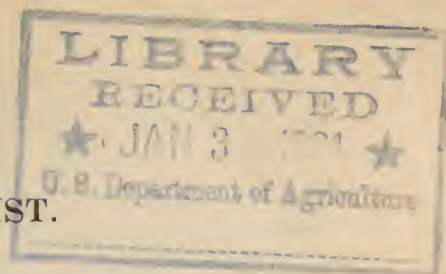


Historic, Archive Document

Do not assume content reflects current scientific knowledge, policies, or practices





REPORT OF THE CHEMIST.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY,
Washington, D. C., October 15, 1920.

SIR: I submit herewith the report of the work of the Bureau of Chemistry for the fiscal year ended June 30, 1920.

Respectfully,

C. L. ALSBERG,
Chief of Bureau.

HON. E. T. MEREDITH,
Secretary of Agriculture.

REPORT OF WORK.

The struggle to maintain efficiency despite mounting operating costs, rapid turnover of the personnel, and reduction of the force through resignations, for which inadequate salaries alone are responsible, has been the main characteristic of the year's work. The average salary for chemists is \$2,275 per annum, the minimum \$1,200, and the maximum \$4,500. The average salary for food and drug inspectors is \$1,840, the minimum \$1,400, and the maximum \$2,500. In addition, all employees upon a salary of \$2,500 or less receive, by special act of Congress, a bonus of \$240 per annum.

On June 30, 1920, the staff of the bureau consisted of 593 persons, of whom 263 were chemists and technically trained men, 42 inspectors, 155 clerks, and 133 miscellaneous employees. During the year the bureau lost by resignation, transfer, or death 74 technically trained men, 12 inspectors, and 68 clerks. The total loss was 210 persons, which is 35 per cent of the present force, and does not take into account a considerable number of vacancies. Among those who resigned were the chief of the eastern food and drug inspection district; the chemist in charge of the color laboratory and his understudy; the chemist in charge of the food research laboratory; the chemist in charge of the office of State and municipal cooperation; the chiefs of the food and drug inspection stations at Denver and Baltimore; the chemist in charge of the plant chemical laboratory; the chief inspector for the central food and drug inspection district; the librarian; the executive in charge of the office of accounts and his understudy; and the secretary to the chief of the bureau. The chief of the New York station, one of the ablest and most respected chemists in the service, Albert F. Seeker, was lost by death.

In order to maintain the law enforcement work it has been necessary to reduce very materially the constructive research work of the bureau designed to promote efficiency in the food and drug industries and to develop new methods for the discovery and detection

of sophistication. This expedient has for the time being been successful so far as the apparent volume of work accomplished would seem to indicate, since the total number of cases recommended to the Solicitor for prosecution exceeded by 40 the total for last year, when a far larger number of cases was developed than in any previous year. Furthermore, the number of imports of food and drugs was unusually large, so that with the depleted staffs at the port laboratories of the bureau it was exceedingly difficult to examine all entries uniformly. The volume of this kind of work can not be regulated, nor can it be planned for in advance.

While, therefore, the enforcement of the food and drugs act during the year was probably quite as effective as in any preceding year, this favorable showing was the resultant of at least four factors: (1) Increased efficiency and experience; (2) the lag that exists in the recording of results (a large number of the cases developed in any year do not appear in these records until the succeeding year); (3) the use of research chemists for law-enforcement work, with a corresponding lessening of the bureau's efficiency in constructive research; (4) increasing the proportion of seizure actions as compared with criminal prosecutions over that which prevailed in former years. The amount of labor involved in developing a criminal prosecution is, as a rule, very much greater than that required to consummate a seizure.

The neglect of research, which has been unavoidable, will inevitably in time impair the effectiveness of the enforcement of the law, since the bureau is dependent upon research for the means to combat new types of sophistication which are constantly appearing as methods and materials change with the evolution of the food and drug industries. Finally, without its research work the bureau can not render to the general public, the farmer, and the food and drug manufacturer that consulting and advisory service concerning the chemistry and technology of foods and drugs, organic chemicals, agricultural chemistry, and a host of kindred subjects which the country has a right to expect. However, as the conduct of any individual research usually covers a period of years, the effect is not yet apparent in the bureau's research output as measured by the number of its publications during the year. The bureau put out 7 department bulletins, 4 circulars, and 1 farmers' bulletin. In addition, the results of more than 75 investigations were made public, while those of over 50 are now in press. The experimental work upon a number of others has been completed. At the beginning of the fiscal year 15 applications for public service patents were pending. Twelve additional applications were filed during the year; 6 were granted, 6 denied, and 15 are pending.

The total appropriation for the bureau was \$1,391,500, of which about \$50,000 remained unexpended and reverted into the Treasury. The latter sum represents in the main moneys allotted for salaries but unexpended because vacancies due to resignations could not be filled promptly or, indeed, in many cases, filled at all. Incidentally, it may be stated that for some time past there has not been a year when a portion of the bureau's appropriation has not remained unexpended. In 1918 it was as little as \$7,881.73, but in 1917 it was \$105,978.08

ENFORCEMENT OF THE FOOD AND DRUGS ACT.

DOMESTIC FOODS AND DRUGS.

Fourteen hundred and seven recommendations for seizure and 851 recommendations for criminal prosecution were made to the Department of Justice, through the office of the Solicitor. Table 1 gives a list of the classes of products on which action was recommended, and also the distribution of the recommendations among the various types of products.

TABLE 1.—*Recommendations of actions on alleged violations of the Food and Drugs Act transmitted to the Solicitor.*

Article.	Criminal actions.	Seizures.	Article.	Criminal actions.	Seizures.
Alimentary pastes.....	3	5	Gelatin.....	20	4
Beverages and beverage ingredients.....	20	6	Ice-cream cones.....		3
Candy.....	2	1	Jam, jelly, and marmalade.....	6	4
Cereals.....	1	4	Meat and poultry.....	2	
Chocolate and cocoa.....		15	Nuts.....		2
Coffee substitutes.....	3		Olives.....		3
Colors, food.....	2		Oils, olive, table, salad, etc.....	125	17
Dairy products.....	12	24	Pie fillings.....	3	
Drugs, crude.....	4	1	Poppy seed.....		2
Drugs, pharmaceutical.....	7		Preservatives.....	1	
Drugs, various remedies.....	77	606	Saccharin.....	5	8
Drugs, remedies for stock.....	9	79	Shellfish.....	80	
Drugs, venereal disease remedies.....	3	215	Sirups, honey, sugar.....	1	5
Eggs.....	45	16	Spices and relishes.....	7	1
Egg substitutes.....	17	8	Tomato and tomato products.....	6	84
Feeds.....	242	36	Vegetables.....	18	83
Fish.....	11	67	Vinegar.....	17	28
Flavoring materials.....	30	28	Water, mineral.....	29	8
Fruits.....	10	44	Total.....	818	1,407

Examination of Table 1 shows that prosecution was recommended most frequently on shipments of patent medicines, of mineral waters, of stock feeds, of edible oils, of flavoring materials, of beverages, of eggs and egg substitutes, of dairy products, of fruit and vegetable products, of gelatin, of fish and shellfish, and of saccharin.

The distinctive characteristic of the year's work on drugs was the systematic campaign, begun last year, against misbranded medicines for the treatment of venereal diseases, and continued with such success that misleading statements upon the packages and labels of these preparations have almost wholly disappeared so far as interstate commerce is concerned. With the assistance of the Bureau of Animal Industry, many successful actions were brought against misbranded veterinary remedies, especially against those claiming to cure or prevent hog cholera.

Some of the cases against shipments of fruits were directed against rain-damaged raisins of the California crop of 1918 that were so moist as to have become moldy or that were contaminated with enough unremovable sand spattered upon them by the rain to render them inedible. Vigorous action was taken in cooperation with the California authorities to prevent the shipment of evaporated apples with excessive moisture. Thousands of tons had to be adequately dried, with a corresponding saving to the consumer. In consequence, moisture content has been included in the trade's in-

spection and a chemist is now in the employ of the industry to see that in future the consumer gets apples, and not water at the price of apples. While hereafter the public will be saved annually some thousands of dollars, the total cost to the bureau of this work over and above salaries was approximately \$225.

A number of other fruit products, especially vinegar and beverages, such as misbranded or adulterated cider, or imitations sold as genuine fruit beverages, required prosecution. Among the latter, imitation orange-juice beverages were particularly prominent. Machines known as homogenizers or emulsors, designed to subdivide oils or similar liquids so finely in water or other liquid immiscible with the oil as to produce permanent emulsions, have been in use for a variety of purposes for a number of years. These are now employed in the soft-drink industry to emulsify such oils as orange oil in manufacturing a cloudy, strongly-flavored beverage. Because these beverages are cloudy, they are easily palmed off as containing fruit juice. As orange juice is used not merely as a beverage, but also in infant feeding, such a deception may have serious consequences. It is therefore important to see that these drinks are branded in such manner as to give the customer full information of their true character. Sold under such conditions, they are legitimate products. Announcement was made last year of the discovery of a new method for the identification of waste apple products vinegar. With the help of this method seizures of such vinegar sold as genuine cider vinegar were made this year and are now awaiting judicial determination.

Despite the fact that between one-seventh and one-eighth of all the cases brought under the terms of the food and drugs act are against feeds, flagrant abuses still persist. Whenever there is a rising market for such products as cottonseed meal, as was the case last year, violations of the law become quite frequent. For a number of reasons the bureau can not avoid paying an amount of attention to feeds out of all proportion to that paid to foods and drugs. Nevertheless, the situation is quite out of hand, and more drastic action by special appropriation, so that there may be enforcement of the law with reference to feeds without sacrificing the efficiency of the control of human foods, is called for.

A typical example of the value of the food and drugs act to purchasers of stock feed is to be seen in the case of the bureau's experience with the substitution of bran for shorts during the year. Throughout 1919 the difference in price between bran and shorts ranged from \$14 to \$22 per ton. For many months, from July to October, this difference ranged from \$17 to \$19 per ton. During the same period red dog flour was quoted at a price very close to that of shorts, usually from \$2 to \$5 per ton higher. Few sales, however, were made, a large part of the red dog flour being mixed with and sold as shorts. Because of the unusual demand of the feeders for hog feed, the price of shorts, which is ordinarily less than that of bran, became so high as to induce many individuals to grind bran finely and to substitute it for and sell it as shorts. In this case the buyer, almost always a stock feeder, was defrauded of at least \$18 per ton. This substitution of reground bran for shorts was very common during the latter half of 1919 and the early part of 1920. Action was

taken on the product of 12 mills located at various places from the Atlantic to the Pacific, and from North Dakota to the Ohio River. Each of these 12 mills had an output of from 4 to 12 and more cars weekly, a carload ranging from 25 to 30 tons. If it be assumed that 12 mills have a weekly output of eight 25-ton cars each, that the illegitimate profit amounts to \$18 per ton, and that the fraudulent transactions lasted for but 16 weeks, the total fraud upon the purchaser of this kind of feed from these mills alone was in excess of \$690,000. The action which the bureau was able to take has reduced this fraud to practically nil, and it is therefore safe to assume that the sum of money which was saved the feeders of the United States is of the same order of magnitude as the entire annual appropriation of the bureau of Chemistry.

The work dealing with the use of rice hulls as an adulterant, reported upon last year, was continued, as was also the investigation of alleged abuses in the sale of peanut by-product feeds and alfalfa feeds. Furthermore, an investigation of the adulteration of feed molasses with water was begun.

Butter containing less than 80 per cent of butter fat or more than 16 per cent of water, or both, was the chief dairy product proceeded against. Moreover, the efforts that have been made for years past to improve the milk supply of St. Louis, Mo., reached a culmination this year. Years ago deplorable conditions were encountered at St. Louis. Instances of violation of the food and drugs act had been detected there and successful prosecutions instituted. Such prosecutions had little or no effect in bringing about a general betterment of the St. Louis milk supply. While it is clearly recognized that the duty of safeguarding a city's milk supply is a municipal function, this principally because the city health department is the only agency in a position to maintain that constant supervision which is essential, still this bureau could not ignore the conditions in St. Louis, where violations of the food and drugs act were flagrant, more especially as there were recurring from time to time milk-borne typhoid epidemics, with consequent sacrifice of life. Accordingly there has been carried on over a period of several years an intensive study of the existing conditions and contributing causes, with experimentation to determine the essential elements necessary for clean milk production. Milk going for the St. Louis supply was found to be largely watered, skimmed, filthy, and containing excessive numbers of bacteria. It was determined that sterilization of utensils, care, and cleanly methods of production will in that locality, as elsewhere, produce milk with few bacteria. It was further found that unclean milk cans were the chief contributors of bacteria to milk shipped to the St. Louis market. An educational campaign was undertaken some years ago. All of the facts with respect to conditions and causes were laid before producers, distributors, and city health authorities in St. Louis and a constructive program for correction was outlined.

Subsequent investigation indicated no appreciable improvement, whereupon specific violations of the food and drugs act were brought to the attention of the Federal grand jury in St. Louis, resulting in indictments against 20 producers and buyer-shippers on multiple counts. This was the culmination of the work of a number of years, and during the current year pleas of *nolo contendere* have been en-

tered by most of the defendants in these cases, the result being, as anticipated, that the public has been advised by consequent publicity of the dangerous condition of its milk supply and has been brought to realize the urgent necessity for a strong municipal control thereof.

The cases against shipments of fish involved for the most part canned salmon which contained some fish that were decomposed before they were canned. This project, begun in the spring of 1919, occupied the attention of the regulatory force of the bureau to a greater extent than any other. Much of the salmon involved had at one time or another been in the possession of the Army. All parcels that proved objectionable were permitted to be distributed only after the packers had eliminated the objectionable portions. To accomplish this the top of each can was cut off by a specially constructed machine so as to permit thorough examination of the contents. All doubtful salmon was sent to the dump or the fertilizer factory, or was used as fish food at hatcheries. Such good salmon as remained was recanned or resealed with new tops, reesterilized, and then re-examined by the bureau's agents.

Action was also taken against shipments of canned "blue-fin tuna," "striped tuna," and bonita labeled to create the impression that the cans contained the "white meat," which is obtained from a different species. These cases are awaiting judicial determination.

The cases against shellfish involved the charge of adulteration with water. Announcement was made of the weights which are representative of properly filled cans of minced razor clams and minced hardshell clams.

The project which occupied the bureau more than any other except the salmon work was the inspection of ripe olives for the purpose of removing from the channels of trade those that were spoiled and might therefore harbor the *Bacillus botulinus*, a micro-organism producing a virulent toxin. Two lots containing this organism were located and promptly seized. No cases are on record of poisoning by green olives in brine, so-called "Queen" olives. As it was quite impossible, with the bureau's limited force, to locate and inspect the hundreds of small lots of olives scattered about the whole country on grocers' shelves, the cooperation of State and municipal officials was enlisted to inspect and prevent distribution of any lots which were in the least degree suspicious. At the same time the attempt was made to induce the packers to have all olives sterilized at low temperatures returned to their plants in California for the purpose of removing all that showed evidence of decomposition and of reesterilizing the rest at high temperatures. Most of the packers cooperated. With the cooperation, therefore, of State and municipal officials and of the trade itself it was possible to afford the public a degree of protection that the limited personnel of the bureau and the limitations of the law itself would not have permitted. Since that time the industry, in cooperation with the State authorities of California, has employed competent scientists, and is taking such action as will render a recurrence of fatalities extremely unlikely.

The high price of sugar led to an increase in the use of saccharin which was quite extensive in certain localities, but much less extensive in interstate commerce. Action was taken against foodstuffs containing saccharin, notably various sirups, as well as so-called con-

centrated sweeteners consisting of saccharin and sugar or some other diluent. These cases are awaiting judicial determination. During December a case alleging misbranding of saccharin labeled as "the perfect sweetener," "healthful," and "absolutely harmless" was tried in St. Louis. The jury disagreed.

The cases against shipments of flavoring materials, mineral waters, eggs, oils, gelatin, and tomato products involved charges similar to those reported in former years.

The work upon egg substitutes has largely reduced the number in the channels of trade. None of those examined were found to be real substitutes for eggs, either in food value or in their effect in baking.

The numerous cases against shipments of vegetables resulted from the substitution in canning of the cheaper, wholesome, nutritious long cranberry bean, also known as Naga Uzura bean, for the more expensive red kidney bean. These cases are still awaiting judicial determination.

Over 1,000 of all the shipments sampled during the year required a consideration of some phase of that section of the law which demands the declaration on the outside of the package of the true quantity of food contained therein. Of these, 41 per cent went to the Solicitor for prosecution; 60 per cent of the prosecution cases bore a charge of short weight and 40 per cent a charge of non-declaration of the quantity of the contents. Eighty per cent of the cases recommended for prosecution bore additional charges for a violation of some other section of the law. Eighty-five different products were involved. One-tenth of all cases involved feeds and one-sixth fruits and vegetables, the charges against these products being principally for non-declaration. One-sixth of all samples were canned viscous liquids, such as olive oil and molasses. Moreover, olive oil, bottled goods, and butter were often short in weight or volume.

The education of shippers in the requirements of the net-weight amendment of the food and drugs act was carried on as in former years. In Texas, for example, the shippers believed their packages complied with the law because they had been inspected and passed by the inspectors of the State Bureau of Markets. Circulars were distributed, information published in the local trade papers, association meetings attended, and cooperative relations established with the State Bureau of Markets of Texas in order to give publicity to the requirements of the Federal law. In consequence recent shipments of fruits and vegetables from this section of the country are marked with the quantity of the contents of the packages. The bureau has enjoyed the fullest cooperation of State and city sealers of weights and measures, who have tested scales, investigated complaints, and planned and carried out special campaigns.

A review of the work of the last five years in the enforcement of the net-contents-declaration provision of the food and drugs act shows a steadily increasing number of prosecutions, due not to an increasing failure on the part of the shippers to comply with the law but to increasing knowledge on the part of enforcing officials obtained through the bureau's investigations of shrinkage and of processes of packaging. A report on some of these investigations, Department Bulletin 897, Weight Variation of Package Foods, was

prepared for publication. Of all notices of judgment published during the past five years, 307, or 9.2 per cent, contain reference to violations of the net-weight amendment. Of these 307 cases, 19 per cent contain no other charge than violation of the net-weight amendment. Sixty-two per cent contain a charge of shortage in weight or volume. The average shortage in those cases prosecuted for that reason solely was 10.8 per cent. One hundred and twenty-five seizures in which net-weight violations were involved were made during the period. The products against which most of these notices of judgment have been published are, in order: Olive oil, cottonseed meal, mineral water, tomato pulp, and evaporated apples.

The net-weight provision of the law was amended so as to bring hams, sides of bacon, and similar meat products, when wrapped, within its provisions. The language of this amendment is as follows:

[Public, No. 22, 66th Cong., H. R. 7413.]

AN ACT Making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1920.

That the word "package" where it occurs the second and last time in the act entitled "An act to amend section 8 of an act entitled 'An act for preventing the manufacture, sale, or transportation of adulterated or misbranded or poisonous or deleterious foods, drugs, medicines, and liquors, and for regulating traffic therein, and for other purposes,'" approved March 3, 1913, shall include and shall be construed to include wrapped meats inclosed in papers or other materials as prepared by the manufacturers thereof for sale.

In order to prevent the slack filling of canned fruits and vegetables, the bureau has made an extensive investigation of the commercial methods of canning employed in the case of some 30 of the more common fruits and vegetables for the purpose of determining what is the greatest amount of solid material, exclusive of liquid, which can be packed in cans of various sizes without causing any impairment of quality. Following this investigation the bureau addressed circular letters to commercial canners throughout the United States, specifying definite amounts of solid material, exclusive of liquid, which should be present in cans of various sizes. The letters issued during the year referred to spinach, Swiss chard, beet tops, Lima beans, pears, pitted cherries, and sauerkraut. Announcements supplementing previous ones were issued on wax and refugee beans, peaches, and green peas. A very extensive inspection campaign has been carried on for the purpose of securing observance of the opinions expressed in these circular letters. As a result of this campaign, the practice of packing cans with an excessive amount of liquid and a deficient amount of fruits or vegetables, which was formerly followed by many canners, has been very largely discontinued. The results obtained are of great economic importance from the standpoint of the consumer, inasmuch as great fraud, which the consumer has been unable to detect prior to purchase and opening of the cans, has been practiced in connection with the slack filling of cans of certain fruits and vegetables.

During the past year the courts have rendered several decisions containing important interpretations of the law:

The decision referred to in Notice of Judgment 7691 concerned the adulteration of oil of sweet birch and oil of wintergreen with synthetic methyl salicylate. Seizure of the goods had been made under

the law and the claimants requested release under bond for re-labeling. The court held that the release as requested was not mandatory but discretionary with the court. The goods were accordingly not released under bond but were ordered forfeited to the Government.

The Circuit Court of Appeals for the Fifth Circuit has rendered an important decision in connection with the Sherley amendment. In the construction to be applied to a label for mineral water which is recommended for the treatment of various diseases, the court held that a statement recommending the water for the treatment of various diseases meant that the water was an alleviation or cure for the diseases mentioned, and the contention that the water condemned was not a drug was not tenable after the water had been put in interstate commerce with the recommendation that it possessed certain elements or ingredients which were claimed to be curative or at least to alleviate the diseases named in the label.

In a case involving an article labeled as a substitute for eggs, the contention was made by the defendant that the representation on the label was not one of fact but of opinion only and therefore not in law misleading. The court held that as the defendant had chosen its own definition for the term "substitute," when it stated upon the label that the article could be used in place of eggs in baking and cooking, the only inference that could be drawn was that the article would produce the same or similar results as eggs. Accordingly it was held that the allegations of the information that such statements were false and misleading clearly brought the statements within the category of the law.

In a number of judicial districts some difficulty has been encountered in filing libels under section 10 of the act for the seizure of food and drug products shipped in violation of the act. This difficulty arises in part from the practice of a number of jurisdictions which require that the libel can not be filed until first signed by the judge. The illness of the judge or his absence from the jurisdiction in such cases sometimes causes a delay in the seizure of goods adulterated or misbranded under the act and their consequent escape from the penalty of the law. One judge has recently refused to sign the libels unless they are supported by a chemist's affidavit, his position being that to do otherwise would be a violation of the fourth amendment.

The service and regulatory announcements published during the year contained 36 opinions and 600 notices of judgment. While there is evidence that the courts are again tending to impose severer penalties for violations of the food and drugs act, the publicity given through the court proceedings and the notices of judgment is still the principal penalty. Indeed, these notices give the most reliable history of the development of the courts' interpretation of the law, as well as of the department's policies with reference thereto. Unfortunately, these notices are not sufficiently studied by manufacturers. If they were, infractions of the law could and no doubt would be avoided by them.

A new edition of the Food and Drug Manual, containing the procedure and instructions to be followed by the bureau's inspectors and by collaborating officials, was issued for the sole use of these officials.

A directory of Federal and State dairy, food, drug, and feeding stuffs officials was also published.

Cooperation with State and municipal officials has been growing rapidly. Statistical data fail to show the extent to which the field force of the bureau is cooperating with, as well as assisting and being assisted by, the various State and city agencies. Such statistics as are available will be found in Table 2, giving the cases instituted by State agencies, and in Table 3, giving the cases instituted by city agencies. It will be seen that during the year 333 such cases were instituted by these agencies, 120 more than in any previous year. In addition there was, of course, an interchange of a vast amount of information either by direct personal communication with the bureau's agents in the field or by correspondence with the bureau or through the bureau's monthly review, the character of which has been somewhat changed by the elimination of a great deal of detailed information, with the understanding on the part of cooperating officials that such information may be secured by correspondence on request. The tables, moreover, do not indicate the large amount of work in connection with those cases that did not go to prosecution or to seizure. One hundred and fifty-nine samples of this kind were analyzed by collaborating officials, and, in addition, a large number of which the bureau has no record that were found to require no further action.

TABLE 2.—Number of actions instituted by State officials alleging violations of the Federal food and drugs act.

States.	Prosecutions.			Seizures.		
	Food.	Feed.	Drug.	Food.	Feed.	Drug.
Alabama.....				1		
Arizona.....				1		
Arkansas.....	2				1	
Florida.....	8	1			3	
Georgia.....	2	2		1		
Illinois.....				6	2	
Indiana.....		11		3	2	
Iowa.....	2	4		1	2	
Kansas.....		7		2	11	
Kentucky.....		4				
Louisiana.....	2					
Maine.....		4			1	44
Michigan.....	1	9	1	2	4	1
Minnesota.....	1					
Mississippi.....		3				
Missouri.....				1		
Nebraska.....	1			2		
Nevada.....				1		
New Hampshire.....						6
New York.....	1					
North Carolina.....		1				
Ohio.....	3	1		37	1	3
Rhode Island.....	1					
South Dakota.....	1					
Tennessee.....					1	
Texas.....		2		4		4
Utah.....				4		
Vermont.....						15
Virginia.....		2				
Washington.....	1			2		
Wisconsin.....		2		3		
Wyoming.....	1			2		
Total.....	27	53	1	73	28	73

TABLE 3.—Number of actions instituted by municipal officials alleging violation of the Federal food and drugs act.

Cities.	Prosecutions.			Seizures.		
	Food.	Feed.	Drug.	Food.	Feed.	Drug.
Lexington, Ky.				1		
Cleveland, Ohio.	1	1		8		4
Memphis, Tenn.						3
Salt Lake City, Utah.				1		
Washington, D. C.	57		2			
Total.	58	1	2	10		7

During the year 273,540 pounds of straight dyes were certified. Of this amount 138,395 pounds consisted of straight dyes certified under foundation certificates. The relative quantities of the straight dyes certified, exclusive of repacked colors, were as follows:

Amaranth, 43.3 per cent; Tartrazine, 17.7 per cent; Ponceau 3 R, 16.6 per cent; Orange I, 12.7 per cent; Yellow A B, 4.1 per cent; Indigo Disulpho Acid, 2.9 per cent; Naphthol Yellow S, 1.4 per cent; Erythrosine, 1.3 per cent; Yellow O B, 0.006 per cent; Light Green S. F. Yellowish, none.

IMPORTED FOODS AND DRUGS.

During the year the variety and quantity of foods and drugs offered for entry into this country have greatly increased, though there is little that is new or needs special mention. The number of samples taken and examined, particularly at the larger ports of entry, has very nearly, if not quite, equaled the number taken in any year previous to the World War. In other words, during this year, in so far as variety and sources of supply are concerned, importation of foods and drugs has rapidly approached a normal status, a condition contributing very greatly to the difficulties of administration due to the bureau's depleted force and funds.

It might be noted that jams have been imported from Australia, and that the amount of butter imported has been much above that coming to this country in most previous years. It has come principally from Canada, but also from Denmark, Holland, and Argentina, and in small amounts from other countries. Returned shipments of American butter have also been received. Some shipments of butter on examination were found to be adulterated in that they contained too little butter fat or too much water. Such shipments have been refused entry, except that, when reworking would produce a satisfactory product, release has been granted for reworking if conditions could be maintained which would leave no question as to the identity of the goods, and the finished product on examination has been found satisfactory.

During the year many varieties of foreign mineral waters have been offered for entry, even some which have not previously come to the bureau's attention. This is in contrast with the last few years, during which both the number of varieties and the amounts imported

have been very small. The percentage of shipments refused entry as adulterated because of pollution due to careless bottling or to contamination of the sources of the supply has been rather high. Relabeling has been required in some instances to eliminate exaggerated and unwarranted statements as to curative or therapeutic effect. Goods labeled as radioactive have revealed on examination little or nothing to justify such labeling.

Among adulterated drugs might be mentioned an ingeniously sophisticated shipment of so-called saffron, consisting of the dyed and weighted flowers of a plant unrelated to saffron and without either tinctorial or flavoring value. Quite a number of shipments of anise seed have been found to be adulterated with exhausted seed from which the volatile oil had been extracted, one shipment containing as much as 65 per cent of this worthless product. A number of shipments have been examined of Levant wormseed, *santonica*, which is gathered in the deserts of Turkestan and is the source of *santonin*, a valuable drug, the importation of which had practically stopped. Many of them, however, were found almost totally deficient in *santonin* and were refused entry.

Shipments of crude drugs deficient in active principles have been allowed entry for legitimate manufacturing purposes only, under conditions more fully outlined in last year's report. Many medicinal preparations bearing statements of therapeutic or curative effect have been relabeled more nearly in accord with the limits of usefulness of the ingredients.

Among the crude drugs which have been substituted for well-known drugs or for the official species noted this year not mentioned in the report of the Chemist in former years are the following: *Piper ribesoides* Wall. for the official cubeb, *Piper cubeba* L.; *Berberis*, sp. for Columbo root, *Jateorhiza palmata* (Lamarck) Miers; *Richardsonia pilosa*, H. B. K. for ipecac, *Cephaelis ipecacuanha*, Rich.; Indian valerian, *Valeriana wallichii*, D. C., and Mexican valerian, *Valeriana mexicana*, D. C., or related species for valerian, *Valeriana officinalis*, L. A shipment of Cocillana, N. F., *Guarea rusbyi* (Britton) Rusby, was invoiced as quinine bark.

Table 4 gives the distribution of the official samples examined by the various field stations. It does not include samples of thousands of shipments examined in a preliminary way.

TABLE 4.—Report of field stations for year ended June 30, 1920.

Laboratory.	Import samples.			Interstate sam- ples.			Miscel- laneous.	Total sam- ples.	Hearings.	
	Le- gal.	Ille- gal.	Floor in- spec- tion sam- ples.	Le- gal.	Ille- gal.	Check anal- ysis.			Im- ports.	Do- mes- tic.
Central district:										
Chicago.....	198	140	842	170	567	91	560	1,726	126	262
Cincinnati.....	118	13	44	75	294	24	289	813	9	195
Minneapolis.....	89	14	133	17	145	16	184	465	3	164
New Orleans.....	21	37	83	27	124	18	291	518	22	194
St. Louis.....	43	8	31	97	361	47	565	1,121	11	282
Kansas City.....	11			41	31	2	23	108	1	145
Total.....	480	212	1,133	427	1,522	198	1,912	4,751	172	1,242
Eastern district:										
Baltimore.....	103	22	42	202	373	6	908	1,614	12	143
Boston.....	572	237	9,980	60	399	3	353	1,624	182	118
Buffalo.....	209	689	358	11	61	2	269	1,241	629	116
New York.....	2,401	2,806	22,707	221	317	22	1,172	6,939	1,592	340
Philadelphia.....	120	152	1,015	60	168	2	256	758	139	46
Porto Rico.....	138	463	1,491		60		276	937	461	
Savannah.....	60	16	25	63	268	15	206	628		155
Total.....	3,603	4,385	35,618	617	1,646	50	3,440	13,741	3,015	918
Western district:										
Denver.....	5	7	251	37	84		211	344		37
San Francisco.....	472	474	37,013	71	460	26	1,144	2,647	447	45
Seattle.....	229	113	9,400	44	79		696	1,161	96	19
Total.....	706	594	46,664	152	623	26	2,051	4,152	543	101
Grand total.....	4,789	5,191	83,415	1,196	3,791	274	7,403	22,644	3,730	2,261

SUGARS, SUGAR DERIVATIVES, SIRUP.

The carbohydrate laboratory, which last year became disorganized, owing to the resignation of its director and practically the entire staff, has been reorganized under new leadership and has resumed active cooperation with the industry upon the production and refining of sugar and of sugar sirups. Directions will be issued before the coming crushing season for the production, by means of the yeast enzyme, invertase, of cane sirup that will neither crystallize nor ferment readily. Invertase will be furnished those desiring to try out the method and personal assistance will be given to as many producers as possible in the sirup-producing section.

The work upon the possible use of commercial maltose sirups in candy manufacture has been practically completed. A survey has been made of many of these sirups upon the market for the purpose of developing procedures for their analysis and for other reasons.

The attempt was made to discover substitutes for cane sugar in the canning of fruits and vegetables. Neither glucose nor maltose was found satisfactory because of their influence upon color and flavor. It was, however, possible to use some samples of refiners' sirup in the production of certain canned products.

The sweet potato, it has been discovered, contains enough of the enzyme, diastase, to convert all of its own starch into sugar and dextrin. Hence it would seem possible to make sirup commercially from sweet potatoes, and work looking to this end is in progress.

In extending the work upon the utilization of corn cobs, described in the report for the fiscal year 1918-19, it has been found that the valuable aldehyde, furfural, may be obtained from this material in commercial quantities. The data have been published.

The work of the bureau upon the production of rare sugars having been an important factor in establishing their manufacture commercially in the United States, in future the work will be limited to the production of such rare sugars as can not be obtained commercially. During the year a wide variety of pure rare sugars was furnished to various investigators for research purposes. Progress has been made in the development of a method for producing the rare sugar sorbose. New directions for the preparation of rhamnose and of levulose have been made ready for publication.

Papers have been printed upon the amide of α -*D*-mannoheptonic acid, upon the rotatory powers of the amides of several α -hydroxy acids of the sugar group, upon the occurrence of melezitose in honey, upon the crystallography of melezitose, upon the heptoses from gulose and some of their derivatives, and upon the acid fermentation of xylose.

Papers upon crystalline chlorotetracetyl fructose and related derivatives, upon the isomeric hexacetates of α -*D*-mannoheptose, upon sedoheptose, a new sugar from *Sedum spectabile*, upon volemite, upon cellulose phthalate, and upon the optical properties of a series of heptitols are in press.

FATS AND OILS.

For the first time the nature and proportions of the fatty acids found in cottonseed oil were determined and published. Myristic, stearic, arachidic, and oleic acids were found. Myristic acid had not previously been found in cottonseed oil, and it had not been determined whether stearic or arachidic acid or both were present. In cooperation with the Society of Cotton Products Analysts, it was established that the locality in which cotton seed is produced has but the slightest influence upon the composition of the oil obtained from that seed. The physical and chemical constants of a large number of authentic oils from all parts of the country were determined and were found surprisingly uniform. Undoubtedly some other factor, probably faulty sampling, is responsible for the contrary statements reported in the literature. The bureau's publication on the subject will undoubtedly finally settle this controverted point.

A supplement to Department Bulletin 769, The Production and Conservation of Fats and Oils in the United States, revising the statistics of this industry up to January, 1919, has been issued. Papers have been printed upon the composition of tomato seed, Hubbard squash seed, okra seed, and hollyhock seed oils, and upon Chinese colza, a valuable oil seed not well known in this country. The oils from okra and hollyhock both give the Halphen reaction, hitherto regarded as characteristic of cottonseed oil. Okra, hollyhock, and cotton belong to the same plant family, the Malvaceae. The methods of preparing the menthol and phenyl-hydrazine derivatives of the higher fatty acids, as well as the properties of these compounds.

were studied in the hope, which proved illusory, that the properties of the individual derivatives would differ to such an extent from one another as to make it easier to separate the derivatives from one another than the parent acids. A report upon the results is in press.

Comparative analyses of a large number of samples of classified grades and kinds of unscoured wool have been published in a news letter and in trade journals. These analyses show the percentage of grease, ash, water-soluble matter, potash, and nitrogen in foreign as well as domestic wools. Improvements in the solvent process of extracting grease from wool and in the bleaching of wool grease have been developed in the laboratory and are soon to be tried out on an industrial scale in cooperation with a large wool scouring and spinning establishment.

CHEMISTRY AND NUTRITIVE VALUES OF PROTEINS.

The results of some of the studies on the chemistry of proteins have been published under the following titles: The Hydrolysis of Stizobin, the Globulin of the Chinese Velvet Bean, *Stizolobium niveum*; Some Proteins from the Georgia Velvet Bean, *Stizolobium deerin-gianum*; Distribution of the Basic Nitrogen in Phaseolin. Papers are in press upon the determination of the jellying power of gelatins and glues by the polariscope, upon the preparation and properties of ash-free gelatins, and upon the acidity of ash-free and commercial gelatins. Work is in progress upon the hydrolysis of coconut globulin, upon the protein of the mung bean, of tomato seed press cake, of the Lima bean, and of the cohune nut.

The work upon the nutritive value of beans, especially of the genus *Phaseolus*, of cow peas and of the Chinese and Georgia velvet beans has been progressing favorably. The results obtained with the navy bean, showing that it can not support growth without the addition of cystine to the diet when the navy bean is the sole source of protein, have been published under the title *The Rôle of Cystine in Nutrition as Exemplified by Nutrition Experiments with the Proteins of the Navy Bean, Phaseolus vulgaris*. Similar studies are in progress on the adzuki, Lima, and mung beans. All of them, except possibly the mung bean, appear to be lacking in cystine. It has not been possible, hitherto, to obtain any growth on either the ground velvet bean or the raw isolated velvet-bean protein. Partial growth has, however, been obtained on the coagulated protein, which would seem to indicate that possibly failure to obtain growth in these cases may be due to some kind of toxicity. However, this will require further careful investigation.

The results of the investigations upon commercial corn gluten meal and upon the nutritive value of peanut flour as a supplement to wheat flour have been made public. An investigation upon the nutritive value of soy-bean flour as a supplement to wheat flour has been completed.

SEA FOODS.

New laboratories have been established at San Diego, Calif., and at Pensacola, Fla. At the San Diego laboratory special attention will be paid to the best methods of canning and preserving Pacific coast fish, particularly those of the tuna and sardine types. The

possibility of utilizing by-products that are now wasted or that may be utilized in some more satisfactory manner will also be examined. At Pensacola particular attention will be paid to the study of the composition and food value of Gulf fishes and to the best methods of preparing them for transportation and handling them in their passage to the consumer. Studies have been made upon the possibilities of canning frozen fish, and preliminary results seem to indicate that under proper precautions this may prove to be feasible.

Papers have been published under the titles *A Chemical Study of Frozen Fish in Storage for Short and Long Periods* and *The Food of the Small Sea Herring and Ammonia and Amines as End Products of Its Decomposition*. Department Bulletin 908, *The Maine Sardine Industry*, which embodies the results of a number of years' work, is in press. The chemical study of the variation of the food value of shad at different times has been completed.

In general, the studies upon the handling, cold storage, and transportation of fresh fish, described in some detail in the report of the Chemist for 1919, have been continued this year and are producing improvements in the industry. The studies begun last year in connection with the spoilage and the flora of fish, particularly of Pacific salmon, have been continued and are described in this report in connection with the general discussion of the bureau's work on food flora, spoilage, and fermentation.

A study of the trade waste effluents on the York River, which was made in cooperation with the Bureau of Fisheries, has been completed, and a report of the work, embracing the conclusions reached in regard to the relation of the effluents from the paper and pulp mills at West Point, Va., to the quality of the oysters, has been submitted to the Chief of the Bureau of Fisheries. A report was made to that bureau upon the sewage-disposal effluents at Bridgeport Harbor, Conn. Jointly with the Bureau of Fisheries, conferences were held with the Bridgeport officials and manufacturers. Steps to eliminate the objectionable conditions in that harbor are contemplated by the officials.

POULTRY AND EGGS.

Department Bulletin 846, *Examination of Frozen Egg Products and Interpretation of Results*, has been issued. It gives directions for the chemical and bacteriological examination of frozen eggs and also outlines the manner of interpreting results. This work will enable the bureau to operate more efficiently in preventing inedible eggs from finding their way into frozen liquid eggs for bakers' use. Department Circulars 52, 55, and 74 were issued under the titles *How to Wrap Heads*, *How to Load Cars of Eggs*, and *How to Break Eggs for Freezing*, respectively.

During the year a number of shippers have consulted the laboratory regarding construction of chill rooms and poultry and egg-packing establishments. Either typical or special plans have been furnished. Several of the plans involved a cost of \$50,000 for construction. When this work was begun in Indiana in 1914 there was not a single chill room in that State. At the present time there are more than 20 such rooms and there are proportionately equal num-

bers in other poultry-producing sections. Three large railroads have sought advice and information concerning the details of construction of refrigerator cars for their lines.

Meetings were held in 16 cities with representatives of various railroads, the Railroad Administration, and Freight-Inspection Bureau. Models were used to illustrate the different types of loads as embodied in the new freight specifications for eggs; also correct methods for the use of fillers and flats in and for the proper construction of cases were demonstrated. The work with the shippers and producers which had been carried on for a number of years was continued, especially in the South where it is now needed.

As a preliminary to a general investigation of the causes entering into the absorption of foreign odors and flavors by eggs during cold storage, experiments were performed on the relative efficiency of various methods of treating eggs to seal the pores. The effects of such treatment have been studied with special reference to the loss of weight of the eggs in storage and to the degree of resistance of the eggs to bacterial invasions that cause spoilage.

The work on the most economical methods for the fleshing of poultry has been transferred from the laboratory to poultry-packing plants in the Middle West. It was demonstrated that the rations which were found most efficient in the laboratory were also most efficient under commercial conditions. Especial attention has been paid to the development of a satisfactory ration without buttermilk, which is not everywhere available. This has required a study of the fowls' dietary requirements of inorganic salts.

Toward the close of the year the food research laboratory in Philadelphia was discontinued and the work transferred to the branch laboratory in Indianapolis.

DAIRY PRODUCTS.

The work to develop analytical and microscopical methods for distinguishing from fresh milk remade milk produced by combining mechanically skim-milk powder, water, and butter fat is, it is believed, approaching a successful conclusion.

The investigation first reported last year to develop methods to appraise the quality of the cream from which a given sample of butter is made has been continued, and it is believed that very valuable practical methods have been developed. Some of these are in process of preparation for publication. Another season's work, it is hoped, will conclude this project, which has an important bearing on certain phases of the enforcement of the food and drugs act.

A paper upon a volumetric method for the detection and estimation of neutralizers in butter and in certain allied products is in press.

An extensive survey of the condenseries and milk-powder plants in the Middle West has been made with a view to determining the character of the milk used. An investigation is in progress to develop methods for estimating the quality of the milk used in the preparation of evaporated, condensed, and dried milk, with particular reference to the bacterial content and the acidity of the raw material. In this connection the use of neutralizers and their detection in the finished product is being studied.

BEVERAGES.

Papers have been published upon the longevity of bacteria in commercial bottled waters, upon acids in beverages, and upon the clarification and preservation of fruit juices. Much instruction has been given manufacturers upon the best methods of operation, especially in the use of such sugar substitutes as maltose sirup.

FLOUR AND CEREALS.

Department Bulletin 839, The Microscopical Examination of Flour, proposes a method for the determination of the grade of a flour based on the use of the microscope to count the number of offal particles which differs considerably in the different grades of flour.

Reports have been issued or completed upon a simple method for measuring the acidity of cereal products and its application to sulphured and unsulphured oats, upon the composition and baking value of flour particles of different sizes, upon pearled barley and its manufacture and composition, and upon the laboratory control of wheat-flour milling.

FOOD FLORA, SPOILAGE, AND FERMENTATION

Reference to the year's work upon the spoilage and the flora of specific articles of food are made elsewhere in this report, where such foodstuffs are specifically considered. The work upon spoilage centered principally upon the study of botulism and upon the study of the spoilage of salmon.

A summary of the bureau's investigations of poisoning due to ripe olives was published in the May 1 number of the Journal of the American Medical Association. Other papers upon the results of the investigations of botulism have been prepared under the titles Botulism from Canned Asparagus and The Possible Pathogenicity of *Bacillus botulinus*. The work on botulism is tending to the study of a number of related bacterial groups as possible causes of a variety of food poisonings related to but not so fatal as botulism. Moreover, it has been shown that massive doses of *Bacillus botulinus* free from toxin when injected subcutaneously or intravenously are capable of producing untoward effects. It seems that similar results may be obtained with other related groups of putrefactive organisms. It is possible that studies of this kind will in time clear up many obscure clinical conditions that are designated in general as ptomaine poisoning but that we know to-day have nothing to do with the presence in the food of the group of chemical substances known as ptomaines.

In the study upon the spoilage of salmon the following reports have been issued: An Aerobic Spore-Forming Bacillus in Canned Salmon; and Bacteriological Experiments with Salmon. Papers have been prepared under the following titles: Bacterial Decomposition of Salmon; and Bacterial Groups in Decomposing Salmon. These studies have given the first information on the bacterial flora of fresh salmon, and they show that the conditions under which salmon are handled in Puget Sound make it possible to keep these fish for at least 48 hours before there is any noticeable invasion of the flesh by

the bacteria that occur upon the skin. It was also found that washing the fish so as to remove the dirt and slime from their skin will delay the invasion of the flesh by microorganisms.

Department Bulletin 819, A Pink Yeast Causing Spoilage in Oysters, was issued.

The work upon oriental fermentations, especially the production of soy sauce from soy beans, is being continued, and a paper has been issued under the title Laboratory Experiments on the Manufacture of Chinese Ang-Khak in the United States. A report on the identity of *Aspergillus oryzae* is in press.

The studies upon the fermentation of pickles and of sauerkraut have been continued, and papers issued upon the pickle investigations of the bureau and upon the control of sauerkraut production by adjusting the temperature, with reports of experiments.

The process for producing vinegar from orange juice has been perfected, and two papers, one upon the production of orange vinegar by the rapid process, the other upon the general subject of the manufacture of orange vinegar and upon its composition, are in press. There is every indication that the production of orange vinegar is establishing itself commercially as a small but valuable industry in the orange-producing sections of California. Orange vinegar can never, because of its cost, compete with cider or distilled vinegar, but it can appeal to a discriminating trade because of its own merits and characteristics.

PLANT CHEMISTRY.

A method for the determination of soil acidity has been published under the title, Determining Soil Acidity and Alkalinity by Indicators in the Field, and a paper on soil reaction and plant distribution is in press. In cooperation with the Bureau of Plant Industry, field surveys have been made by this method which indicate that soil reaction greatly influences the distribution of plants. These observations promise to be of great importance in ecology and in agriculture.

There is in press a report which describes definitely the nature of the odorous constituents of apples. Now that these substances are known, it is possible to reproduce the flavor of apples by synthetic means. In the course of this work, it was established that in respiration apples give off acetaldehyde, a discovery of great significance in plant physiology and probably also of practical importance in connection with the storage of apples.

Two papers were published on the constitution of capsaicin, the pungent principle of capsicum, and one upon vanillyl-acyl amides, the series of compounds of which capsaicin is a member. These amides show a definite pungency varying with the size of the molecule. The chemical constitution of capsaicin may now be considered as settled definitely. The reconstituted substance is identical crystallographically with capsaicin.

A crystallographic study of the raphides and crystals of calcium oxalate and other salts in plant cells was begun, with the thought that criteria might be obtained for the identification of plant tissues in food and drug products. It will be necessary to revise the crystallographic and optical data on calcium oxalate, since this substance has not been studied except superficially for 50 years or more. An-

alysis of crystallographically characterized material will be necessary, since the last analysis on record was made in the days when water was HO.

Department Bulletin 803, A Chemical Study of the Ripening and Pickling of California olives, was issued, as well as papers on *Ilex vomitoria* as a native source of caffeine, upon the effect of lime upon the sodium chlorid tolerance of wheat seedlings, and upon pine-needle oils.

Directions have been distributed for the manufacture of citrus-fruit butter and of confections from orange and grape-fruit peel.

DRUGS AND PHARMACOLOGY.

An exposition of the activities and aims of the bureau's pharmacognosy laboratory was published in the Journal of the American Pharmaceutical Association. The following publications have been issued or prepared: *Santolina chamaecyparissus* L., an Adulterant of *Matricaria chamomilla* L.; The Resin of Man-Root (*Ipomoea pandurata* L.) Meyer, with a Note on Two Other Convolvulaceous Resins; The Crystallography of Morphine and Certain of its Derivatives; Relative Content of Volatile Oil and Ash in Sage Leaves; Partial Analyses of 330 American Crude Drugs; Acid-Insoluble Ash Standards for Crude Drugs; and Commercial Hydrastis (Golden-seal).

A report was issued upon the composition of oil of chenopodium from various sources. The object was to learn whether some of the untoward effects occasionally observed clinically when this oil is used as an anthelmintic could be explained. It was found that certain precautions in the distillation of the chenopodium oil from the plant must be observed in order to avoid the decomposition of the active principle, ascaridole, by prolonged contact with steam or boiling water. Oil distilled in Java was found to be very similar to the oils of American origin. Oil distilled from wild plants collected in Florida was found to contain less ascaridole than the oil distilled from cultivated plants in Maryland. The same constituents were found in it that were found in the Maryland oil. The terpenes of chenopodium oil were found to contain *p*-cymene, *l*-limonene, and probably γ -terpinene. In order to learn whether the therapeutic action of chenopodium oil is dependent solely upon ascaridole there were prepared pure ascaridole, the terpenes of chenopodium oil, and a derivative of ascaridole. These were furnished to the United States Public Health Service and to the International Health Board to be tested for toxicity and anthelmintic action. A report was also issued upon the essential oil of *Rubieva multifida*, a relative of chenopodium, to determine if it might be used in place of oil of chenopodium. It was found to contain phellandren and anethole but no ascaridole.

The work upon the toxicity of gossypol, the phenol found in cotton seed, has been practically completed. It was determined that long-continued feeding of this substance produces perfectly characteristic symptoms, the principal ones of which are loss of weight and appetite and a paresis of the extremities. Careful analyses were also made of different varieties of seeds, and it was shown that they differ

very considerably in gossypol content. In consequence, experiments upon rats were carried out in which different varieties, notably Egyptian, Lone Star, Price, and Durango cottonseed meal, were fed. It was found that the toxicity of different varieties of seed runs roughly parallel with their gossypol contents. It was also found that heating and extraction with certain organic solvents, such as ether, removes the gossypol. It follows, therefore, that in these observations is to be found the explanation of the discordant results that various investigators have obtained in feeding cottonseed meal, either to farm stock or to laboratory animals. It also follows that it should be feasible to so treat cottonseed meal commercially as to remove or destroy practically all the gossypol content of the meal. Recently plants have been constructed for the extraction of cottonseed cake with organic solvents so as to remove the 4 to 6 per cent of cottonseed oil that remains in the press cake. It is likely that this treatment if carried out thoroughly will either completely or very largely remove the gossypol from the cottonseed cake so treated. If this is found to be the case such cake should be more suitable for feeding than ordinary commercial cake and should be relatively non-toxic. It may be possible to feed it in very large quantities.

The work to determine the effect of feeding small quantities of toxic substances over long periods of time by the methods described last year was continued and extended to include several heavy metals, such as lead and zinc, as well as a number of other substances occurring as adulterants in foods. During the war, in cooperation with the Bureau of Biological Survey, an investigation of the effectiveness of various toxic agents in the extermination of rats was undertaken. Strychnine was not found very satisfactory. Barium carbonate was found on the whole quite satisfactory. It was determined that when it was present in the proportion of 20 per cent of the total quantity of the food submitted to the rats practically 100 per cent of the animals died. A manuscript embodying this part of the work has been prepared for publication. Observations were made upon the relative toxicity of different forms of arsenious oxid. It was found that in the finely powdered or amorphous form it was much more toxic than in the form of well-defined crystals. It was about twice as efficient as barium carbonate. Various observations were made which should be of very great value both in the use of barium carbonate and in the use of arsenic as rat exterminators. The work upon arsenic has practically been completed. Papers have been prepared for publication under the following titles: The Toxicity and Physiological Action of Arsenic and Zinc; Observations upon the Intra-peritoneal Injection of Fixed Oil; Toxicity of Strychnine for Some of the genus *Mus*; A Comparison of the Effect of Certain Saponins on the Surface Tension of Water with their Hemolytic Power.

INSECTICIDES AND FUNGICIDES.

In Department Bulletin 795, The Adulteration of Insect Powder with Powdered Daisy Flowers (*Chrysanthemum Leucanthemum* L.), are described the methods for the detection of this form of adulteration; in Department Bulletin 824, Insect Powder, are described the methods for the detection of the addition of powdered insect flower

stems as an adulterant to insect powder; and in a paper published under the title of *The Microscopical Identification of Mowrah Meal (Bassia) in Insecticides* are described the methods for the detection of this adulterant. Studies upon proper standards for hellebore and upon methods for detecting its adulteration are approaching completion.

In Department Bulletin 893, *Experiments on the Toxic Action of Certain Gases on Insects, Seeds, and Fungi*, which was published in cooperation with the Bureau of Entomology, are described the experiments upon the action of phosgene, arsine, cyanogen chlorid, chloropicrin, illuminating gas, and carbon monoxid. Only cyanogen chlorid and chloropicrin give promise of being useful for fumigation purposes. Neither of these war gases, however, can be used in greenhouse fumigation because of their injurious action on plants. Nevertheless, they probably will prove to be of value in the fumigation of stored products.

In Department Bulletin 866, *Pickering Sprays*, are published the results of three seasons' experiments with types of sprays containing smaller amounts of copper sulphate than standard Bordeaux mixture. It was found that such sprays, containing from 0.6 to 0.7 per cent of copper sulphate, controlled fungous diseases on potatoes and cranberries very effectively. Their control of fungous diseases on grapes and apples was not definitely determined, the results being complicated by burning or other injury to the foliage and fruit. It was also found that sprays made with barium hydrate instead of with lime were very successful as fungicides for potatoes. Increased yields of tubers were obtained on plots of potatoes treated with Bordeaux and with a stronger Pickering spray, indicating that these sprays exert similar stimulating and protective action on potato plants. Moreover, the sprayed potatoes yielded tubers with a higher amount of solids than those from unsprayed plots.

One of the investigations upon spraying that has been in progress for some years has been completed, and the results are being prepared for publication. This investigation was planned to determine how much of poisonous elements remain on fruits and vegetables sprayed with poisonous sprays, and also to determine how such poisonous residues may be removed from the fruit or vegetable to be marketed, and finally to determine the conditions of spraying that would yield fruit and vegetables with the smallest possible quantity of objectionable material remaining upon them as they reach the hands of the consumer.

The effect of the various compounds of arsenic on insects, including bees, has been studied, and the manner of action of the various compounds noted. It has been found that even insoluble arsenic compounds seem to be soluble in the bodies of insects. This solubility varies for different compounds and it seems possible to use certain insects as indicators of the insecticidal value of arsenical compounds. There are indications that the compound that shows the highest percentage of soluble arsenic in the bodies of these insects is the best insecticide with respect to killing property. The data are being collected and analyses of bees will be made shortly. It is intended to collect and tabulate all the cooperative data on the subject as soon as the analyses are completed. It has also been found that a com-

pound of copper and barium with arsenious acid, one of a number of new arsenicals prepared in the course of the bureau's work on the improvement of the methods of manufacturing insecticides and fungicides and on the discovery of new insecticides and fungicides, is most effective in killing insects.

Investigations have also been made upon the sticking qualities of lead and calcium arsenate upon various types of foliage, particularly that of the potato.

In cooperation with the Bureau of Entomology, as a part of the boll-weevil campaign, studies have been made to determine how much soluble arsenic cotton plants will stand. For the same purpose, some hundreds of analyses of samples of calcium arsenate, destined for use in combating the boll weevil, have been made for the Bureau of Entomology, in order that no shipments of calcium arsenate unsuitable for use upon cotton might go into the South. It was deemed extremely important that the quality of the insecticide be carefully guarded in order that no prejudice or failure might arise due to the poor quality of some of the insecticides used.

For the Bureau of Entomology studies have also been made of the quantities of hydrocyanic acid that remain in fumigated materials, and for the Bureau of Plant Industry numerous determinations have been made in connection with that bureau's studies upon the control of cereal diseases. For the Insecticide and Fungicide Board more than 600 samples of insecticides and fungicides, including antiseptics, have been examined, and, where necessary, bacteriological tests have been made.

DEHYDRATION OF FRUITS AND VEGETABLES.

During the season of 1918 many manufacturers of dehydrated products suffered serious losses through insect infestation. The insect in practically all cases was found to be the Indian meal moth, *Plodia interpunctella*. In cooperation with the Bureau of Entomology, an appropriate investigation was undertaken which made it possible to advise manufacturers how to avoid these losses. The results have been very encouraging, so that during the past season the losses of certain of the manufacturers have been very greatly lessened.

Investigation has shown quite conclusively that vegetables commercially dehydrated without blanching or other pre-treatment deteriorate upon storage. As a result of the bureau's propaganda during the past season, the major portion of the vegetables dehydrated have been processed and will therefore hold up much better when placed on the market. Many plant managers are not as yet adept in the practice of blanching, and much investigation is needed to determine the proper methods for blanching each product. Manufacturers have been placed on the proper road for the production of products of quality.

Much work has been done upon the dehydration of fruits with a view to reducing or eliminating preliminary sulphuring. At the present time some apples are being produced without any sulphuring whatever, while a large volume of fruit is being dehydrated with but very little sulphuring. Some of these products are being mar-

keted at a premium over corresponding sun-dried materials, and it is believed that in time dehydration will largely replace sun drying, because the dehydrated product is superior and the process under many conditions may be more economical.

Work was done in cooperation with the Bureau of Markets on the curing of sweet potatoes and assistance has been given in furthering the proper handling of southern sweet potatoes. A report upon the preparation of sweet-potato flour by the methods that are being used with success in the preparation of white-potato flour has been prepared for publication.

Much propaganda has been made to extend the use of dehydrated products, and large quantities of these materials have been distributed to hospitals, asylums, and other interested parties for the purpose of familiarizing the public with these products and of assisting in the creation of a wider market for them. At present the industry needs much information concerning improved methods of preparing the raw material before dehydration, and more knowledge concerning the chemical changes which occur on deterioration is essential. Future work will be concentrated very largely upon these and related problems.

COLOR INVESTIGATIONS.

A general discussion of the work of the color laboratory has been printed in the *Journal of Chemical and Metallurgical Engineering*. The work of this laboratory has been hampered by numerous resignations. Though the staff consists of but 12 chemists, during the few years of its existence it has lost more than 35 men, who have left to fill positions in commercial dye plants. The training of these men in itself represents no small contribution to the progress of the industry. Toward the end of the year the laboratory was moved to the color laboratory building at the Arlington Farm, although the building is not yet completely equipped.

One of the features of the laboratory's work has been the application of optical crystallographic methods in dyestuff research. These methods have been found of the greatest use in the work to determine the purity and character of compounds as well as in other ways. These methods have been introduced to the industry and the bureau's facilities have been placed at the disposal of the industry for the training of experts.

The work upon photosensitizing dyes has been continued. Kryptocyanin (KIII), a new dye with a sensitization maximum at 7,400 λ , has been prepared in amounts aggregating several grams. Three dyes of this series have been prepared crystalline. Two of these have been tested at the Bureau of Standards and found to be useful, but not equal in sensitizing action to KIII.

It is reported that more than 100,000 pounds of phthalic anhydride are being produced monthly by the bureau's process and that it is being exported to Europe. The price has fallen so materially that the annual saving probably runs into the hundreds of thousands of dollars. A list which enumerates some 300 different uses for phthalic anhydride and gives the references to the literature and the names of the compounds will be issued shortly.

An idea of the scope of the color work of the bureau can, perhaps, be gained best by examining the list of its researches published or prepared for publication during the year. A few of these papers are mentioned elsewhere in this report. The others are: The Melting Point of Pure Phthalic Anhydride. The System: Phthalic Anhydride—Phthalic Acid; The System: Naphthalene—Phthalic Anhydride; The Vapor Pressure of Phthalic Anhydride; The Fusion of Sodium *p*-Cymene sulfonate with Sodium Hydroxide for the Production of Carvacrol; The Fusion of Sodium Benzene *m*-Disulphonate with Sodium Hydroxide for the Production of Resorcinol; A Synthesis of Thymol from *p*-Cymene; The Preparation of 2-Chloro-5, 6-Dinitrocymene; Purification of Benzoic Acid by Fractional Condensation; The Crystallography and Optical Properties of the Photographic Sensitizing Dye, Pinaverdol; The Absorption Spectra of the Nitric Esters of Glycerol; Some Aspects of the Behavior of Charcoal with Respect to Chlorine; The Production of Hydrochloric Acid from Chlorine and Water; The use of Catalysts in Sulfonation of Aromatic Compounds; Synthesis of *s*-Xylidine.

LEATHER AND TANNING.

Publications entitled Notes on the Determination of Water Solubles in Leather, and Kaolin for Tannin Analysis have been issued. Reports have been made before technical societies upon waterproofing leather, upon a method for testing materials for increasing the water resistance of sole leather, and upon the relative absorption of oils and greases by wet and dry leather. Articles on the effect of humidity on the strength and stretch of leather, on the value of palmetto and willow bark as sources of tannin and Farmers' Bulletin 1183, The Care of Leather, have been prepared for publication.

Eighteen hundred pairs of Army shoes have been made up from specially selected leather and material. The shoes have been put in service at Camp Funston, Fort Bliss, and Columbus, N. Mex., and have been constantly under the inspection of a member of the leather and paper laboratory. Most of these service tests are nearing completion. A portion of the leather has been cut up into taps for half-soleing. Taps have been numbered and paired off according to contrasting features. Arrangements have been made to repair shoes of policemen, letter-carriers, and civilians with these taps. The records of the wear of these tapped shoes are being kept under the supervision of the laboratory. In this way it is hoped to obtain data supplementing the results from the Army tests. In cooperation with the American Leather Chemists' Association much work was done on the following subjects: The determination of water solubles in leather, the sampling and preparation of leather for analysis, moisture in leather, Epsom salts in leather, the determination of oils and greases in leather.

Among other results it was learned that relative humidity materially affects the tensile strength of leather so that a study is now being made to determine the necessity of testing under controlled conditions of temperature and humidity. This point is of importance since it has been ignored in all work on the strength of leather published in this country, and so far as known has been considered

only superficially in work done abroad. Further work has been done on the preparation of dubbings for shoe uppers and waterproofing materials for sole leather and some of the dubbings and waterproofing compounds are being tried out in the Army service tests mentioned.

Experiments have been made to develop methods for tanning leather on a small scale that can be used, especially by farmers, for home-tanning operations. Only simple, inexpensive homemade equipment was used and materials that are easily available. A farmers' bulletin on the subject is being prepared, since, judging from the large and increasing number of inquiries, there is a great demand for this sort of information.

Farmers' Bulletin 1055, *Country Hides and Skins: Skinning, Curing, and Marketing*, was published in cooperation with the Bureau of Markets and the Bureau of Animal Industry. It describes the correct method for skinning, curing, and marketing country hides and skins. Also a poster, *More Money for Better Hides*, was widely distributed. Both were in such demand that within a few months after publication a reissue of each was necessary. As a means of strikingly illustrating the importance of this subject, elaborate displays of defective hides and leather were assembled, and through the cooperation of the Office of Exhibits were exhibited at the various State fairs throughout the country and at the international live-stock exhibition in Chicago. The exhibits thus visualized the serious consequences of carelessness in skinning, curing, and marketing, and of excessive branding, and the damage caused by pests such as the grubworm.

Assistance has been rendered to some of the northern tanners by determining, in cooperation with the Bureau of Animal Industry, the character of a peculiar defect of certain skins which is not apparent until the skins are split. The trouble was found to be due to the follicular mange, and suggestions were given the tanners to aid them in detecting such defective skins before splitting, thereby saving many skins suitable for certain kinds of leather, but almost an entire loss for split leather.

An investigation of the difficulties experienced by a near-by tanner in unhairing a certain lot of hides showed that this was due to curing with salt containing alum, which set the hair in the skin and consequently reduced the value of the hide. A news note bringing out this point has been published.

Samples of oak bark improperly prepared for leaching have been analyzed for tannin after commercial extraction and found to have been very poorly extracted. The attention of several tanners was called to this extravagant practice, avoidance of which should result in a marked saving of tanning materials.

Some time has been given to the improvement and more general utilization of domestic sumac, to establishing grades of sumac, and to inducing purchasers to pay a price commensurate with the quality.

PLANT DUST EXPLOSIONS AND FIRES.

As no specific appropriation was made for this work, on July 16, 1919, the United States Grain Corporation appropriated \$50,000 for the continuation of the educational and investigational work carried on by the bureau during the preceding years. Nearly the whole force of the bureau that had been engaged upon this work was transferred

to the rolls of the Grain Corporation, only the leaders remaining upon the roster of the Bureau of Chemistry. Active inspection was carried on in mills and elevators in which the Grain Corporation had wheat or stocks of flour in storage to secure the removal of hazardous conditions and the installation of devices which have been developed for the prevention of fires and explosions. Special literature, consisting of circulars, posters, and folders, was prepared and circulated among the owners and employees of the mills and elevators throughout the country.

On September 13 a disastrous explosion occurred in a Kansas City grain elevator, with a loss of 14 lives. The loss to the Grain Corporation was about \$25,000, which represented almost the total losses from such causes during the entire period of its existence. It never had stocks of a value less than \$100,000,000 on hand, and they often amounted to \$500,000,000. With the passing out of existence of the Grain Corporation toward the end of the year, the force was disbanded and the work discontinued.

Owing to lack of funds, little work could be done to prevent thrasher explosions and fires. Except for field demonstration, this project is closed, but such work is urgently needed. For lack of it a large number of explosions and fires occurred in the Walla Walla territory in southwestern Washington, causing extensive damage to grain and machines. Department Circular 98, The Installation of Dust-Collecting Fans on Thrashing Machines, has been issued.

For lack of funds the work upon the study of fires in cotton gins was limited to correspondence and conferences with manufacturers of machinery, fire marshals, underwriters, and other interested parties.

In cooperation with the National Lamp Works, the Westinghouse and the Edison companies, it was demonstrated that dust explosions can be caused by the breaking of any type of incandescent-lamp bulb. Work was done at Cleveland, at the Edison plant at Harrison, at the Westinghouse plant at Bloomfield, and at the Pennsylvania State College. The object of the engineers of the lamp companies is to develop equipment that will remove some of the dangers and make it possible to establish safe practice.

PAPER, CONTAINERS, AND FABRICS.

As reported in 1917, the investigations on blue-print paper have been of service in establishing more solidly the manufacture of such paper in this country, and it is now possible for the Government, and engineers generally, to procure in this country all the blue-print paper needed, of a quality superior to that formerly obtained from abroad. During the year, at the request of the Navy Department, the specifications for blue- and brown-print paper were revised, after which they were adopted by the Navy Department. In a similar manner the bureau was called upon by the War Department, Treasury Department, Shipping Board, and the General Supply Committee. An effort has been made toward the adoption throughout the Government service of uniform specifications for the purchase of blue- and brown-print paper, of which at least 500,000 pounds are consumed annually. Specifications for the production of water-resistant papers for baling have been published.

Paper products, fiber board, wall board, and water-resistant wrapping papers are rapidly replacing wood and even tin as containers for certain kinds of food and merchandise. There are no methods for testing these materials or insuring the manufacture of a satisfactory box board that will withstand the forces of destruction met with in transportation, especially in overseas shipments. Neither is there any satisfactory method for determining the strength of fiber board, wall board, corrugated board, or water-resistant baling papers. Much work has been in progress in the last three years on these subjects, and some of the results have been published in the form of a description of an impact tester for fiber board, as well as a report upon water-resistant papers for baling.

The investigations relating to the water resistance of fiber board and the adhesives used in the manufacture of solid and corrugated fiber board and wall board have greatly stimulated the interest of the industry, especially those on the effect of silicate of soda when used as an adhesive on fiber board and on the value of the proper sizing of the board in increasing its water resistance. Following the work of the bureau on fiber board, the silicate of soda manufacturers and the fiber board associations established two fellowships at the Mellon Institute to investigate their technical problems. A much more intelligent and conservative use of silicate of soda has resulted from the bureau's work. Economy in silicate has been effected and a more durable water-resistant board is being made, although the deteriorating effect of silicate of soda on fiber board has not been overcome entirely.

Factory scale experiments have been made on the use of the adhesives from corn cobs, the production of which was described in 1919. Commercial mill runs have shown that this adhesive has great value in the production of corrugated and other fiber board. Valuable results have been obtained and board manufacturers very favorably impressed. Laboratory tests have given indications that both the corn-cob adhesives and certain kinds of purified concentrated sulphite cellulose liquors are very useful adhesives.

The results of the investigations upon the examination of enamel ware and upon the use of hydrogenated oils in place of palm oil in the manufacture of tin plate, described last year, have been published this year. Investigations of the suitability of different types of containers for the storage of baking powders and of dehydrated vegetables and fruits have been completed and prepared for publication.

Specifications for the purchase of waterproofing and mildewproofing for canvas and of waterproof automobile top dressings have been prepared at the request of the War Department, and samples of waterproofing materials have been tested and advice given on the award of contracts. By this means the bureau was instrumental in saving the War Department approximately \$24,000 on a single requisition and in securing a material much superior to that which it was on the point of ordering at about three times the price. Some of the indications from this work are (1) that the oleates of the heavy metals are more toxic than stearates to fungi; (2) that the soaps appear to fall in the following order in their inhibitive effect, barium, magnesium, calcium, strontium, mercury, manganese, lead, iron, cobalt, copper, zinc, nickel, aluminum, and chromium; (3) that

Aspergillus niger and *Penicillium* show a high degree of resistance to metallic soaps. A paper covering the work on soaps of the heavy metals is in preparation. Papers on methods of testing the water resistance of fabrics and on testing the mildew resistance of fabrics have been published. Farmers' Bulletin 1157, Waterproofing and Mildewproofing of Cotton Duck, is in course of publication.

NAVAL STORES.

Department Bulletin 898, Turpentine: Its Sources, Properties, Uses, Transportation, and Marketing, with Recommended Specifications, is in press. It endeavors to present to the producer and consumer certain elementary but very important information of great use to the industry.

METHODS AND APPARATUS.

Methods have been published for the estimation of monobromated camphor in migraine tablets, of water solubles in leather, of iodid and bromid in mineral waters and brines, of saccharin in urine, and of caffeine in vegetable material.

Papers have been published on the use of kaolin in tannin analyses and on the combination of fractionation with spectrophotometry in proximate organic analysis. Papers are in press on a color test for oxalic acid and on the Kjeldahl nitrogen method and its modifications. Reports are in press upon methods for the estimation of phosphatides, for the detection of neutralizers in butter, for the estimation of phenolphthalein, and for the separation of magnesium from sodium and potassium chlorids.

As a by-product of the regular testing to which all chemical reagents purchased by the bureau are subjected, notes upon sulphuric acid free from nitrates and the diphenylamine test for nitrates, upon potassium ferricyanide, upon methyl orange, and upon the quality of the chemicals received by the Bureau of Chemistry during the war were published.

There were distributed to the chemists of the bureau and to collaborating chemists information sheets containing critical discussions of the methods of examining the following products: Condensed milk, sweetened condensed milk, milk, cream, and oysters.

ANALYTICAL WORK FOR OTHER DEPARTMENTS AND BUREAUS.

Because of the return of the various Government establishments to a normal basis, only about one-third as much analytical work was done for them this year as last. The figures are collected in Table 5. In addition, a number of extensive investigations were carried out for other Government establishments, and much advisory work on the preparation of specifications and the like was done. The usual assistance was given the Post Office Department in connection with fraud-order cases.

For other bureaus of the Department of Agriculture a great deal of analytical work was done. For example, nearly 1,000 samples of insecticides and fungicides were examined for the Insecticide and

Fungicide Board, the Bureau of Entomology, and the Bureau of Plant Industry. More than 200 samples of water were examined for the Bureau of Public Roads, in connection with an investigation of the causes of deterioration of cement tile. The failure of cement tile to withstand the action of the soil and drainage waters is especially marked in southwestern Minnesota.

TABLE 5.—*Samples analyzed for other departments.*

Departments.	Number of samples.	Departments.	Number of samples.
Department of State.....	4	The Panama Canal.....	33
Department of the Treasury.....	843	District of Columbia.....	9
Department of War.....	2,723	General Supply Committee.....	34
Department of Justice.....	301	Federal Trade Commission.....	3
Post Office Department.....	148	United States Grain Corporation.....	152
Department of the Navy.....	544	Miscellaneous.....	29
Department of the Interior.....	53		
Department of Commerce.....	322	Total.....	5,398



