistry during the fiscal year ended June 30, 1913.

Very respectfully,

CARL L. ALSBERG,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

The work of the Bureau of Chemistry may be said to be divided into three groups:

(a) *Regulatory.*—The enforcement of the food and drugs act, which is designed to prevent the interstate shipment of foods and drugs which are unwholesome, or adulterated, or offered for sale under misleading labels. The Bureau of Chemistry gives assistance to the Insecticide and Fungicide Board by making analyses, holding hearings, and collecting samples.

(b) *Standardizing.*—The preparation of specifications for purchasing supplies, under contract, by the United States Government, and testing to see that supplies furnished are in accordance with the specifications.

(c) *Investigational.*—This work is of two types; the first serves more purely regulatory purposes and includes such investigations as the search for new forms of sophistication, the development of methods for the detection of adulteration, and the discovery of the cause and source of contamination in foods. The second type consists of constructive work looking to the development of new uses, sources, and methods of preparation of foods and drugs with reference to the conservation of the food supply, the prevention of waste, and the utilization of waste by-products. This type of work includes necessary investigations in analytical, agricultural, and biological chemistry. The two types of investigation merge into each other. An investigation undertaken solely for regulatory purposes often discloses facts which lead to constructive work of great importance and vice versa.

REGULATORY.

SHERLEY ACT.—The work of the Bureau of Chemistry under the food and drugs act during the year was greatly stimulated by two important acts of Congress amending this law. The first, known as the Sherley amendment, enacted August 23, 1912, deals with medicines branded with false and fraudulent statements concerning their effect on disease. To make this act rapidly effective, as many chemists as could be spared were transferred during the winter from food to drug work. These chemists, transferred to the laboratories in Washington, New York, and Chicago, in a few months analyzed hundreds of these preparations. As a result of this work seizure of several of these preparations was recommended and the resulting cases were won by default. Even at this early date a vast improvement in the labeling of medicinal preparations has resulted. Such positive therapeutic claims as "a sure cure," "a reliable remedy," and the like are being replaced on the labels by less misleading expressions, such as "will be found beneficial in" or "will relieve many of the symptoms of." Claims that preparations are cures for such serious diseases as tuberculosis or cancer do not appear on the labels as often as formerly.

Through the Secretary of the Treasury it has been possible to apply the Sherley Act to nearly all importations of drugs, so that false and fraudulent labels should soon disappear from imported medicinal products.

NET-WEIGHT ACT.—The second amendment, the net-weight act, enacted March 3, 1913, requires that all packages shipped in interstate commerce shall be plainly and conspicuously marked to show the quantity of the contents. Although this act went into effect immediately, it provides that no penalties shall be imposed for 18 months from the date of the enactment. The equitable enforcement of this act, apparently so simple, is actually very complex. Shrinkage, variations of containers, and errors in weighing, measuring, and counting by hand or by machinery must be studied for a vast variety of products. The gathering of this information devolves upon the Bureau of Chemistry. Many of the investigations show that manufacturers endeavor to furnish full-weight products, but that there are practical difficulties which cause variations in the weight of individual packages. Moreover, for the study of shrinkage, experimental shipments of a large variety of goods to various points in different climates are being made to detect changes in weight and bulk due to variations in temperature and humidity. At the same time the normal water content of foods is being investigated, a most important matter if the law is to be enforced intelligently. Though a vast amount of material is being accumulated in this way, it will be some years before all the necessary facts have been ascertained for all products.

INSPECTION.—The number of inspectors has been increased from 41 to 44. They have collected approximately 10,000 samples for examination, in addition to many other samples secured for information, and have visited several thousand manufacturing establishments to note violations.

A general policy of concentration has been inaugurated to insure greater efficiency. The inspectors have been grouped in the larger

centers, as far as practicable, and now cover their territory by traveling from these centers. As a result the work is more effectively systematized and the necessary clerical work can be done by clerks, so that the inspectors are free to spend nearly all of their time in the field. Thus the stations at Houston, Tex., and Oklahoma City, Okla., were abandoned and new headquarters for that section created at Dallas, Tex.

BRANCH LABORATORIES.—There are now 21 branch laboratories since, in accordance with the policy of concentration, the one at Galveston, Tex., has recently been closed. The Territorial legislature is contributing to the support of the laboratory at Hawaii. The work of these laboratories is mainly to hold hearings for manufacturers in their territory who have been cited under the act, to examine samples assigned to them, and, when called upon, to assist the local district attorney. Often they are directed to gather technical information concerning some industry in their territory. This year they have made extensive investigations, necessitated by the enactment of the net-weight act.

Special mention should be made of certain parts of the regulatory work.

MILK.—During the past winter and spring special attention has been paid to the milk in the small towns, which frequently have insufficient, if any, milk-inspection service. The small towns adjacent to the great cities have become the object of careful inspection, for in such places milk which can not pass the city inspection is often placed on sale. Formerly it was the policy to take one sample of a shipper's milk and if the bacterial count was very high to recommend prosecution. This sometimes resulted in injustice and frequently caused the producer to cease shipping, as he did not know how to improve the quality of his milk. The present policy is to examine a series of samples, to cooperate with the Dairy Division of the Bureau of Animal Industry in teaching cleanliness to producers of milk, and to prosecute, finally, if the producer fails to follow suggestions. This has resulted in a notable improvement without seriously curtailing milk production.

SHELLFISH.—The water and bacteriological laboratories cooperated in a study of the character of the water of the Potomac River and of the Maurice River, N. J., to determine to what degree these waters were polluted and the effect of such pollution on the shellfish obtained from these rivers. The investigation of the Potomac River was made with the active assistance and cooperation of the Maryland and Virginia State Boards of Health. This work has been completed. Further, the shellfish have been examined regularly, particularly those from waters believed to have been contaminated from sewage.

FLOUR AND FEED.—A comparison of the chemical composition of natural flour and flour bleached with chlorin has shown that the chlorin bleaching lowers the iodine number of the fat and introduces into the fat, which in natural flour contains hardly a trace of chlorin, a determinable amount of this element. This fact has been utilized in an analytical method for detecting a chlorin-bleached flour.

Investigations into the milling industry showed that it was a general practice to add screenings and mill refuse to mill by-products feeds during their manufacture. Many illegal shipments were seized. The adulteration of feed barley with weed seeds, hulls, screenings, or worthless material for the purpose of raising the weight before shipping consignments to ports on the Atlantic coast for exportation has been stopped.

OLIVE OIL.—During the last six months of the fiscal year the source and quality of a large number of samples of olive oil have been investigated. As a result of this examination it is believed that in some instances olive oil is intentionally misbranded by the shippers. The fine distinction between various grades of olive oil dependent on the places of production, which, as in the case of wines, is of much importance to the trade where it is determinable by the senses, has not been taken up by the department.

MALT BEVERAGES, WINES, AND DISTILLED LIQUORS.—Certain beverages are labeled as made solely from hops and malt when, as a matter of fact, they are made from malt mixed with grains. Seizures were made of these misbranded products. The facts obtained in an extensive investigation of the composition of beverages brewed under known conditions made this regulatory work possible. Certain wine manufacturers in Ohio shipped quantities of fictitious wines branded as if made from a particular variety of grapes grown in another State. Several shipments of this product were seized.

Spurious brandy under misleading labels has for years been imported. Its importation has been stopped.

Vodka, a potable spirit manufactured from potatoes or grain by a Russian Government monopoly, was found to be imitated very closely in containers and labels by various firms in New York City and Brooklyn. The liquor in these packages was found to be ordinary ethyl alcohol diluted. This led to the seizure and confiscation of many such illegal shipments and to the assessment of court fines against the manufacturers.

CANNED FOODS.—A most comprehensive investigation of the canning industry was conducted by the Bureau of Chemistry during the late summer and fall months of 1912. Effects of inspections made for several years past were apparent in the improved sanitary conditions of the factories, cleanliness of help, character of raw materials used, and their treatment. Since the issuance of Food Inspection Decision 144 most packers are raising the standards of their goods by eliminating various added diluents.

From August to October, 1913, a representative of the Bureau of Chemistry visited Italy and studied the manufacture of Italian tomato sauce and tomato paste, large quantities of which are annually imported into the United States. This study was made primarily to learn conditions of manufacture, particularly in regard to sanitation, as a guide for the examination of products offered for importation. Criteria have been set for foreign manufacturers for the entry of their products into the United States.

CITRUS FRUITS.—The marketing of unripe fruit, sweated to improve its color in the effort to conceal inferiority, was stopped through court action. Food Inspection Decision 150 was issued to

prevent the marketing of fruit rendered worthless by the frost in California.

PHYSICIANS' SUPPLIES.—Special attention has been given to products of physicians' supply houses which do not pass through the usual trade channels of wholesale and retail drug houses and therefore escape the notice of inspectors. Many of these products were found to be adulterated or misbranded.

STANDARDIZING.

Because of a tendency during the past year to let contracts for Government supplies without calling for samples of materials for which there were adequate specifications, fewer samples of contract supplies have been tested than in preceding years. On the other hand, more satisfactory work has been done on the examination of very many samples of deliveries of goods of a miscellaneous character. A large number of the samples examined were submitted by other departments and often necessitated investigations. Statistics concerning the variation in paper caused by the effect on sizing of the various methods of drying have been accumulated. Several States have followed the advice of the Bureau of Chemistry in purchasing paper for their archives.

INVESTIGATIONAL.

CITRUS FRUIT BY-PRODUCTS.—The study of the utilization of waste oranges and lemons is approaching completion. The experimental work on the manufacture of citric acid from lemon juice is practically complete. It has been found that the fruit which has heretofore been discarded will yield from 15 to 60 pounds of citric acid per ton. The citric acid, at the prevailing market price of 35 to 45 cents a pound, renders these culls worth from \$5 to \$25 a ton. Special endeavor to devise methods for the recovery of the essential oil in quantity from both oranges and lemons has resulted in a method by which 60 per cent of the oil present can be recovered. A yield as high as 6½ pounds of essential oil of orange or lemon has been obtained from a ton of fruit. These citrus oils have a market value of \$2.50 to \$5 a pound. The gross maximum income a ton from the best quality of culls by methods thus far devised would therefore approximate \$45. The laboratory has been open for inspection to citrus growers and to others interested in this work. Several companies are considering the manufacture of these by-products.

FRUIT BY-PRODUCTS.—Studies on the utilization of waste fruits were conducted in collaboration with the Bureau of Plant Industry to further the preservation and concentration of fruit juices. The studies on fruit respiration have been continued in collaboration with the Office of Experiment Stations, the work on bananas being practically completed.

GRAPES.—The estimation of the acid content of ripening Concord and Catawba grapes showed that the total tartaric-acid content is fairly constant in the green and ripe fruit, and that the malic-acid content is variable; that malic acid is eliminated during ripening, so that at full ripeness this acid is much less in quantity than the tar-

taric acid; that the amount of cream of tartar in the juice samples and in the water extract of the same whole fruit shows that this salt increases in the fruit during ripening; that cream of tartar is deposited as crystals in the ripening fruit; that free tartaric acid is always present in considerable quantity in green and in partially ripened fruit, but that in the well-ripened fruit it disappears to such an extent that the crushed and cold-pressed fruit often shows none at all.

The analytical results of technical samples of wines are now sufficiently completed to allow the determination of sophistication of native wines with starch-sugar, and also with cane sugar where this is used in any considerable amount. The chemical studies of normal pure wines and sophisticated wines from American native grapes have shown that under average climatic conditions a sound wine high enough in alcohol and low enough in acid can, with slight exceptions, be more easily produced than is commonly claimed. The slight exceptions are Ives and Concord grapes, which tend to have a low sugar content, while Clinton, Norton, and, occasionally, Catawba grapes tend to have a high acidity. Storage and maturing of these wines in wooden containers assist in bringing them into potable condition through the beneficial effects of fermentation processes which destroy the malic acid, and the natural precipitation of cream of tartar which takes place under these conditions is markedly beneficial to the product.

GRAPE JUICE.—Two field laboratories were established during the season for the manufacture of grape juice, one at Highland, N. Y., and one at Westfield, N. Y. The limits of variation in composition of the juice were studied to learn how to detect added water and to determine the cause of the presence of small amounts of alcohol in grape juice ready for the market. The results of this work show that the alcohol present is due to fermentation during pressing the grapes, and that no fermentation takes place in the juice after it is stored. This is important information, since fermentation decomposes some of the sugar naturally present in the grape and necessitates the addition of sugar to sweeten the finished product.

WILD CHERRIES.—A study of the products of the wild cherry was made, and information concerning the composition of this fruit, widely used as a flavor, has been obtained.

CRUDE DRUGS.—Analyses have been made of a large number of samples of anise and fennel seeds and cubeb berries to set standards for the composition of the pure articles and to detect the admixture of inferior or exhausted seeds. A method was developed to distinguish the genuine Peru balsam from imitation and from mixtures. The analytical part of the investigation of the adulteration of pyrethrum, or insect powder, has been completed. Results of the investigation of oil of chenopodium show that ascaridole, the medicinally active constituent of wormseed oil on which the vermifuge properties of the oil depend, is a very unstable compound of the peroxid type. Its relations to other compounds have been elucidated, and a number of new and interesting substances prepared from it.

CONDIMENTS.—The results of the examination of a large number of samples of pepper showed that the requirements in the standards given in Circular 19, Office of the Secretary, in regard to sand in pod

peppers are too low for the commercial product imported at the present time into the United States.

The proper conditions for detecting charlock, a common weed seed, in ground mustard and prepared mustard by chloral hydrate solution have been determined. Information has been collected concerning the occurrence of charlock in grain fields, the separation of the seed from grain, and the utilization of the seed for the production of oil and the practice of using ground charlock as an adulterant of mustard preparations.

An investigation of the impurities in table, dairy, and other grades of salt manufactured from the Ohio River Valley brines has been completed. Special search was made to detect in these brines the presence of poisonous barium chlorid.

Information furnished by the Bureau of Animal Industry indicated that a great many of the spices used by meat and sausage packing establishments were adulterated or misbranded. This prompted a general investigation of the subject by the inspectors and the collection of a great many samples for technical examination.

POULTRY AND EGGS.—The food research laboratory has extended to Missouri and contiguous States the demonstration of suitable marketing of poultry and eggs as conducted during two preceding years in Tennessee and Kentucky. A remodeled refrigerator car, in which mechanical refrigeration has been installed, has carried into the small towns a practical demonstration of the benefits to be derived by careful preparation for market combined with refrigeration. Ten carloads of turkeys, chilled in this refrigerating plant, were shipped to the North from Kentucky for the Thanksgiving and Christmas markets. In spite of the warm weather prevailing all arrived in excellent condition. Late in the year a study of breakage of eggs during transportation was begun. As the result of the work of the Bureau of Chemistry three establishments started the sanitary preparation of frozen and dried eggs in the producing section of the Middle West. A study of the methods for detecting the time of storage of eggs has been completed. During the summer of 1912 the deterioration of eggs and egg products was studied. The bacteriological laboratory investigated bacteriological changes in shell eggs preserved in varying solutions of sodium silicate. A method for the determination of reducing sugars in eggs was devised to ascertain the sugar content of yolks and whites. The decomposition of the sugar present in the egg by inoculation with *B. coli* was also studied. The results obtained indicate that the determination of reducing sugars may be applicable in judging the quality of frozen or dried eggs.

CORN MEAL.—The Chicago and Savannah laboratories have jointly investigated spoilage in corn meal. Through the cooperation of one of the mills visited shipments of bolted and of roller-process meal from degerminated corn were made under controlled conditions. This meal, stored in commercial warehouses under trade conditions, is being examined at stated intervals to determine the changes taking place. It is proposed to include unbolted, undegerminated, and stone-ground meal in future experiments. An effort has been made to secure the adoption of a uniform method for determining moisture, thus reducing this common source of disagreement to a minimum. At the same time this investigation will furnish valuable data for

the enforcement of the net-weight amendment. It will also determine the permissible limit of moisture in corn meal. Moisture is the most important factor in spoilage. Spoilage of corn meal has become a most important hygienic question in the South because of its alleged relation to pellagra.

GELATIN.—The investigation of gelatin has been continued. Results obtained show the presence in gelatin of such metallic impurities as zinc, copper, arsenic, and lead. The cause of these impurities has been shown to be the action of sulphurous acid on the zinc and copper containers during manufacture. This work will enable the manufacturers to avoid introducing these impurities into gelatin.

SUGARS AND SIRUPS.—A method for the crystallization of raffinose, one of the sugars from cottonseed meal, was devised, making possible a thorough study of this sugar. The experimental work in sorghum sirups has included manufacture on a small scale in eastern Kentucky, testing various methods of clarification, such as settling, heating, or addition of lime. Special investigations of maple sirup have been made to show the effect of the composition of the evaporators and buckets on the appearance and flavor of the sirups. Pure cane sugar is being prepared for use in determining the polariscopic standards for cane sugar. Cane sugar has been estimated by means of an enzym from yeast.

INSECTICIDES.—An investigation has been made of the toxic effect on fruit trees of certain constituents used in insecticides, notably copper and arsenic. Apprehension has been entertained by some, especially the orchardists of the semiarid or irrigated districts of the West, that the continued use of the large amount of spray containing these substances might ultimately result in a serious accumulation in the soil and consequent injury of the tree through absorption of poison by the roots.

CANNED FOODS.—The work of the canning laboratory established in California has been continued. Some of the investigations dealt with the best methods for canning the fruits and vegetables of the Pacific coast, all of which differ in composition from those of the East. Investigations of jelly making have been begun.

As a result of studies of the packing methods of canned white beans and pork and beans, it is now possible to judge when imperfect beans have been used. It was found that because of the competition in the market moldy and decomposed beans were used by some canners for certain grades.

The effect of feeding shellac to laboratory animals was studied, since shellac is now used to line tin cans to prevent corrosion. Shellac is also used in finishing certain kinds of candies.

Collaboration was continued in Washington with the Commissary General of the War Department and with the National Cannery Association to learn the effect of storage on canned foods, the gases normally within the cans, and contamination of the contents of the cans with heavy metals dissolved from the cans.

COAL-TAR DYES.—Special attention has been paid to amaranth, orange I, ponceau 3 R, and naphthol yellow S. A number of quantitative tests for individual coloring matters in food have been devised.

ANALYTICAL METHODS.—Investigations of analytical methods of various kinds are always needed in conducting various lines of work: Among those recently studied are: Methods for the examination of asafetida; the detection of small quantities of strychnin in the presence of large quantities of quinin; the determination of moisture, arsenic, and lead; and the determination of tin in canned goods. Some of this work is done in cooperation with the Association of Official Agricultural Chemists. The method on which the leather and paper laboratory has worked in cooperation with the American Leather Chemists' Association for determining glucose in leather has been fully established in this laboratory and made the official method of the association. The contracts laboratory has cooperated in a similar way with the American Society for Testing Materials and with the Bureau of Standards.

PHARMACOLOGICAL INVESTIGATIONS.—Information was obtained concerning the action of caffenin under a variety of conditions. Acute and chronic intoxications with salts of tin were studied and observations upon the action of tartrates were made.

LEATHER.—Work has been undertaken to determine by experiment the durability of sole leather of different tannages, loaded and unloaded, oiled and unoled, rolled and unrolled, bleached and unbleached. For this investigation and for the purpose of developing a laboratory method to determine durability of leathers, a machine has been designed for the purpose of imitating as closely as practicable the effect of wearing on sole leathers. A method whereby the kind of skin from which a piece of leather was made can be determined from a small piece of leather has been published. Work has been done in collaboration with the American Leather Chemists' Association on the disposal of tannery and leather wastes.

UTILIZATION OF WOOD WASTE.—Investigations on an industrial scale are in progress in wood distillation, and in the separation and refining of products therefrom, to secure information on the best conditions of preparation, and to develop best forms of apparatus for maximum yields of the several products. The work so far indicates that it is practicable to reduce the time required for distillation and to obtain larger yields of better quality of certain products. Successful experiments have been conducted in the separation of resin oils from the heavy oils obtained in the destructive distillation of resinous woods. The work to improve the quality of wood turpentine and to determine their technical value and their toxic effects, when used as paint and varnish thinners as well as when used for drug purposes, has been continued.



