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REPORT OF THE CHEMIST.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY,
Washington, D. C., October 15, 1918.

SIR: I submit herewith the report of the work of the Bureau of Chemistry for the fiscal year ended June 30, 1918.

Respectfully,

CARL L. ALSBERG, *Chief.*

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

The year has been one of readjustment. The urgent demands of the various war agencies, the scarcity of technically trained men, as well as the new work authorized by the Food Production Act, made it necessary to close up such projects as have no immediate bearing on the prosecution of the war as rapidly as they could be brought to such a stage that the time, the effort, and the money expended upon them would not be lost. The scientists thus liberated have been assigned to work for the various war agencies or else have been used to fill the gaps in the bureau's force engaged in the enforcement of the Food and Drugs Act. Greater vigilance than ever before has been necessary in the administration of this statute, since the general changes in the organization of the trade, as well as the scarcity or high price of many materials, have proven a great temptation to sophistication. Hence it has been necessary to make every effort to keep the bureau's regulatory force intact, though this has not been possible, even approximately. The rapidity of the turnover of the personnel is shown by the fact that on April 5, 1918, of a total force of less than 650 employees of all kinds more than 270 had been employed in the bureau for one year or less. There were in addition a great number of vacancies.

In spite of these handicaps and in spite of the very large demands upon the bureau made by the war agencies, the work of the bureau shows no great falling off. Eight hundred and one food and drug cases were sent to the Solicitor for consideration with a view to prosecution—a somewhat larger number than in the previous year. This was due in the main to the zeal of the bureau's field force. During the year the organization of this force was modified, in that the three districts were subdivided into stations, the chemists as well as the inspectors at each station being put under the direction of a single official, who in turn is responsible to the chief of the district. The results have amply demonstrated the wisdom of this plan.

Concerning the research activities during the year the bureau prepared or cooperated in the preparation of 15 Department Bulletins, 1 Farmers' Bulletin, 1 Yearbook article, and 1 circular of the

Office of the Secretary. In addition, the results of more than 60 investigations were made public and those of about 30 others are in press. The experimental work upon a number of other investigations has been completed.

The bureau has endeavored to meet, or even to anticipate, the needs of the various war agencies. Every single request for assistance has been met, so far as it has lain in the bureau's power. Indeed, more offers of assistance have been made by the bureau than the war agencies have found it possible to accept. In consequence, the war work of the bureau has been most diverse and there is hardly a war agency with which the bureau has not cooperated. Much time has been given by members of the bureau to service upon important war committees, to the furnishing or gathering of technical information requested in connection with war matters, and to acting as consultants. The technical war work of the bureau has ranged from the analysis of the garbage of the cantonments to the supervision of chemical plants manufacturing war materials. The bureau has not been intrusted with the responsibility for any one single large chemical war undertaking, but it has assisted in innumerable ways whenever opportunity presented. Many of the details of such war work are given in the following pages. Some of it is of too confidential a nature to mention.

Under the provisions of the Food Production Act of August 10, 1917, enacted by Congress for the purpose of stimulating food production during the war, the work of the bureau was shaped in the following directions: The prevention of spoilage and waste in the handling of poultry and eggs; the stimulation of the production of sea food; the stimulation of the consumption of fish and the prevention of spoilage in the transportation of fish to market; the prevention of dust explosions and fires in mills, elevators, and thrashing machines in order to conserve grain; the stimulation of the industry of dehydrating fruits, vegetables, and fish in order to conserve perishables. The details of this work will be found in the following pages, under the general headings of conservation, demonstration, and technological investigations.

During the past few years the wisdom of the legislation authorizing the bureau to "furnish * * * samples of pure sugars, naval stores, microscopical specimens, and other products" has been demonstrated. The interruption of imports created a famine in rare and unusual chemicals necessary in chemical and medical research and practice. In a number of instances the bureau has been able, acting under the authority above quoted, to assist by supplying such rare materials as certain sugars, dyes, amino-acids, and organic chemicals. The service thus rendered has not been extensive. It should, however, be extended, since there is perhaps nothing more important that a Government agency might do to assist in the establishment of a strong, self-reliant chemical industry.

ENFORCEMENT OF THE FOOD AND DRUGS ACT.

While the changes in the trade and the scarcity and high price of raw materials have tended to revive flagrant types of adulteration and misbranding that have been almost unknown for a decade, the spirit pervading the country has been such that the bureau, with its

collaborating State and municipal officials, and in some instances with the cooperation of the United States Food Administration, has been able to get results in the suppression of such abuses very much more speedily than would be possible in normal times. The interest of the Food Administration in certain of these matters has been due to the fact that practices which lead to a violation of the Food and Drugs Act also lead to waste, either in food or in basic materials, such as tin, steel, and coal, or in transportation facilities. The outstanding features, therefore, of the year's work in the enforcement of the Food and Drugs Act have been the recurrence of practices long since discarded as objectionable and more effective cooperation with other officials. To these may be added the fundamental changes in the nature of the food and drug materials offered for import because of Government control of shipping.

In two cases the courts have handed down decisions of importance in interpretation of the law. In the first of these, published in Notice of Judgment 6142, the Circuit Court of Appeals for the Seventh Circuit affirmed the judgment of conviction in the lower court against the Union Dairy Co. for a shipment of milk from Troy, Ill., to itself at St. Louis, Mo., the charge being that the milk was watered, and also filthy, putrid, and decomposed. The Union Dairy Co. contended that it was shipping the milk from a receiving station in Illinois to itself in Missouri, there to be treated, impurities removed, and the milk standardized; that while in transit it was not an article of food as defined by the Food and Drugs Act and did not become such an article of food until after treatment. The Circuit Court of Appeals held that it would be an unjustifiable construction of the act to make liability turn upon a difference in identity of consignor and consignee or the secret intent with which a shipper made the shipment; that it was also unnecessary for the court to receive evidence to establish the fact that the addition of water to milk injuriously affected the quality or strength of the milk.

In the other case, as reported in Notice of Judgment 6151, the United States Supreme Court reversed the judgment of the District Court sustaining a demurrer to the indictment alleging an article labeled in part "Compound Ess Grape" to have been adulterated and misbranded. The article did not contain any product of the grape, and the United States Supreme Court held "to call it 'compound essence of grape' certainly did not suggest a mere imitation, but on the contrary falsely indicated that it contained something derived from grapes." Mr. Justice McReynolds delivered the opinion of the court and made the comment, "The statute enjoins truth; this label exhales deceit."

DOMESTIC FOODS AND DRUGS.

Six hundred and thirty-one recommendations for criminal prosecution and 460 recommendations for seizure were made through the Office of the Solicitor to the Department of Justice. Reports of the termination in the courts of 807 cases were received by the department. Of these, 149 represent cases alleging false and fraudulent labeling of medicines or misbranding of drugs, in all of which the courts found for the Government; and 147 represent cases alleging adulteration or misbranding of stock feeds, in all of which save two the courts found for the Government. Ninety-five of the 807 cases

were reported to the United States district attorney by collaborating officials of the various States and the District of Columbia.

The accompanying table gives the distribution of the official samples examined by the various field stations. In addition thousands of shipments were examined in the field, hundreds of which involved a preliminary laboratory examination not reported in the table.

Report of field stations for year ended June 30, 1918.

Station.	Import samples.				Interstate samples.			Miscellaneous samples.	Total samples analyzed.	Hearings.	
	Legal.	Illegal.	Released without prejudice.	Floor inspection samples.	Legal.	Illegal.	Check analysis.			Personal.	By correspondence.
Central district:											
Chicago.....	208	144	9	667	239	456	120	741	1,917	204	201
Cincinnati.....	79	16	0	57	50	165	23	180	524	45	179
Minneapolis.....	35	65	5	178	94	69	3	341	612	100	83
New Orleans.....	2	59	0	379	84	140	21	547	853	80	152
St. Louis.....	41	29	0	46	2,907	1,289	14	953	5,233	179	172
Total.....	365	313	14	1,327	3,374	2,119	181	2,762	9,139	608	787
Eastern district:											
Boston.....	134	185	182	7,345	65	187	2	245	1,007	179	99
Buffalo.....	76	197	49	28	24	72	6	138	559	90	71
New York.....	4,428	2,643	737	11,830	188	307	45	109	8,457	306	2,542
Philadelphia.....	137	94	24	638	74	134	1	225	689	136	39
Porto Rico.....	295	405	167	2,085	17	11	1	752	1,648	534	194
Savannah.....	32	3	0	0	155	241	0	555	986	25	67
Washington.....	38	19	1	1	314	378	76	748	1,574	162	108
Total.....	5,140	3,546	1,160	21,927	837	1,330	131	2,772	14,920	1,432	3,120
Western district:											
Denver.....	8	12	5	260	39	47	1	147	259	8	7
San Francisco.....	333	497	77	13,814	133	174	15	1,198	2,428	462	116
Seattle.....	156	256	26	8,401	95	83	3	477	1,096	186	73
Honolulu.....	6	36	0	786	0	1	0	37	80	36	0
Total.....	503	801	108	23,261	267	305	19	1,859	3,863	692	196
Grand total.....	6,008	4,660	1,282	46,515	4,478	3,754	331	7,393	27,922	2,732	4,103

The service and regulatory announcements published during the year contained 46 opinions and 1,250 notices of judgment. The following six food inspection decisions were issued:

- No. 171. Macaroni, Spaghetti, Vermicelli, Flour Macaroni, Flour Spaghetti, and Flour Vermicelli.
- No. 172. Condiments other than Vinegars and Salt.
- No. 173. Canned Vegetables, Canned Peas, and Canned Pea Grades.
- No. 174. Baking Powder.
- No. 175. Colors in Food.
- No. 176. Evaporated Apples.

Of these, all but No. 175 are based upon recommendations of the Joint Committee on Definitions and Standards.

The control of shipments of polluted or spoiled food products has continued a major project of the bureau. In controlling and preventing the shipment of decomposed shell eggs the bureau has cooperated with the United States Food Administration and with the State and municipal food officials in developing a plan to prevent the shipment of uncandled eggs. This has resulted in the speedier consignment of eggs to market, with a consequent prevention of spoilage and saving of shipping space formerly occupied by inedible

eggs. It is reported that never before have the eggs arriving in the market been of so uniformly high quality.

Continued attention has been given to the sanitary supervision of the milk supplies at certain points receiving milk in interstate or foreign commerce. At the same time steps have been taken in cooperation with the local officials to improve the very poor sanitary conditions in some of the milk condensaries. The standardizing of milk for condensing purposes has been investigated. A large amount of work in connection with the examination of samples of condensed milk has been performed for the information of the Quartermaster's Department of the Army, the United States Food Administration, and the allied Governments.

With a view to preventing the shipment of polluted clams by the methods which have been largely successful in preventing the shipment of oysters from polluted beds, a study of the clam industry has been begun.

The work begun in other years to prevent the packing of decomposed tomato stock has been continued and extended, and steps have been taken, in cooperation with local officials and with the manufacturers themselves, to improve the sanitary conditions of the packing plants. The adulteration of canned tomatoes with added water has also received much attention.

The extensive use of corn meal and corn flour as a substitute for wheat flour has made it necessary to give attention to shipments of spoiled corn meal which have deteriorated, owing to unfavorable conditions of manufacture, storage, or shipment.

As already indicated, scarcity of supplies and high prices have made it necessary to give much attention to types of food products which have not in recent years been especially subject to sophistication. For example, owing to the embargo upon olive oil, much so-called olive oil actually consisting wholly or very largely of cottonseed oil or corn oil has found its way upon the market. Drastic action in the way of seizure and criminal prosecution has been necessary to correct this type of violation.

The shortage in the apple crop during the past two years has occasioned the use of distilled vinegar as an adulterant, and it has been necessary, therefore, to give especial attention to shipments of vinegar.

The high price of eggs has brought forth a flood of so-called egg substitutes. As a general rule, these preparations consist essentially of a mixture of starch and baking powder, colored yellow, with or without added casein. They have neither the food value nor the effect of eggs in cooking or baking, and are sold under labels which bear extravagant claims as to their culinary value and at prices far in excess of their intrinsic worth. A study has been made of such egg substitutes, and action inaugurated.

The cessation of importations of gelatin led to the sale as edible gelatin of glue contaminated with mercury or zinc, a practice against which action was begun last year, and continued with success this year.

Much attention has been given to the adulteration of oats with barley, weed seeds, and screenings, and seizures and criminal prosecutions in such cases have been instituted.

The campaign against cottonseed meals adulterated with hulls, and cottonseed meals which are not up to the guaranty of protein and fat and are over the guaranty of fiber given upon the label has been continued. Though many cases have been made and conditions greatly improved, the situation is not yet entirely under control, so that this work will be prosecuted with vigor during the coming year. After a cooperative study with the Bureau of Markets, a "Notice to Shippers of Cotton Seed" was issued, outlining the position taken by the department relative to the illegality of the practice of returning, or deliberately adding, foreign matter to cottonseed.

Descriptive definitions have been announced for hominy feed, corn feed meal, alfalfa meal, ground cottonseed hulls, and cottonseed hull bran. Definitions for linseed meal, oil meal, old process oil meal, new process oil meal, and flaxseed meal have been suggested to, and tentatively adopted by, the Association of Feed Control Officials of the United States. Action has been taken against manufacturers who adulterate linseed meal with screenings oil feed. Tankage containing garbage has been found, and action has been taken against such products sold under a false guaranty of composition or adulterated with considerable amounts of sand and glass.

Investigation of rye milling has shown that there is little chance of the contamination of rye flour with ergot. This passes mostly into the screenings, and is used in poultry feed. Such poultry feeds are under investigation. Vigorous action has been taken against the illegitimate use of rice hulls.

The education of shippers of fruits and vegetables concerning the requirements of the net-weight amendment to the Food and Drugs Act was attempted. Also an extensive investigation of the canned-goods industry, with a view to the control of the practice of "slack filling," has been made. At the present time this practice of underfilling the can or of substituting water or brine for a portion of the food product which it should contain is especially pernicious, not merely because it may deceive and defraud the consumer, but also because it is accompanied by a waste of shipping space and of valuable basic material, such as tin and steel, of which there has been a shortage.

Food Inspection Decision 175, on "Colors in Food," which was issued during the year, amends Food Inspection Decisions 76, 117, 129, and 164 by adding to the permitted list four dyes soluble in alcohol and oil and more or less suitable for coloring butter and fats. No batches of these dyes have as yet been submitted for certification. Certification was, however, asked in all for 20,327 pounds of dyes, as compared with 46,802 pounds in 1916-17. The quantities of amaranth, erythrosine, and indigotine, for which certification was asked, were greater than in the preceding year.

One hundred and forty criminal prosecutions and 30 seizures were inaugurated against "quack" medicines, and increased attention was given these products when offered for import. In cooperation with the Public Health Service the traffic in "quack" medicines for the treatment of venereal diseases was surveyed in the vicinity of the cantonments. No evidence of an increased sale of such products in these localities was obtained.

As a contribution to the department's program to increase pork production a vigorous and successful campaign against fraudulent hog-cholera remedies was conducted.

The campaign to improve the practice of dispensing by retail pharmacists in the District of Columbia, which has been in progress for some years, has been continued. There is still room for some improvement in the practice of the druggists of the District of Columbia and of Porto Rico. Carelessness continues, so that a considerable number of cases have been referred to the courts. Moreover, the retail drug trade seems slow to adjust itself to the requirements of the new Pharmacopœia and the new National Formulary. Conditions, however, have in general improved. A few years ago the carelessness prevailing was so great that hundreds of prosecutions might have been brought had it not seemed wiser to cite as a warning in the less flagrant cases of carelessness and prosecute only in the more flagrant ones. It is believed that similar conditions have prevailed, perhaps still prevail, in many other sections of the country, and that the practice in the District of Columbia was not far from the average of the country when this campaign was begun. There is need that the drug-control officials of the country give more attention to the suppression of carelessness in pharmaceutical practice.

Carelessness was also found in the practice of physicians' supply houses. The products of more than 20 of these were examined, and many cases of deficiencies of the active ingredients were found, as well as not a few substitutions of a cheaper drug for an expensive one.

COOPERATION WITH STATE AND MUNICIPAL OFFICIALS.

One hundred and fifty-six cases were instituted by officials in 29 States under the Federal Food and Drugs Act, 61 criminal prosecutions, and 95 seizures. Among these there were 64 food cases and 1 drug case, as against but 9 food cases and no drug case last year, conclusive evidence that food-control officials are beginning to use the Federal act for the protection of their people in the manner in which feed-control officials have long availed themselves of it. It is thus evident that effective cooperation between Federal, State, and municipal officials is spreading.

The character of the "Clearing House Letter," described in this report for last year, has been changed to include not merely last-minute regulatory information but also plans or programs of work intended to be carried out month by month in the immediate future. Under the title of "The Monthly Review of the Bureau of Chemistry" it goes to about 400 officials. The Office of Cooperation of the bureau, with the help of the bureau's library staff, is compiling laws, regulations, definitions, and standards, both domestic and foreign, applicable to foods and drugs, for the use of officials.

Correspondence between the bureau and city and State officials has been far greater than during previous years, an indication that a much larger measure of educational work relating to food and drug control is being done than formerly, thus adding undoubtedly to the efficiency of city and State food and drug control. There have been many specific instances of cooperation between local officials and the bureau's field force.

IMPORTED FOODS AND DRUGS.

Figures indicating the extent of the import work are given in the table on page 4. New products obtained from countries that have not heretofore shipped to the United States and new varieties of the old from new sources continue to be offered. Many products, for example, African ginger and Argentine cheeses, have been arriving not infrequently in a decomposed, moldy, or wormy state, owing to the disturbed shipping conditions, which give rise to serious delays. Because of disorganization of the trade other materials continue to be poor in quality. For example, about 15 per cent of the importations of black pepper offered for entry were found to contain excess of dirt or shells. Among drug substitutes offered for entry may be mentioned: *Piptostegia pisonis*, offered for jalap (*Exogonium purga*), and found to contain 20 per cent of an active purgative resin, differing from other purgative convolvulaceous resins hitherto described; *Glycyrrhiza uralensis*, for licorice (*Glycyrrhiza glabra* var. *typica* and *glandulifera*); *Digitalis thapsi*, shipped from Spain for *Digitalis purpurea*; the single flowers of wild Roman chamomile (*Anthemis nobilis*), for *Matricaria chamomilla*; *Pteris* sp., for sarsaparilla (*Smilax* spp.); pebbles and *Amomum* sp., for cardamom seed (*Elettaria cardamomum*); *Artemisia pontica* and *Artemisia arborescens*, for *Absinthium*; *Aethusia cynapium* leaves, for *Coivum maculatum*; *Cuprea* bark, for *Cinchona*; and spurious cantharides for the genuine. In cooperation with the United States Public Health Service, all importations of synthetic organic arsenicals were examined, and held to the standards prescribed by the Federal Trade Commission for domestic manufacturers licensed under alien enemy patents.

CONSERVATION OF FOODSTUFFS.

POULTRY AND EGGS.

A number of projects have reached such a stage that the results have been published in the following Department of Agriculture Bulletins: No. 565, "How to Candle Eggs"; No. 663, "The Installation and Equipment of an Egg-Breaking Plant"; No. 664, "The Prevention of Breakage of Eggs in Transit when Shipped in Car Lots"; No. 657, "A Wheatless Ration for the Rapid Increase of Flesh on Young Chickens."

SEA FOODS.

A part of the work on the preservation of fish by freezing has been published as Department Bulletin 635, "The Commercial Freezing and Storage of Fish." Under the title "A Chemical Study of Food Fishes," analytical data on the composition of 20 common species have been recorded. Analyses of 16 varieties of fish ordinarily shipped from Florida or the Gulf of Mexico coast, and of 20 varieties from the coast of California have been made. Some of these data will be used by the California State Council of Defense in a campaign to educate the people to eat more fish and sea foods. Accurate cost data on the best methods of preserving Pacific coast fish were secured. The most promising results were obtained in smoking sardines, kippering shad, and salting mackerel, rock cod, and

barracuda. Although the preservation of sardines by the Scotch cure was very successful, this product seems more suitable for home consumption than for shipment East, since lengthy storage tends to turn the oil rancid. The determination of the constants of the oil showed it to be quite unsaturated. Directions for the preparation of smoked sardines and also kippered shad have been widely distributed, and it seems likely that a fish-curing industry will shortly establish itself on the Pacific coast. Improved methods of drying fresh and salt fish have also been studied at Gloucester, Mass.

A report on the sardine industry of Maine, containing recommendations for better and more economical methods of operation, has been prepared. A paper on the formation of ammonia and amines in canned sardines during storage has been published. Special investigations on the proper methods to be followed in drying, salting, and frying sardines for canning have been made. Successful experiments were made on the prompt removal by vacuum of water from sardines after steaming and inverting, and on the various oils and blends of oils as possible substitutes for olive oil, which is now almost unobtainable. The use of traces of essential oils and highly flavored oils to make cottonseed and peanut oil more attractive for packing sardines promises to be of value. A study, with electric thermometers, of the "heating" of sardines on the boats did not confirm this popular idea. Better methods of handling fish before canning were introduced.

The feasibility of canning fish hard frozen immediately after capture has been investigated with a view to determining whether by this means canning operations might be made more continuous, especially in localities with a warm climate, such as the coast of the Gulf of Mexico.

DEHYDRATION.

Much work was done to assist in the establishment of an industry for the drying of fruits and vegetables, so that these perishable products may be carried over economically from the period of abundance to the period of the year when production all but ceases. Many methods of drying and many types of drying equipment were employed, and the collection of cost data, apparently at present unavailable, begun. Much attention was given to the preparation of the products for the drying operations, since in many cases the palatability of the final product is greatly influenced by the preliminary treatment. The best methods of storage and of preparation for the table were also investigated. In much of this work the bureau enjoyed the cooperation of the Sanitary Corps of the Army.

DEMONSTRATION.

There is little of the bureau's regulatory or investigational work that is not promptly demonstrated to the industry. This year, however, as food conservation and production measures, the educational work on poultry, eggs, and fish, and on the prevention of explosions and fires in thrashers, mills, and elevators, was prosecuted with especial vigor.

POULTRY AND EGGS.

Work in the Imperial Valley of California resulted in the shipping of a large crop of turkeys dressed instead of alive, with the saving of 10 or 20 per cent shrinkage in weight. Demonstrations of the handling of eggs for market and storage and of the fleshing of broilers, so that the cockerels not only paid for themselves but returned a profit and provided almost twice as much foodstuff as heretofore, contributed in making the hatch in California larger this year than ever before. In Texas similar demonstrations were held in 19 counties. In the Salt River and Yuma Valleys in Arizona and the Pecos River Valley in New Mexico demonstrations to increase the turkey crop have been begun. In cooperation with the State Agricultural College much has been accomplished in Arkansas. Extensive candling demonstrations have been given in Louisiana. Much success has been met with in improving the methods of handling eggs in Mississippi and Alabama.

Demonstrations on the best methods of fleshing poultry have kept practically all of the feeding stations in Tennessee and Kentucky open and filled to capacity, where last year a number were closed because of the high price of feeds and lack of knowledge on the part of the feeder as to how to use to advantage such feeds as were available. It has been estimated that during 1918 more than 1,000,000 pounds of chicken flesh, which otherwise would not have been obtained, will have been produced in these States.

Egg-candling campaigns have been conducted in Kansas, in cooperation with the State Agricultural College and the State Food Administration. Similar work to improve the handling of eggs has been done in Missouri and in Iowa, in cooperation with the State Agricultural College, the State Food and Drug Department, and the State Food Administration. A similar campaign was conducted in Nebraska.

FISH.

In cooperation with the Bureau of Fisheries and the United States Food Administration, a campaign to develop the fisheries on the Gulf of Mexico, especially on the western coast of Florida, and to distribute the catch in the cities of the Middle West, has been very successful. The bureau undertook to arrange for and supervise the shipment of fresh fish, and the Food Administration propaganda in the cities of Nashville, Louisville, and Indianapolis, as well as the fine quality and the moderate price of the fish, caused greater consumption than in previous years. A market for Gulf fish has now been created in these localities, where this year these fish will probably be moved in large quantities during the autumn and winter. As a consequence, the fisheries at Fort Meyer, Punta Gorda, and near-by ports have been active all summer, instead of practically closing down. Plans are being made to establish freezers at suitable places on the Gulf of Mexico, to prevent gluts due to heavy catches and to insure an even distribution of fish as well as its better condition on arrival at the market. One freezer is in process of construction. For another, which includes a well-equipped general plant, bids have been submitted to contractors. A third is under serious consideration. The bureau has also been able to straighten out diffi-

culties in transportation of fish in a number of localities, notably on the North Carolina and Virginia coasts, where the service to the northern markets was upset by the congestion of the railroads.

MILL AND ELEVATOR DUST EXPLOSIONS AND FIRES.

A general fire and explosion prevention campaign has been carried on in order to reduce the great losses due in many instances to lack of knowledge on the part of employees. At meetings held in various parts of the country mill and elevator owners and employees were shown, by means of moving pictures, lantern slides, and miniature dust explosions, the danger of dust explosions and fires, and were made acquainted with the circumstances under which they occur. Following the meetings the various mills and elevators were inspected and recommendations made to the managers and superintendents with reference to arrangements which appeared dangerous. The men were then asked, by means of special cards, to pledge themselves to take all possible precautions to prevent fires and explosions in the plants where they were employed. The signing of the cards was acknowledged by the department and appropriate cards sent to the men. Through posters, circulars, and the like, much publicity was given to the work, and, while from the nature of the situation it is as yet impossible to prove in figures that this educational campaign has resulted in the conservation of much grain and feed that might otherwise have been lost by fire, the impression prevails in the industry that such has been its effect.

An educational campaign was conducted among the thrashermen and farmers, particularly in the Northwest, on the methods of equipping thrashing machines with devices to prevent explosions and fires. These measures include systems for grounding the machine to carry off static electricity, the installation of especially devised suction fans placed on the machine, which not merely reduce the explosion fire hazard but also collect smut spores and improve the grade of grain by cleaning and removing dust and foreign materials, and the use of automatic fire extinguishers. As a result of the campaign the equipment of thrashing machines in the Northwest with explosion and fire prevention devices has become very general, and most of the manufacturers of thrashing machines are planning to make some of these devices standard parts of their equipment.

COOPERATION WITH WAR AGENCIES.

The Bureau of Chemistry has cooperated in many ways with the United States Food Administration. It has acted in a consulting capacity, furnishing technical information concerning trade practices, methods of manufacture, and the like, and it has in many instances, especially in the early days of the war, through its inspectors, made a number of special investigations. It has been instrumental in securing the cooperation of State and municipal food and feed control officials. It has assisted particularly the Food Administration's baking division, and it organized the supervision of commercial bakeries throughout the country, working through State and municipal officials. It has caused thousands of inspections of bakeries to be made, with the result that greater compliance with the baking regulations was secured than would otherwise have been possible.

This work has been very thorough in certain States where close cooperation between the Food Administrator and the local food-control officials existed. It has been less effective in those States where such cooperative relations could be less perfectly established.

The bureau has cooperated also with the Food Administration in the control of certain perishable products, in the control of the fat and oil supply, and in the control of canned goods, especially with a view to the conservation of tin plate.

It has also cooperated in the control and licensing of the arsenic and insecticide industries. As a result, an adequate quantity of such insecticides was made available.

In this connection it may be mentioned that the control by the War Department of the acetic acid supply threatened to make it impossible for a Paris green to be manufactured. The bureau assisted in introducing the use of distilled vinegar for this purpose instead of acetic acid. It has cooperated also in controlling and licensing the ammonia producing and the fertilizer industries, a matter of much importance, since an equitable distribution of ammonia is necessary if both the refrigeration and explosives requirements of the country are to be met.

When war was declared the services of the Bureau of Chemistry were offered to the Quartermaster General, since it seemed that the organization of the bureau, with its laboratories scattered through the principal producing centers of the country, was eminently adapted to assist in the purchase and inspection of the vast quantity of food-stuffs and drugs needed by the Army. At first but little use was made of the bureau's facilities. Gradually the officers in charge of some of the quartermaster's depots outside of Washington requested representatives of the bureau to undertake the examination of supplies offered. Later similar requests were made in Washington. The volume of such requests has steadily increased until a vast amount of work of this nature is being done by the bureau. In these matters no responsibility has been placed upon the bureau, either with reference to the preparation of specifications, the letting of contracts, or the acceptance of deliveries. The bureau's function in these instances is largely limited to the objective report of the chemical or physical examination of the goods.

The demand upon the bureau's force, already greatly depleted, became so great that, in spite of the fact that a very large proportion of the time of the bureau's field force was given to this work, it became necessary for the Quartermaster's Department to assign a limited number of additional men to the various laboratories of the bureau. These chemists work under the immediate supervision of the chemists in charge of the laboratories. The work, having developed gradually as a matter of evolution rather than according to a predetermined plan, resulted in a not inconsiderable amount of unnecessary work and duplication. In consequence it has become necessary to establish in the bureau a special office to deal with the relations between the bureau and the Quartermaster's Department, in so far as food and feedstuffs are concerned. At the same time, for the more expeditious conduct of this work, it will be necessary to establish special laboratories in localities in which the bureau now has no laboratories.

As a supplement to the chemical and physical examinations which have heretofore been requested, the bureau was asked to undertake examinations by way of factory inspection. A large amount of work has been done for the Quartermaster's Department upon the waterproofing, mildewproofing, and fireproofing of various materials, and a large quantity of such materials has been tested. Many examinations of bag, strap, harness, belting, upper, and sole leathers have been made, and investigations have been conducted on the suitability of leathers for certain special purposes. Also, a great number of samples have been tested. In addition, much work has been done for this department on the baling of goods and on shipping containers for overseas.

Very excellent cooperative arrangements have been established with the Sanitary Corps of the Army. A predetermined plan, which in practice has proved satisfactory, was developed almost with the organization of the food section of that corps. The field laboratories of the bureau were placed at the disposal of that section for use in making nutritional surveys at the cantonments, for the elimination of waste, and for the improvement of the dietary. In this connection the bureau's field force examined a large variety of materials, varying from garbage to the foodstuffs that are privately purchased by the enlisted men in the zones about the cantonments. The Sanitary Corps placed in those laboratories, in which the volume of work required was excessive, officers well trained in methods of chemical analysis, some of whom were formerly members of the Bureau of Chemistry. The bureau has cooperated also with the Sanitary Corps in the matter of the dehydration of fruits and vegetables, and this corps has placed in the laboratories of the bureau men to assist in the securing of properly prepared and satisfactory dehydrated products. For the Surgeon General of the Army the bureau has undertaken to manufacture and supply the rare sugars which are required in some quantity and variety for the use of the bacteriologists of the Medical Corps.

Much of the chemical research and development work required by the Bureau of Aircraft Production has been placed under the supervision of the Bureau of Chemistry. This work has become so extensive that a number of men have been detailed to it by the Bureau of Aircraft Production. In this manner the Bureau of Chemistry has assisted in securing photographic chemicals and, as indicated elsewhere (p. 15), it has undertaken the production of sensitizing dyes which are so necessary in photographing under certain adverse conditions of illumination. Through its field laboratories it has examined many shipments of castor beans and castor oil offered for entry with a view to determining whether they are suitable for use in the preparation of lubricants. It has assisted in the study of airplane "dopes." It has investigated and reported upon the operation of a number of plants producing materials required in airplane manufacture, especially certain alcohols and ketones.

Laboratory space and manufacturing equipment have been turned over to the various branches of the War Department for their use.

Several members of the bureau have served on important committees of the War Industries Board, and in a number of instances

the bureau, through its inspectors, has furnished information to that board.

The bureau has furnished the War Trade Board with experts who have devoted the greater part of their time to assisting that board in considering requests for export and import licenses for chemicals.

The bureau has assisted the War Department in a number of ways of value in connection with gas warfare.

TECHNOLOGICAL INVESTIGATIONS.

DUST EXPLOSIONS.

In cooperation with The Pennsylvania State College, Department Bulletin 681, "Grain-Dust Explosions: Investigation in the Experimental Attrition Mill at The Pennsylvania State College," was issued. The inflammability of a number of dusts has been determined and an experimental apparatus developed to study the ignition by different means of dusts in suspensions of varying densities. The effect of moisture content upon the inflammability of oat-hull by-products has been investigated. Arrangements have been made with two industrial companies to test the practical value of passing inert gases containing too little oxygen to support combustion into grinding machinery as a preventive of explosions.

Various methods of designing milling equipment, to prevent the accumulation of static electric charges, have been proposed. Many special investigations of explosions and fires in grain mills, elevators, food plants, and storage warehouses were conducted to establish the specific cause and to develop methods of prevention. The numerous fires in the cotton gins of the Southwest last year led to a preliminary investigation which indicates that possibly static electricity may be a causative factor in these disasters. The matter will be pursued further during the coming season.

COLOR INVESTIGATIONS.

The guiding principle in this work is that the mechanisms of organic reactions and the laws that govern them should be studied, as well as the practical details of manufacturing processes. For these studies the works chemist has neither leisure nor opportunity. Yet such fundamental knowledge is vital to the progress of the industry. For example, the industry is seriously hampered by the lack of suitable quantitative methods for the determination of many of the substances with which it deals. It is, therefore, difficult for the works chemist to exercise such exact control over many of the processes as will yield the maximum amount of the desired product. Consequently much attention is being given to the development of quantitative methods for the determination of the more important substances. Furthermore, chlorination, sulphonation, and oxidation, especially in the vapor phase, and the behavior of catalysts have been made the subject of experimental and theoretical studies which already have yielded what promise to be new methods for the production of phthalic anhydrid, H-acid, and benzaldehyde and benzoic acid. Of these, the process for making phthalic anhydrid is being developed commercially in a satisfactory manner.

Methods have been devised for chlorinating, sulphonating, and nitrating cymene, and numerous useful compounds and dyes have been prepared from it. Cymene is a hydrocarbon obtained as a by-product from the sulphite-spruce paper industry. Two million gallons per annum are estimated to be available. No commercial use is now made of it. A paper on the nitration of paracymene has been published.

New methods for refining anthracene pressed cake have been devised, and processes for obtaining pure anthracene, phenanthrene, and carbazol are in an advanced stage of development. Improvements have been made in the methods for purifying anthraquinone. Inasmuch as these projects required that vapor pressure measurements upon a large number of compounds be made, a new dynamic method for measuring vapor pressures was developed.

A large number of dyes necessary for the sensitizing of gelatin emulsions of silver halids required in photography are being prepared and studied in cooperation with the Bureau of Aircraft Production and the Bureau of Standards. The production of a large number of quinolines used in the synthesis of these sensitizing dyes is in progress.

A number of dyes useful in biological research are being prepared and studied. Among them are included known and new sulphophthaleins for the measurement of the hydrogen-ion concentration of solutions and vital red required in considerable quantities by the Surgeon General for certain blood studies.

A compilation of the literature of all American patents on dyes is in an advanced stage of preparation.

Five patents based on work of the Color Laboratory have been allowed and a number of others are pending.

NAVAL STORES.

Data on the extent of adulteration of turpentine and misgrading of rosin for the last three years have been compiled. Information on the commercial weighing of naval stores has been gathered. Observations which indicate that adhesives containing rosin in combination with various oils can be used satisfactorily in the manufacture of fiber and wall board requiring special waterproof properties have been made. Glass rosin type samples have been deposited with the Chamber of Commerce, Pensacola, Fla., and with the United States Food and Drug Inspection Station, Boston, Mass. The British Government Inspection Bureau has been assisted in purchasing rosin.

The description of a simple colorimeter for determining the color grade of turpentine has been published. A satisfactory process of refining wood turpentine applicable to the commercial plant has been developed.

LEATHER, TANNING, AND FINISHING MATERIALS.

Data on the wear resistance of leather from different parts of the hide have been published, and a report on a mechanical wearing test of shoe-soling materials is in press. The description of a volumometer specially designed in this connection has been printed. A bulletin on domestic sumac, giving detailed directions for the proper gathering and curing of sumac, has been published.

In cooperation with the War Industries and Shipping Boards, plans have been made to endeavor at several plants to recover chromium from the waste chrome liquors. The procedures for the purification of tannery effluents advocated by the bureau are in successful commercial practice.

Extensive experiments on the effect of various treatments on upper leathers, undertaken primarily for war purposes, will furnish information of value to both tanner and user of leather. In this connection an accelerated aging test by exposure to ultra-violet light is being tried.

MILDEWPROOFING.

Information on mildewproofing which has been gathered for some years past for the benefit of farmers has proven of value to the Quartermaster General. Several satisfactory formulæ have been developed, and several reliable methods for judging the mildew resistance of treated fabrics devised.

PAPER.

Assistance has been rendered the Navy Department in securing satisfactory blue and brown print paper, and a communication on "Blue and Brown Print Papers, Characteristic Tests and Specifications" has been made. Recommendations made to the General Supply Committee and other Government departments that lighter-weight blotting paper be used have been adopted. The conditions prevailing in the paper industry have helped the propaganda which for some years the bureau has been pushing to conserve paper-making materials through the use of lighter-weight papers.

The description of a photometer for the measurement of the translucency of paper has been made public.

CONTAINERS.

At the request of the Navy Department, the development of a water-resistant fiber shipping container, strong enough to substitute for the wood canned-goods shipping case, was attempted. Specifications for such containers were submitted to the Navy Department, and adopted in all essential particulars by the Fiber Board Manufacturers' Associations and by the Food Administration. Inasmuch as the usual paper-testing methods are not adequate for determining the utility of fiber board for shipping containers, a new impact tester has been developed for this purpose.

The War Department has been assisted in securing a satisfactorily wrapped bale for shipments overseas, and the specifications drawn for baling paper have been adopted by the War Department.

Because of a threatened shortage of tin plate, the possibility of using various types of fiber containers for certain foodstuffs ordinarily packed in tin was considered. The difficulty of securing importation of palm oil, considered essential for the manufacture of tin plate, led to an investigation of the use of hydrogenated cottonseed oil as a substitute for palm oil. It has been shown that palm oil is not essential for the production of tin plate. Cooperation with

the industry on the subject of proper steels for use in the manufacture of tin plate for food containers and on the rust-resisting qualities of different kinds of tin plate has continued.

RESEARCH.

PLANT CHEMISTRY.

The study of poisonous beans offered for import has led to the preparation of a monograph on the chemical and botanical characteristics of the edible and poisonous beans of the lima type, *Phaseolus lunatus*. Methods have been devised which, upon a laboratory scale, render such poisonous beans fit for food. If they are practicable on a commercial scale, these cheap beans may become available for food purposes. A very simple method for the isolation of the cyanogenic glucoside of these beans, linamarin, has been devised, and its enzymatic and acid hydrolysis has been studied.

In cooperation with the Bureau of Plant Industry, hundreds of samples of soy beans of different varieties, grown in various localities, have been examined to determine the range of variation in composition dependent upon variety and climate. The beans low in protein were generally high in fat, and vice versa, while the effect of climatic conditions seemed greater than the effect of variety in influencing composition. No correlation was found between the weight per thousand and the fat or protein content. In general, though there are some exceptions, varieties high in protein in one locality are also high in protein in others. Studies have also been made on the manufacture of palatable products from soy beans.

The study of various seeds offered for import as mustard has led to the preparation of a paper on Chinese colza, discussing the chemical and anatomical characters of the seed, as well as the morphological characters of the plant in different stages of growth. Similar work is in progress on other species of Brassica, such as Japanese mustard (*Brassica cernua*), Chinese mustard (*Brassica juncea*), and Russian brown mustard (*Brassica besseriana*). These, as well as white mustard (*Sinapis alba*), have been grown successfully in three localities in the United States.

As part of a cooperative study with the Bureau of Entomology on boll-weevil control, the bureau has published a paper on cotton entitled "Chemistry and Histology of the Glands of the Cotton Plant with Notes on the Occurrence of Similar Glands in Related Plants," and one entitled "On the Chemistry of the Cotton Plant, with Special Reference to the Upland Cotton, *Gossypium hirsutum*." The ethereal oil previously reported as occurring in the flowering and fruiting plant has also been obtained from young plants, mainly seedlings. It occurs in small amount, about 0.015 per cent, and is located in glands distributed generally over the plant. If unexposed to light the glands contain, in addition to the oil, gossypol; if exposed to light, quercetin or quercimeritrin. Both quercimeritrin and isoquercetrin could be found in the petals. Gossypitrin and gossypetin, isolated from other types of cotton, were not observed in Upland cotton.

Department of Agriculture Bulletin 568, "The Presence of Arsenic in Hops," and Bulletin 666, "The Effect of Alkali Treatment on Cocoas," have been issued.

In connection with a study of the adulteration of "soft drinks," a paper has been published on gingerol, the pungent principle of ginger, and on paradol, the pungent principle of grains of paradise.

The results of studies on the fertilizing value of stable manure treated with borax to destroy the larva of the house fly have been made public, under the title "Boron: Its Effect on Crops and Its Distribution in Plants and Soils in Different Parts of the United States" and "The Effect of Three Annual Applications of Boron on Wheat."

Articles upon the occurrence of manganese in insect flowers and insect flower stems, and also upon the effect of sodium nitrate applied at different stages of growth on yield, composition, and quality of wheat have been printed. An investigation upon the reduction of nitrates by seedlings has been completed.

A new method for the separation of the coloring substance from leaf greens has been devised, and spectroscopic studies have been made upon these color compounds. The determination of the composition of many of the salt-bushes and their allies has been completed. The data will be published in order to give information concerning the food value of these important forage plants of the semiarid Southwest.

CHEMISTRY AND NUTRITIVE VALUE OF PROTEINS.

As part of a study to establish criteria for judging the suitability of gelatins for food purposes, physico-chemical studies have been made of gelatin, some of the results of which are in preparation for publication. Complete hydrolyses have been made of kafirin, the chief protein of kafir, and of arachin, the chief protein of the peanut. The data have been published.

The results of the chemical examination of the globulin of buckwheat and of stizolobin, the globulin of the Chinese velvet bean, *Stizolobium niveum*, have been published. Stizolobin contains all the necessary basic amino-acids, and feeding experiments with the protein of the Chinese velvet bean have shown that this is biologically complete and is properly utilized by animals. A study of the relative nutritive values of many other kinds of beans was begun.

A chemical examination of the globulin of the coconut is in progress. This globulin, which constitutes most of the protein in the coconut, contains all of the basic amino-acids necessary for normal growth. Feeding experiments in progress with coconut press cake, and the isolated globulin of the coconut indicate that both the press cake and the globulin are biologically complete. This study is timely, since the copra-crushing industry is assuming much importance in the United States, and there is a great demand for coconut oil in its rapidly growing use in preparing the so-called butter substitutes. The feeding value of copra cake does not seem to be appreciated as yet in the United States. A proper appreciation of this feed by dairymen will assist in keeping a copra-crushing industry in the United States after the war.

SUGARS AND SIRUPS.

Bulletin 466, "Maple Sugar: Composition, Methods of Analysis, and Effect of Environment," has been issued. Methods for the preparation of xylose, rhamnose, arabinose, and maltose have been perfected. The preparation of dulcete from galactose has been carried out upon a large laboratory scale. The optical-crystallographic properties of the pentose sugars and of the rare trisaccharid melezitose have been determined. Melezitose has been found to occur in large proportion in a manna from the Douglas fir, and has also been found in the free crystalline form in honey of the honey-dew type from Pennsylvania and Maryland. A number of articles have been published upon these subjects, as well as upon the acetates of certain sugars and upon the amides of certain oxy-acids.

Much progress has been made in learning the conditions for preparing carbon of high absorptive power for use in clarifying sirups. The methods for the clarification and filtration of sugar-cane sirup have been improved.

BEVERAGES AND VINEGAR.

Two papers have been published upon the carbonation of beverages and one upon the occurrence of manganese in water supplies. Department Bulletin 656, "Concord Grape Juice: Manufacture and Chemical Composition," has been issued, and a similar study upon white grape juice is in progress. Extensive, authentic data on American wines, accumulated through more than a decade, have been compiled and filed for reference, under the title "Wine Investigation: Composition and Natural Acid Reduction of Wines Made from Native American Grapes," thus closing this project. The investigation of the sectional, seasonal, and other variations in the composition of fermented apple juice (cider-vinegar stock), begun in 1916, has been extended. Some of the results have been tabulated for the benefit of food and internal-revenue officials. A study of the changes that cider undergoes during fermentation and prolonged storage and its subsequent conversion into vinegar in rotating generators has been published. As a conservation measure, studies were made upon the use of sugar substitutes in soft drinks. A series of papers on the subject has been published in the trade press, and the formulæ recommended are in actual use.

FRUITS AND VEGETABLES.

A study upon the composition of loganberry juice has been completed. The results of an investigation of the acid content of fruits and of a study of arsenic in sulphured food products due to the use of sulphur containing arsenic have been published. Department Bulletin 581, "Microscopical Studies on Tomato Products," correlating the amount of decayed material used in the preparation of tomato products with the appearance of these products under the microscope, has been issued. The general use of apple pomace and the preparation of pectin from apples and other sources has been studied. The use of pectin as a filler in the preparation of jellies and similar products and for the preparation of jellies from fruits which contain but a small amount of pectin is growing, and brings with it a number of problems demanding solution.

CEREALS AND FLOUR.

Department Bulletin 570, "The By-Products of Rice Milling," and Bulletin 634, "A Physical and Chemical Study of the Kafir Kernel," have been issued. Studies on the composition of grain sorghum kernels, and on the milling and baking of flour from einkorn, emmer, spelt, and Polish wheat have been published, and a manuscript entitled "The Composition of Wheat Flour Substitutes and the Breads Made Therefrom," has been prepared for publication. A study of flour, under way for some years, has shown that there is a definite relation between the commercial grades of flour and the number of offal particles present. The increased use of flour substitutes has made their intensive study necessary for the purpose of preparing definitions and standards for these increasingly important products.

FOOD FLORA, SPOILAGE, AND FERMENTATION.

The Microbiological Laboratory has been accumulating a large number of living cultures of various strains of the organisms that are to be found upon foodstuffs, and especially those that are concerned with food spoilage. In this work the foundation is laid for a better knowledge of the flora of foodstuffs and its relation to food spoilage, the results of which will be compiled in a series of papers dealing with groups of organisms. Such a paper has been issued under the title "*Aspergillus Fumigatus*, *A. Nidulans*, *A. Terreus*, *N. Sp.*, and Their Allies." Moreover, it has been learned that certain species of *Fusarium* and one species of *Aspergillus* are concerned in the destruction of the germinal area of the corn kernel, if the corn is stored with a very slight excess of water.

In studying food poisoning resulting from the growth of *Bacillus botulinus*, especially in its relation to canned foods, all known strains of this organism were brought together for comparative study. It appears that there is a series of closely related organisms capable of producing cases of food poisoning approximating the clinical picture of botulism. It will, therefore, be necessary to study a long series of cases and isolate and compare the significant organisms before the range of conditions under which these cases of serious poisoning are liable to occur can be known.

The results of the investigation of the organisms entering into the spoilage of canned sardines have been made ready to print. Among the observations made may be mentioned that while the gills of fish may contain the characteristic organism that produces spoilage, the intestines, when they are free from food, are practically sterile. Bacteriological studies have also been made of fish "slime" and of the transmission of organisms after death through the gill openings to the flesh of the fish. The protection afforded by the skin against bacterial invasion is also being studied.

The methods of judging frozen egg products have been analyzed critically. It was found possible to correlate closely the results of chemical and bacteriological examination with the appearance, the physical properties, and the flavor of eggs, as determined in the egg-breaking plant. This investigation should tend to clear up the difficulties that have arisen in the examination of frozen eggs for regulatory purposes. Studies also have been made upon the bacteria in storage eggs.

Reports on the chemical analyses of bacteriological bouillons and on a comparison of bacterial counts on whole and skimmed milk, separated and centrifuged cream, have been prepared.

With a view to improving the methods of vinegar production in the home from a wide variety of fruits, the acetic group of organisms has been studied, and, for the purpose of improving the production of soured foods, a study of the group of lactic organisms has also been conducted. A mass of data on the composition of silage has been gathered for the Office of Farm Management.

Studies upon the fermentation of the soy bean and the production of soy sauce have been in progress, and investigations begun upon sauerkraut production three years ago have been extended to include the pickling of numerous varieties of vegetables and fruits and the preservation of these vegetables by various forms of brining. Not only cabbage but potatoes, spinach, beets, string beans, sweet corn, and even peaches have been handled by this process in a satisfactory manner. In cooperation with the States Relations Service, Farmers' Bulletin 881, "Preservation of Vegetables by Fermentation and Salting," has been issued.

DRUGS AND PHARMACOLOGY.

The results of a study of commercial viburnum barks and preparations, and of Karaya gum as a substitute for tragacanth are ready to be submitted for publication. Observations on the leaves of *Eupatorium glutinosum*, offered for entry as "Peruvian matico," have been made public. Examination of the root of *Macrotomia cephalotes*, offered as alkanet, has shown it to yield a coloring matter similar to that of alkanet, but present in larger amount. A paper on this subject is in press.

A study of the manufacture of arsphenamine and of the patent literature on the subject has been completed.

Results of investigations on the pharmacology of oil of chenopodium, on the action of an isomer of caffeine, on the distribution and elimination of zinc and tin in the body, on the action of tartrates, citrates, and oxalates, on the influence of diet on the toxicity of sodium tartrate, on the production of glycosuria by zinc salts, on the action of succinate and its hydroxy derivatives have been published.

OILS AND FATS.

In cooperation with the Bureau of Plant Industry, the oil yields of a large number of samples of peanuts of different varieties, grown in various localities, have been examined, and a report on the results prepared. A preliminary analysis of the results seems to indicate that there is very little relation between the volume, weight, and oil content of the nuts. Analyses of okra-seed oil, papaya-seed oil, cantaloup-seed oil, lemon-seed oil, areca fat, tea wax, sugar-cane wax, squash-seed oil, cob-nut oil, licania-seed oil, and the oil of *Aleurites triloba* have been completed. The results of an investigation on the oil of salmon as a method for the determination of the species in the canned product are in press.

INSECTICIDES.

An investigation of the decomposition of di-lead arsenate by water, the results of which have been published, has demonstrated how injury may take place when treated foliage is subjected to the frequent action of light rains, fog, and dew. In cooperation with the Bureau of Entomology, the action of pure arsenious oxid, arsenic oxid, di-lead and basic lead arsenate, and calcium arsenate have been tested on various insects. A number of new calcium arsenates have been prepared and their chemical and physical properties investigated. Methods for preparing the two most promising—tri-calcium arsenate and calcium meta-arsenate—on a manufacturing scale have been developed, and a patent covering methods for the commercial preparation of tri-calcium arsenate has been obtained. The results of an investigation to determine whether fruits sprayed with Bordeaux mixture may retain enough copper to be objectionable are in process of preparation. A similar study has been made upon the retention of hydrocyanic acid in foodstuffs that have been treated with this gas for the purpose of destroying insects. The work on the poisoning of bees by sprays is to be published by the Bureau of Entomology. The efforts to modify the formula for Bordeaux mixture have progressed to such a point that it is possible to say that in all probability a formula which will contain much less copper than the present formula can be used for potatoes. The results obtained in the study of the adhering qualities of various copper and sulphur fungicides are to be published by the Bureau of Plant Industry. A report upon plants used as insecticides is in press.

ANALYTICAL METHODS.

There have been published methods for the separation of aluminum from iron by means of ether; for the preparation of heavy leathers for analysis; for measuring the absorption of paper; for the estimation of anthraquinone; for the detection of added color in butter and oleomargarine; for the determination of arsenates in insecticides by potassium iodate; for the estimation of fat in condensed milk and milk powders; for the detection of added water in milk by means of a simplified molecular concentration constant; for the analysis of acetylsalicylic acid and adulterants; and for the determination of the volatile oil content of citrus fruits.

There are in press papers upon the estimation of theobromin; of loosely-bound nitrogen as ammonia in eggs; of copper in insecticides; of copper and zinc in gelatin; and of vanillin and coumarin in factitious vanilla extracts. There are also in process of publication papers upon the evaluation of hexamethylene-tetramine tablets; upon the gravimetric and volumetric determination of zinc precipitated as zinc mercury thio-cyanate; upon the identification and determination of potassium guaiacol sulphonate; upon the separation and quantitative determination of the lower alkylamines in the presence of ammonia; and upon the application of the cryoscopic method for determining added water in milk.

Investigations have been completed upon the determination of acetic acid, methyl alcohol, and acetone in pyroligneous acid; upon the limits of sensitiveness of the United States Pharmacopœia method

for the determination of lead in zinc oxid; upon a new method for the determination of caffeine of general applicability; upon the determination of saccharin; and on the determination by the Kjeldahl method of nitrogen in certain organic compounds.

The food or drug analyst frequently faces the difficult problem of identifying a substance isolated from complex mixtures in very minute amount and in no high degree of purity. This is especially true in the identification of active principles in the course of the analysis of medicines. The analysts in these cases depend either upon a physiological test or upon more or less vague color reactions. From time to time efforts have been made to introduce the use of the microscope in identifying crystalline materials. Inasmuch as the mere appearance of crystals is not necessarily characteristic, the use of the microscope has been of value only to a limited extent. In recent years methods have been developed for the exact measurement of very minute crystals and also for the determination of the optical properties of such minute crystals. These optical-crystallographic methods hitherto have been applied in the main only to inorganic substances, more especially in mineralogy. It would seem that the same methods might be applied with great advantage in food and drug analysis. Therefore work was undertaken to modify the methods of optical-crystallographic study, as applied to minerals, so as to render these methods applicable to the substances met with in the work of the bureau. Department Bulletin 679, "The Application of Optical Methods of Identification to Alkaloids and their Compounds," giving the results of this investigation, was published. Work is now in progress to apply these methods of identification to specific groups of substances, so that in time the optical-crystallographic properties of a large number of substances, the identification of which is required in the course of food and drug analyses, may be recorded. The work upon one such group, the cinchona alkaloids, has demonstrated that these methods are eminently suitable for identifying or distinguishing from one another these closely related bases. The results have been published.

Incidental to this work, a study has been made upon the possible value of optical properties in tracing the configurations of organic substances. Some interesting results have been obtained and made public. In certain simple cases it was found possible to work out space lattices for organic compounds from a consideration of their optical and crystallographic constants. A note on the fundamental polyhedron of the diamond lattice has been published.

COLLABORATION.

The Bureau of Chemistry has cooperated with the Post Office Department in helping to secure fraud orders against a number of concerns marketing through the mails preparations with fraudulent medicinal claims. A number of frauds emanating from Chicago were suppressed.

It has also done much work for the Department of Justice.

The Tariff Board has been assisted in the compilation of data concerning imported chemicals and drugs.

Recommendations have been made to the Railroad Administration on the subject of standard refrigerator cars.

The Bureau of Markets has been assisted in its food survey project, the Bureau of Chemistry having handled the work in certain cities.

The General Supply Committee has been assisted, especially with reference to paper specifications.

In cooperation with the Bureau of Biological Survey, studies have been made on the best methods of poisoning rats.





