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OF
THE SECRETARY OF COMMERCE
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FOURTEENTH ANNUAL REPORT

OF THE

SECRETARY OF COMMERCE

1926

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[September 1, 1926]

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FOURTEENTH ANNUAL REPORT
OF THE
SECRETARY OF COMMERCE

DEPARTMENT OF COMMERCE,
OFFICE OF THE SECRETARY,
Washington, November 2, 1926.

To the PRESIDENT:

I have the honor to submit herewith for transmission to Congress the Fourteenth Annual Report of the Secretary of Commerce, in six parts, as follows:

I. Progress in elimination of waste.
II. Foreign trade.
III. Economic review.
IV. Aeronautics.
V. Legislative recommendations.
VI. Condensed reports of bureaus.

The report has been prepared for transmission to Congress, as required by the organic act of the department.

Yours faithfully,

HERBERT HOOVER,
Secretary of Commerce.

Part I.—PROGRESS IN ELIMINATION OF WASTE

[By Herbert Hoover, Secretary of Commerce]

The general movement throughout the country for elimination of waste in production and distribution has made steady progress. The Department of Commerce, in continuation of its work of the past five years, has devoted much of its activities to this end.

While various divisions of the department have been actively aiding in the campaign in many specific directions, it must be borne in mind that the whole program is one fundamentally to stimulate action among industries, trades, and consumers themselves. It is obviously not the function of government to manage business, but for it to recruit and distribute economic information; to investigate economic and scientific problems; to point out the remedy for economic failure or the road to progress; to inspire and assist in cooperative action in reduction of waste—surely all these are well within the proper field of public service.

It seems worth while at all times to reiterate the fundamental purposes of this campaign. The objectives which underlie it have but one purpose; that is, to maintain American standards of living for both workers and farmers, and to place production on a more stable footing by enlarging consumption and export markets through reduced production and distribution costs. The high standards of living enjoyed by the American people are the result of steadily mounting per capita productivity. There is only one way to further advance these standards, and that is by improved methods and processes, by the elimination of waste in materials and motion in our production and distribution system. The moral and intellectual progress of the Nation is not the offspring of poverty or low living standards. The incentives to crime decrease with increasing security; the opportunity for education, and the growth of understanding are the products of economic progress—not of economic degeneration. Devotion to economic improvement whether in individual effort or in improved methods enlarges the field of leadership; it is not a stimulant of idle or luxurious living.

Just as 20 years ago we undertook nation-wide conservation of our natural resources, so we must to-day even more vigorously sustain this campaign of better nation-wide utilization of our industrial resources and effort. More especially is this the case in view of

the many complex forces which have arisen from the war, and particularly the difficulty of maintaining our situation as against the competition of a world of lower standards overseas.

The term "elimination of waste" is subject to some objection as carrying the implication of individual or willful waste. In the sense used in these discussions elimination of waste refers wholly to those wastes which can be eliminated solely by cooperative action in the community. It does not refer to any single producer, for in the matters here discussed he is individually helpless to effect the remedy. Nor does the elimination of such wastes imply any lessening of fair competition or any infringement of the restraint of trade laws. In fact, the most casual investigation of the work in progress will show that its accomplishment establishes more healthy competition. It protects and preserves the smaller units in the business world. Its results are an asset alike to worker, farmer, consumer, and business man.

It may be worth while repeating the major directions for national effort as they were outlined by the department at the beginning of the undertaking five years ago:

1. Elimination of the waste imposed by inadequate railway transportation, by improved equipment and methods, and the establishment of better cooperation.

2. Vigorous utilization of our water resources for cheaper transportation of bulk commodities, flood control, reclamation, and power.

3. Enlarged electrification of the country for the saving of fuel and labor.

4. Reduction of the great waste of booms and slumps of the "business cycle" with their intermittent waves of unemployment and bankruptcy.

5. Reduction of seasonal variations in employment in construction and other industries.

6. Reduction of waste in manufacture and distribution through the establishment of standards of quality, simplification of grades, dimensions, and performance in nonstyle articles of commerce; through the reduction of unnecessary varieties; through more uniform business documents such as specifications, bills of lading, warehouse receipts, etc.

7. Development of pure and applied scientific research as the foundation of genuine labor-saving devices, better processes, and sounder methods.

8. Development of cooperative marketing and better terminal facilities for agricultural products in order to reduce the waste in agricultural distribution.

9. Stimulation of commercial arbitration in order to eliminate the wastes of litigation.

10. Reduction of the waste arising from industrial strife between employers and employees.

What the country as a whole has accomplished during the past five years in increased national efficiency in these directions is beyond any possibility of measurement. Nor does the Department of Commerce lay claim to credit for the great progress that has been made, save as we may have helped to organize a definite public movement. That movement is the result of a realization by every group—business men, industrial leaders, engineers, and workers—of the fundamental importance of this business of waste elimination. In support of this movement we have had the benefit of notable advances in science, many inventions, much increased economic understanding, and prohibition.

Thanks to elimination of waste and these other contributing factors, we can as a Nation show one of the most astonishing transformations in economic history, the epitome of which lies in the following table from the Department of Labor:

Movement of wages and prices, 1920–1926

[1913=100]

Year	Union wage rates	Prices [1]	Year	Union wage rates	Prices [1]
1920	199	226	1924	228	150
1921	205	147	1925	238	159
1922	193	149	August, 1926	238	150
1923	211	154			

[1] Average wholesale prices of all commodities.

These figures demonstrate one positive thing—the parallel increase of wages with decreasing price.

A comparison with similar British indexes gives evidence that these results are peculiar to the United States, for there was here a decrease instead of an increase in wage.

Index numbers of wages and prices, Great Britain, 1920–1925

[1913=100]

Year	Wage rates	Prices [1]	Year	Wage rates	Prices [1]
1920	256	283	1923	171	162
1921	239	181	1924	173	174
1922	185	159	1925	175	166

[1] Average wholesale prices of all commodities.

The activity of the Department of Commerce in the field of waste elimination is indicated by the fact that since the work was launched in 1921 over 1,200 group conferences have been held, practically all at the request of the industries themselves, and 343 committees are now at work in cooperation with the department on various phases of the program. The progress of the Nation in these matters is indicated by the following condensed statements by department officials in touch with different fields of activity.

These special notes upon the progress of waste elimination and important departmental activities during the year in this connection have been prepared under the direction of Julius Klein, director, Bureau of Foreign and Domestic Commerce; Dr. George K. Burgess, director, Bureau of Standards; William M. Steuart, director, Bureau of the Census; Scott Turner, director, Bureau of Mines; with the collaboration of Paul S. Clapp, Ray M. Hudson, Dr. Addams S. McAllister, Edward Eyre Hunt, James S. Taylor, N. F. Titus, A. Lane Cricher, Dr. E. Dana Durand, F. G. Tryon, E. G. Holt, Mortimer Lane, and others.

ELIMINATION OF WASTE IN RAILWAY TRANSPORTATION

Probably the most outstanding single industrial accomplishment since the war has been the reorganization of our American railways. Our transportation was not only demoralized by Government operation during the war but had suffered from chronic car shortages and insufficient service, not only after the war but for many years before. The annual loss from this periodic strangulation in transportation was estimated in the department's annual report of 1925 to amount to hundreds of millions a year. The insufficiency of transportation interfered with steady industrial operations, created intermittent employment, increased the costs of production and, through periodic strangulation, caused high prices to the consumer. Manufacturers and distributers were compelled to carry excessive inventories as a protective measure, thus not only increasing the amount of capital required in the business, but multiplying the danger of loss by price fluctuation.

The railways, during the past five years, not only have built up adequate service and given a complete correction to these ills, but they have, by great ability of their managers, greatly reduced transportation costs and thus made rate reductions possible which would not have been otherwise the case.

No better indication of these accomplishments can be given than is shown in the following table, which shows increasing efficiency in every direction—equipment, management, and personnel.

Fiscal years	Number of cars loaded	Tons, average train load	Car-miles per car-day	Average number of employees	Revenue freight ton-miles handled per employee	Revenue per ton-mile
						Cents
1921	42,332,670	687	24.4	1,869,501	214,667	1.179
1922	40,657,504	656	22.9	1,643,000	213,960	1.239
1923	47,192,796	704	25.7	1,770,000	243,523	1.126
1924	48,991,763	706	27.3	1,850,000	236,074	1.121
1925	49,677,771	731	27.3	1,765,169	247,788	1.108
1926	51,916,798	752	29.5	1,782,733	264,152	1.092

It is an interesting commentary upon Government operation that private enterprise has been able to operate the railways with far fewer employees and at the same time load almost 15 per cent more cars than the Government administration. In 1920, the last year of Government operation, the total number of employees rose to 1,999,000 as compared with 1,783,000 in 1925.

The result of this great reorganization upon the whole economic fabric of the country has been far-reaching. Rapid dispatch has greatly reduced the inventories of the country, has contributed to stabilization of production and employment, and has increased the efficiency of all production and distribution.

One of the contributions to this success, and a fine example of cooperation between different industries and trades, has been the great service of the regional advisory boards created by the American Railway Association. These boards have been organized in practically every section of the country, and are representative of all of the shippers and receivers in each territory—farmers, manufacturers, and distributers. Transportation needs have been analyzed and anticipated quarterly; car requirements are regularly estimated. The boards have also made studies of markets and marketing methods in the promotion of more even distribution of commodities; they have contributed to the solution of railway problems of better loading and higher operating efficiency.

As a part of the plan of cooperation the department is now conducting an economic survey in Florida of the stocks on hand, methods of distribution, and estimated car requirements of principal commodities moving to and from Florida.

Another point of the cooperation of the department with the shippers and railways is in the development of better methods of packing. From general reports of results obtained in this direction, the claims for damage against the railways have been reduced between 1920 and 1925 from approximately $120,000,000 to $37,000,000. The department has cooperated also in standardization of forms and contracts used in industries associated with transportation which has contributed to reduction of distribution cost.

Many unsolved problems in transportation confront us. Much thought must be given the coordination of our railway and water facilities. The economic relation between motor-truck and less-than-carload railroad distribution is important. Much can be gathered from further study in domestic packing. Enlarged activity in connection with the Shippers' Advisory Boards will tend further to reduce wastes in distribution. With the hand-to-mouth buying permitted by reliable and rapid railway delivery, knowledge of stocks on hand in various regions, and of the probable car requirements for the coming quarter, will be of increasing value. Additional study of the distribution of perishables by producers, shippers, and receivers may aid materially to the elimination of waste in the distribution of foodstuffs.

ELIMINATION OF WASTE THROUGH ENLARGED ELECTRIFICATION

In earlier publications of the department, such as "Super Power Studies in Northeastern Section of the United States," great emphasis was laid upon the possibilities of the elimination of waste which lay in the transformation of the power industry through the discoveries in the science of long-distance transmission and their application by large central generation plants feeding large systems and their interconnection with each other. Such savings lay in the greater economy in power production by saving fuel and labor by the larger central plants; the reduction of the amount of reserve equipment required; a better average load factor, and thus less equipment, through pooling of the daily and seasonal fluctuations, together with wider diversification in use; more security against interruption; better utilization of water power by applying it to base loads while making steam carry the peaks; utilization of secondary power from the seasonal flow of streams to the partial relief of steam; savings in industry by replacement of factory steam plants, the increased day load being supplied by the same generation equipment as night load for cities; the larger application of power in replacement of factory labor; and likewise the economies in the household and farm application of power.

All of these anticipated values have been realized in an extraordinary degree through the initiative and genius displayed in the electrical industry. The electrical generating capacity in the country has increased from 14,280,000 to 23,840,000 kilowatts in five years, an increase of 67 per cent. Although 66 per cent of our energy output is from fuel the development of water power has been most active. Of the total of 8,300,000 water horsepower now developed and connected into the systems 2,500,000 horsepower, or some 43 per cent, has been set to work in the last five years. The enormous savings that have been made in fuel consumption are indicated by the fact that while the electrical output of fuel-burning central stations increased 67 per cent in five years the fuel used increased less than 15 per cent. The average consumption of coal or its equivalent by such central electrical generation plants decreased from 3 pounds per kilowatt hour in 1920 to 2.1 pounds during 1925, a saving at the average rate of 11,500,000 tons per annum; new water power effected a further annual saving equivalent to 3,100,000 tons.

There has been a large increase in the application of electrical power in manufacturing, and while there has been an increase during this period of between five and six million horsepower used in factory production, there has been no increase in boilers and engines installed within these plants, the increase having been made almost entirely by electrical motors operated through purchased power. There has also been a transformation from direct connected steam equipment within factories to factory electrical generation for distribution throughout the plants until at the present moment apparently 70 per cent of factory power is delivered to the machines electrically.

The application of electrical power to home use has received enormous expansion. The number of homes served has increased in six years from 5,700,000 to over 15,000,000. The number of farms served is expanding rapidly, and in some States, such as California, farm electrification far exceeds that in any other locality in the world. Owing to the economies brought about through central generation and interconnection and through the advances in electrical science the average price of power throughout the country is now somewhat less than before the war, it being one of the few commodities to be delivered on less than a pre-war basis.

This transformation, it may be said at once, has increased the productivity of our workmen beyond those of any other country; it contributes to our maintenance of high real wages and to the reduction of human sweat; it relieves the home makers of many irksome tasks and adds immeasurably to home comforts.

There is still further promise of great progress in the reduction of fuel consumption in the extension of electrification, particularly in the further replacement of factory steam plants, in the electrification of our large railway terminals, and the expansion of household use of power.

VIGOROUS UTILIZATION OF OUR WATER RESOURCES

During the year the Department of Commerce, as directed by its organic act, continued to give active consideration to the commercial possibilities in the full utilization of the water resources of our country—inland water-borne transportation, power, irrigation, reclamation, and flood control. A broad national policy is needed for the orderly development of all river and lake systems that we may not suffer great losses through erratic development and failure in coordination to secure the maximum economic returns from each drainage basin.

Water is to-day our greatest undeveloped resource. Our streams and rivers offer us a possible total of 55,000,000 horsepower, and of this less than 11,000,000 has been developed. Of our 25,000 miles of possible inland waterways probably less than 7,000 are really modernized, and the utility of much of these 7,000 miles is minimized by their isolation into segments of what should be connected transportation systems. We still have 50,000,000 acres of possible reclaimable and irrigable lands which, while not now needed for agricultural production, will some day be absolutely necessary to supply growing population.

There are imperative reasons for the execution of a comprehensive plan for the coordinated long-view development of each river system to its maximum utilization. The necessary advances in rail rates from the war, together with completion of the Panama Canal, have distorted the economic relationship of mid-west agriculture and mid-west industry to the rest of the country and to the world markets. This relationship can be restored by conversion of our inland waterways into real connected transportation systems for cheaper movement of bulk commodities and raw materials. There will be increasing demand for hydroelectric power with its saving of fuel and reduction in human sweat. Before expiration of the years required for completion of major construction we shall need more food supplies than our present lands will afford. True conservation of water is not the prevention of use. Every drop of water that runs to the sea without yielding its full commercial returns to the Nation is an economic loss. The immediate situations, the interest of sound economy, and the provision for future needs of the country alike require full use of all our resources.

In its visualization of a policy of water development, the department has indicated seven great projects of major importance: (1) Mississippi system; (2) Columbia River system; (3) Colorado River; (4) Great Lakes system; (5) the Great Valley of California; (6) intracoastal waterways; (7) other important developments, including the Rio Grande and Hudson River.

Each system must be considered as a whole and organized to the maximum results. We need immediate determination of the broad objective and best development of every river, stream, and lake in our country in order that we do not undertake or permit haphazard development, whether public or private, that will destroy the possibilities of the maximum future returns. And, likewise, we must determine what structures shall be undertaken at once.

Progress of science and engineering, inventions in construction methods, improvements in water craft, discoveries in transmissions of electricity have brought us to the threshold of a new era in utilization of our water resources. We are able to undertake great projects with confidence of successful accomplishment. We have emerged from the long postponement of national construction imposed by the war and reconstruction; we have recovered so greatly in national wealth that we now have the capital to compass such projects as our expanding needs require and our undeveloped resources make possible.

The department during the year has vigorously advocated such a policy of water development. Actual inspections have been made on the Great Lakes system, Mississippi River system, Columbia Basin, and in the Great Valley of California. The Secretary of Commerce, in various addresses throughout the country,[1] has directed public attention to the fundamental benefits of the development and indicated its immediate national importance.

The St. Lawrence Commission of the United States,[2] under the chairmanship of Secretary Hoover, has been engaged in consideration of the improvement of the St. Lawrence River from Lake Ontario to Montreal, providing not only canalization for deep-sea navigation to the Lakes, but the development of large quantities of electrical power. A joint board of American and Canadian engineers has been actively at work on the engineering aspects and will report later this year. The Department of Commerce has conducted a searching economic study of the effects and benefits of the project for consideration of the commission.

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[1] Stockton and Sacramento, Calif., June 27, 1925; Kansas City, Mo., Oct. 19, 1925; Chicago, Ill., Mar. 9, 1926; Minneapolis, Minn., July 20, 1926; Hammond, Ind., Aug. 14, 1926; Mitchell, S. Dak., Sept. 28, 1926; Omaha, Nebr., Sept. 29, 1926.

[2] Charles L. Allen, William C. Breed, Charles P. Craig, James F. Davidson, Stephen B. Davis, James P. Goodrich, James R. Howard, and James P. Noonan.

A concurrent study of an alternative route from the Great Lakes across New York State is also in progress. With economic and engineering studies of both routes in hand, sound conclusions can be reached and final recommendations prepared for the consideration of the country.

At the request of Secretary Hoover, negotiations were undertaken with Canada during the year which have resulted in the appointment of a joint commission to consider methods for the preservation of the scenic beauty of Niagara Falls. Concentration of water in a V-shaped notch in the Canadian Falls is breaking down the escarpment at a serious rate, denuding the wings of the falls, and threatening to ruin their scenic beauty.

INCREASED BUSINESS STABILITY THROUGH REDUCTION OF BUSINESS BOOMS AND SLUMPS

One of the largest wastes hitherto in our whole economic system is the periodic booms and slumps of the "business cycle." The waste of the boom through speculation, overproduction, ill-advised expansions, extravagance, relaxed effort, and decreased efficiency, with its inevitable collapse, is followed by still greater wastes during the depression by unemployment; and of all groups the farmer suffers the worst because of the inability of agriculture to readjust itself to new conditions, due to long period of turnover as compared to industry. No greater fundamental service can be done for agriculture than to secure its freedom from this disability.

The causes and remedies have been long under discussion. The most notable advance in understanding and of the direction in which mitigation might be sought was made through the exhaustive investigations of a committee appointed by the Secretary of Commerce in 1922, comprising leading economists and business men. (See Annual Report for 1924.) These studies indicated that widespread business booms and slumps had become more frequent and no less destructive in the 20 years prior to the war than in the previous 20 years. They showed, furthermore, that peace-time slumps in business were the direct result of booms, so that the boom and not the slump should be the object of attack. The report strongly emphasized the importance of statistical information, the credit and currency administration of the country, and possibly a reserve of public works as the tools for the mitigation of these movements.

As a contribution to this greater stability, the department has steadily enlarged its services of business statistics during the past five years. To this has been added a large increase in the statistical services of trade associations and our various economic and educational institutions. Certain fundamental information can be col-

lected only through Government agencies, but the policy of the department has been to encourage private and institutional action in every field where their success is possible. The enlarged publication of all these data in the public press, the steady increase in subscribers to the departmental publications and those of other institutions, are an indication of the growing application of these services to the everyday course of business. In five years the department has expanded the number of items of current business statistics in important lines of commercial and industrial activity which it supplies to the public from 200 to more than 1,500. During the last fiscal year 189 new items were added covering 38 commodities. We are rapidly approaching the time when a business man will be able to determine the exact position of his industry in relation to production, stocks, orders, sales, conditions of sources of supplies, the consuming market, credit, business activity, and broad economic currents—both at home and abroad—which may influence the conduct of his particular occupation. The individual judgment has thus been greatly strengthened. Statistics are like weather reports in their relation to business conditions. They can be made to convey warnings of every incipient movement toward overproduction or inflation so that individual action becomes a great neutralizing force.

No one doubts the extreme importance of credit and currency movement in the "business cycle." Disturbances from this quarter may at once interfere with the fundamental business of producing goods and distributing them. Many previous crises have arisen through the credit machinery and through no fault of either the producer or consumer.

The creation of the Federal reserve system naturally contributed greatly to reduce these storms. In addition to the flexibility given to currency and credit the system has greatly minimized the former disturbance arising from the necessity of clearing through a few financial centers.

In addition to this most important addition to the credit machinery further stability has been added by the creation of the farm loan banks and the intermediate credit banks. Beyond this there is a still further direction in which commerce and industry have secured freedom from the ebb and flow of credit. Not many years ago practically all industry borrowed money from the banks with which to finance raw materials and their conversion, together with the credits which they must extend to their customers. To-day a considerable portion of industry finances itself in working capital from its own resources and is thus entirely free from credit interference.

The importance of the farseeing management of the Federal reserve system in these matters was greatly emphasized by the inadequacy of the policies pursued in the slump of 1920–21. The use of the powers of the Federal Reserve Board to deliberately check incipient speculation by the control of discount rates and of open-market transactions has had much advocacy in economic circles, but has not met with universal business support. On the other hand, that the Federal reserve system should be so managed as to result in stimulation of speculation and overexpansion has received universal disapproval. In any event, the increasing understanding of the relation of credit to the movement of production and consumption is gradually developing policies leading to maintained stability.

The proper direction of credit requires wise judgment, but this judgment can only be formulated upon adequate statistical determination of business movements throughout the country. A notable step in this direction during the fiscal year has been the regular publication of the volume of stock market loans. The automatic display of excessive situations in such loans has established a new statistical barometer which tends by its own warnings to prevent overexpansion and undue contraction. In respect to market loans this statistical service parallels the cautionary effect of the long-established regular publication of the volume of commercial loans.

A third direction of at least theoretic possibilities in securing greater stability of business lies in greater mobility in the construction industries. These industries are perhaps more largely subject to the ebb and flow of business currents than any other, and their ramifications in manufacture of material, transportation, etc., create a situation where the stability of this industry alone very greatly affects the stability of all other industries. The country has yet to devise a better organization of Federal and local governmental public works, together with construction programs of major industries, so that by holding in reserve less necessary items they can be thrown into periods of depression and greatly mitigate the violence of such movements.

The "business cycle," of course, is not based alone upon purely economic forces. It is to some considerable degree the product of waves of confidence or caution—optimism or pessimism. Movements gain much of their acceleration from these causes, and they in turn are often the product of political or other events, both domestic and foreign, and even climatic conditions may play an important part. Most of these causes could, of course, be mitigated by a larger understanding of current conditions, but they necessarily must be reckoned with.

While the causes can probably never be entirely removed, and while broad tides of increased or decreased productivity and consumption will continue to flow, it appears to the department that the violence of these phenomena has been permanently mitigated by the various forces increasingly developed during the last five years. In other words, the curve of the "business cycle" has in the belief of the department been considerably flattened and very large national waste has been to a considerable degree eliminated.

STANDARDIZATION AND SIMPLIFICATION

One of the major attacks upon industrial and commercial waste lies in standardization and simplification. By standardization we secure a positive approach through the establishment of definite notation in dimensions, quality, and performance of materials and machines which must be accompanied by the development of tests to be applied in the determination of the fulfillment of these standards. By simplification we secure a negative approach through elimination of the least necessary varieties, dimensions, or grades of materials and products. The usefulness of standardization and simplification is not limited in the application to materials and machines but is applicable to business practices such as specifications, and warehousing, financial, shipping, and other documents. And uniformity in such specifications reinforces the demand for standardized and simplified products.

A definite campaign of enlarged activities of this character was centered in the Bureau of Standards, division of simplified practice, five years ago. In all cases the actual problems are only undertaken at the request and with the cooperation of industries and commercial bodies. The adoption of these ideas, except for limited areas of weights and measures, is wholly voluntary. The activities of the department are confined to staple products, style articles being entirely excluded as questions of personal taste.

The economic savings by the adoption of standards and simplifications are enormous. The effects are:

(*a*) To facilitate repetitive manufacture giving mass production through concentration on fewer varieties, thereby decreasing the cost of manufacture.

(*b*) To focus demand on specific varieties and enable manufacturers to produce for stock in otherwise dull seasons, thereby reducing intermittency in both labor and equipment.

(*c*) By such general action the smaller businesses are given the opportunities of repetitive manufacture, thereby holding their own in competition against large production units.

(*d*) Greatly reduce volume of inventories required in the distribution trades.

(*e*) More positive competition.

(*f*) More reliable standards as to quality and service.

In practically every case the interest of both producer and consumer are involved, and it is therefore the practice to secure committees representing both groups, together with those of the technical groups relating to a given project.

Simplified practice.[3]—The department acts only upon request from some group concerned. The first step is a survey of the industry determining the number of current varieties, the relative demand for each, and these surveys are conducted by the trades concerned.

The results are studied by a simplified practice committee appointed by the industry concerned and a tentative program of elimination is formulated for presentation at a general conference comprising not alone producers and distributers but also the consumers and the technical profession.

After formal acceptance by a very substantial majority of interested groups and individuals, the recommendations are published by the department as one of the series of simplified practice recommendations, subject to periodic revision by a similar general conference or by action of a standing joint committee of the industry.

Since the department established this cooperative service in 1921, simplified practice recommendations have been developed and accepted by manufacturers, distributers, and users for the commodities shown in the following table:

No.	Item	Reduction in varieties		Per cent reduction
		From—	To—	
1	Vitrified paving brick (fourth revision conference)	66	4	94
2	Beds, springs, and mattresses	78	4	95
3	Metal lath	125	24	81
4	Asphalt (penetrations)	88	9	87
5	Hotel chinaware	700	160	77
6	Files and rasps	1,351	496	65
7	Rough and smooth face brick	75	2	97
	Common brick	44	1	98
8	Range boilers	130	13	90
9	Woven-wire fencing	552	69	87
	Woven-wire fence packages	2,072	138	93
10	Milk bottles and caps	78	10	87
11	Bed blankets (sizes)	78	12	85
12	Hollow building tile	36	19	4

[3] The activities of the division are guided by a planning committee comprised of B. H. Ackles, president National Supply and Machinery Distributors' Association, Detroit, Mich.; W. L. Chandler, secretary National Association of Purchasing Agents, New York, N. Y.; E. W. McCullough, manager department of manufacture, Chamber of Commerce of the United States, Washington, D. C.; A. W. Shaw, president A. W. Shaw Co., Chicago, Ill.; Brig. Gen. H. C. Smither, Chief Coordinator, United States Bureau of the Budget, Washington, D. C.; A. A. Stevenson, vice president, in charge of manufacture, Standard Steel Works, Philadelphia, Pa.; and L. W. Wallace, executive secretary American Engineering Council, Washington, D. C.

No.	Item	Reduction in varieties		Per cent reduction
		From—	To—	
13	Structural slates for plumbing and sanitary purposes			[1] 84
14	Roofing slates, descriptive terms (thicknesses and sizes)	98	48	51
15	Blackboard slates, slab heights and sizes	251	25	90
16	Lumber (first revision)[2]			
17	Forged tools	665	351	47
18	Builders' hardware:			
	Items			26
	Finishes			71
19	Asbestos paper (sizes, widths, weights of rolls)	14	8	43
	Asbestos millboard (sizes, thicknesses)	10	5	50
20	Steel barrels and drums	66	24	64
21	Brass lavatory and sink traps	1,114	72	94
22	Paper	[3]	[3]	[3]
23	Plow bolts	1,500	840	44
24	Hospital beds:			
	Length	33	1	97
	Width	34	[4]	91
	Height	44	1	97
25	Hot-water storage tanks	120	14	88
26	Steel reinforcing bars (cross-sectional areas)	40	11	73
27	Cotton duck (widths and weights)	460	94	80
28	Sheet steel (first revision)	1,819	263	85
29	Eaves trough and conductor pipe	21	16	24
30	Terneplate (weights)	9	7	22
31	Loaded shells (first revision)	4,076	1,758	57
32	Concrete building units (length, width, and height of blocks, tile, and brick)	115	24	80
33	Cafeteria and lunch room chinaware	668	177	73
34	Warehouse forms	[3]	15	
35	Steel lockers	65	17	74
36	Milling cutters			[1] 35
37	Commercial purchase forms	[3]	3	
38	Sand-lime brick (length, width, and height)	14	3	79
40	Hospital chinaware	700	113	84
42	Paper grocers' bags	6,280	4,700	25
44	Box board thicknesses	244	60	75
45	Grinding wheels	715,200	255,800	64
47	Cut tacks and small cut nails (sizes)	428	181	58
	Packing weights	423	121	71
49	Sidewalk lights:			
	Sizes	120	6	95
	Styles	80	5	94
	Shapes	10	2	80
51	Die head chasers (for self-opening and adjustable die heads)			75

[1] Average reduction.
[2] Standard nomenclature grades and sizes for softwood lumber.
[3] Indeterminable.
[4] 1 standard, 2 specials.
[5] Thousands.

Simplified practice recommendations for the following items have been proposed and approved at general conferences of manufacturers, distributers, and users, and are now in process of acceptance by the various groups interested:

No.	Item	Reduction in varieties		Per cent reduction
		From—	To—	
39	Dining-car chinaware	700	113	84
41	Insecticides and fungicides (packages)	38	21	45
43	Paint and varnish brushes	480	138	71
46	Tissue paper:			
	Roll tissue	13	3	77
	Shoe tissue	21	6	72
48	Shovels, spades, and scoops	5,136	2,178	57
50	Checks, notes, etc.	(1)	(2)	(2)
53	Steel reinforcing spirals	7	3	58
54	Sterling-silver flatware	190	62	67
55	Tinware, galvanized and japanned ware	1,154	873	24
56	Carbon brushes and brush shunts	(3)	(3)	(3)
57	Wrought-iron and wrought-steel pipe, valves, and pipe fittings:			
	Sizes of valves and fittings	20,000	19,238	4
	Sizes of pipe	62	49	21

[1] Thousands. [2] 1 size for each instrument. [3] Indeterminable.

Surveys of existing varieties are in progress for the following industries: Seeds, hospital linen, trap screw ferrules, radiators, registers, horseshoes, casket hardware, hollow metal doors and trim, steel sash, wire-bound boxes, office furniture, hardwood lumber, millwork, tires, knitted underwear boxes, waxed paper, explosives, pyroxylin plastics, metallic cartridges, refractories, vitreous china plumbing fixtures, sterling-silver flatware, porcelain enamel table tops, brake lining, piston rings, ball bearings, taper roller bearings, spark plugs.

Eighteen general conferences of manufacturers, distributers, and users, and 58 preliminary conferences with manufacturers were held during the fiscal year. Also 11 revision conferences were held during the year revealing the fact that there is an average adherence to simplified practice recommendations of about 82 per cent. Thirty-eight new fields requested the cooperation of the division in connection with a simplification program. During the year projects relating to 34 commodities have been developed to the point where there is reasonable expectation of their completion into simplified practice recommendations. Forty-five articles were prepared by members of the staff for printing in outside publications.

Since 1921 a total of 3,461 acceptances of simplified practice recommendations have been received from associations, manufacturers, distributers, and consumers. Approximately 250,000 copies of simplified practice recommendations have been sold through the Government Printing Office up to July 1, 1926.

Perhaps the outstanding event of the year has been the appointment of simplified practice committees by a number of the State manufacturers associations to cooperate with the division of simplified practice, in circularizing their membership for recommendations

as to items in greatest need of simplification. This has resulted in a large number of requests for information and many items were suggested as being fertile fields for the application of simplified practice.

Standardization.—The Government has been engaged in effecting standards of precision and performance in weights and measures under a direct constitutional authority since the early days of the Republic. Every new advance in invention such as gas, electricity, radio, high or low temperatures at once necessitates creation of standards and instruments of precision for their determination. The special development of the Bureau of Standards during the past few years has been in the establishment of what may be called for lack of better terms "commercial standardization," the fundamental scientific work of precision, carried by the bureau beyond usual commercial requirements, furnishes the basis for these standards.

American marine standards committee.—This organization is administered as a unit of the division of simplified practice. It was created to promote, develop, and promulgate, in cooperation with all concerned, such standards of design and practice as are deemed in the interest of good economy in the marine industry. It comprises five technical divisions, the first three of which are active, viz: (1) Hull details; (2) engineering (ship machinery) details; (3) ship operation details and supplies; (4) port facilities; and (5) manufacture and construction.

The organization is governed by an executive board elected annually by a membership enrolled in the marine field. Its activities are supervised by a secretary appointed by the board and assisted by the staff of the division of simplified practice. Standards are initiated by the board and developed by committees formed of men engaged in the various branches of the marine industry; their promulgation by the board is contingent upon approval thereof by the committees and membership.

At the close of the fiscal year, the membership comprised over 300 member bodies, and the technical activities were in the hands of some 45 committees. About 30 standards had been promulgated and numerous others were in process of development with good prospects for their early completion.

Central committee on lumber standards.—This committee, appointed by Secretary Hoover at the request of the lumber industry, has functioned continuously since 1922. Three annual conferences of the lumber manufacturers, wholesalers, retailers, contractors, railways, architects, and the other consuming industries have been held at the department. The committee has in cooperation with the department established American lumber standards covering all major

dimensions and grades of softwood lumber involving an annual production of about 30,000,000,000 feet, and has effected an important revolution in the industry. Its work has covered not alone standards but much simplification of dimensions and business practices. This work still continues. The annual savings in waste have been estimated by the industry as exceeding $200,000,000 annually.

Committee on building codes.—The Secretary of Commerce appointed a national committee on building codes in 1921. (See Annual Reports for 1922, 1923, 1924.) This committee has, in cooperation with municipal and State authorities, engineers, insurance companies, manufacturers of building materials, building contractors, and public representatives, made exhaustive studies of existing codes, conducted scientific investigations into materials, and therefrom prepared recommendations for codes for small dwellings, plumbing, masonry wall construction, minimum loads allowable in design of structures, and the arrangement of codes.

The estimated savings in construction by revision of obsolete codes run into as high as 20 per cent of the cost. Some 68 cities have adopted the recommendations, and they have been adopted in part in state-wide regulation in seven States, and others are in course of enacting them.

Specifications.—War experience taught us that one of the great unnecessary wastes of public funds arose from faulty specifications. Four years ago a division was established in the Bureau of Standards to develop standard specifications, and already a great deal has been accomplished in that direction. The Federal Specifications Board, an interdepartmental agency, has now covered over 300 groups of items purchased by the Government. This has required investigation into physical qualities and manufacturing practice, together with the determination of tests to be applied in inspection. Specifications in every case have been submitted to cooperating representatives of industry in order that they may be certain of their practical character. Many State and public institutional purchasing agencies are now using Federal specifications, together with a considerable number of industrial buyers. The work has already resulted in large economies in Government purchases.

In response to a demand from private purchasing agents throughout the country, the Secretary of Commerce organized a special advisory board of official representatives of associations vitally interested in specifications (see Annual Report for 1924) to consider the whole question of purchase specifications as used in commerce and industry. Under the direction of this board the Bureau of Standards has compiled a National Directory of Commodity Specifications containing references to 27,000 items relating to 6,600 commodities which will serve the buying agencies of the country as a guide in securing the best developed specifications.

Savings similar to those which can be effected through the simplification of specifications and the number and sizes of articles can also be obtained by reducing the number and complexity of documents needed in a business transaction. The department has aided business interests to standardize the general size and forms of warehouse documents and receipts, and is working with special committees of warehousemen, shippers, bankers, and transportation agencies to standardize also the terms and conditions on such documents. If standardized terms can be agreed upon, great savings will result in the reduction of delays in carrying on business, the elimination of unnecessary trade disputes, and an increased usefulness of such documents as credit instruments.

A trend toward simplification of documents is also visible in transportation. Congress, in the transportation act, 1920, called upon the Interstate Commerce Commission to devise a uniform through export bill of lading to simplify the traffic aspects of export transactions. This movement is in line with action of the leading commercial countries in formulating uniform rules for the carriage of goods by sea. The department has aided the business community to appreciate the value of these efforts by making careful analyses of the uniform through export bill of lading and the rules for the carriage of goods by sea. The simplification of the terms and conditions surrounding a transaction promotes mutual understanding between traders and stimulates commerce.

Through the committee sponsored by the Secretary of Commerce, representing contractors' associations, architects, engineers, railways, public officials, and other large construction users, standard construction contract forms have been drawn up and are in wide and growing use, which afford better assurance to both contractor and owner, and which should eliminate much of the area of possible dispute and create a more uniform basis for competitive action.

International standards.—The Department of Commerce has taken part in three important international conferences held in this country, the first dealing with the international standardization of screw threads, preceded by an Anglo-American conference; the second on electrotechnical standardization; and the third looking to the formulation of an international body concerned with standardization projects in general. In all three fields definite advances were made.

A first Pan American standardization conference was held in Lima, Peru, and a second will be held in this country in 1927. Progress in all these fields will undoubtedly be slow, but we may expect eventually great industrial and commercial benefits to accrue as it becomes possible to facilitate and systematize the nomenclature and specifications for the commodities that enter into international trade.

Informal conferences have also been held with foreign standardizing laboratories on questions relating to standards of length, standards of sugar, and to thermometric, photometric, electrical, and X-ray standards.

A sum of 15,000 francs was awarded to the Bureau of Standards by the Institut International du Froid in recognition of the work of the laboratory in the determination of the thermal properties of ammonia. This sum is being administered by the National Research Council and is being utilized for the preparation of tables of the thermal properties of methane based on experimental results which were obtained by the Bureau of Standards in 1917 and 1918.

Weights and Measures Conference.—The Nineteenth National Conference on Weights and Measures was held in May and was unusually successful, there being 27 States represented. Important progress was made in preparing model legislation on weights and measures for the use of the several States and municipalities.

REDUCTION OF SEASONAL OPERATION OF INDUSTRY

In June, 1923, the Secretary appointed a committee of leading business and labor representatives upon "Seasonal operation in the construction industries." (See Annual Report for 1924.) This committee, after exhaustive investigation, made most important recommendations. The better understanding of the problem brought about by the committee's exhaustive report and the cooperative activities established in "follow-up" in the most important localities have had a marked effect. The annually enlarged building program of the country has been handled in large part by extension of the building season into the winter months; this has had a stabilizing effect upon prices and given increased annual earnings to workers, not only in construction but in the construction-material industries. The price of most building materials has, in fact, decreased despite the large increased demand.

Closely following the recommendations of the committee on seasonal operation in the construction industries, the Association of Railway Executives declared its interest in placing maintenance of way and construction repair work on as nearly a stable basis as possible. The subject was brought before meetings of railway officials and technical experts, and the practical results are shown by the fact that for every hundred men employed during the most active month of the years 1924 and 1925, respectively, 78 and 77 men were employed during the least active month. In 1922 and 1923 the corresponding figures were 69 and 70. The average monthly variation from the yearly mean has decreased from 11.4 per cent to 8.2 per cent in five years. This one field in which the regularity of employment of several hundred thousand men is affected, is a con-

crete illustration of what has been accomplished in a branch of the public utilities where stable operations are especially hard to maintain.

SCIENTIFIC RESEARCH

The progress of civilization depends in large degree upon "the increase and diffusion of knowledge among men." It is not simply the question of applying present-day science. We must add to knowledge through research in pure science. The improvement of some machine or process is of great value to the world, but the discovery of a law of nature, applicable in thousands of instances and forming a permanent and ever-available addition to knowledge, is a far greater advance.

Perhaps the most notable event in the expansion of scientific research during the year was the establishment of an important committee for the enlarged endowment of research in pure science through the National Academy of Sciences, of which the Secretary of Commerce is chairman.[4] This committee is endeavoring to secure a fund of from $10,000,000 to $20,000,000 to be expended over a period of 10 years, mainly through American universities.

The department conducts through the Bureau of Standards a large amount of research work mostly of industrial character. The projects undertaken are of a type not within the scope of private institutions. Some indications of the work of the bureau in this direction are shown by the following:

Research associates.—One of the most effective developments for cooperation with American industries in research is through the system of research associates. During the past year there were stationed at the Bureau of Standards 62 of these associates, representing 38 industries. The research-associate plan has proved most successful in making available to our industries the unusual research facilities of the bureau. Since the results are all published for the benefit of everyone interested, the work has an influence which is hard to overestimate.

Improvement of wearing quality of paper currency.—Research on improving the wearing quality of United States paper currency was actively carried on in cooperation with the Bureau of Efficiency, the Treasury Department, and the manufacturers of the paper. Study of the paper-making processes in the bureau's semicommercial mill led to commercial production of currency paper having double the former strength, with no increase in cost of production.

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[4] The members of the committee are: Elihu Root, Andrew W. Mellon, Charles E. Hughes, Edward M. House, John W. Davis, Julius Rosenwald, Owen D. Young, Henry M. Robinson, Felix Warburg, Henry S. Pritchett, Cameron Forbes, Albert A. Michelson, John C. Merriam, Robert A. Millikan, Gano Dunn, Vernon Kellogg, William H. Welch, Thomas H. Morgan, John J. Carty, Simon Flexner, Oswald Veblen, James H. Breasted, Lewis R. Jones, Arthur B. Lamb, and George E. Hale.

Guayule rubber.—In cooperation with the Continental Mexican Rubber Co., a study is being made of the properties of guayule rubber. The use of guayule in place of Hevea rubber would prove of great economic value to the United States, as the shrub from which it is produced can be successfully grown in southwestern United States, California, and in Mexico.

Production of crystalline levulose.—The first plant for the production of crystalline levulose has been assembled at the bureau. The important fundamental problem in this development is the determination of an economically sound method of extraction of the levulose from the raw material. Experiments on the diffusion method of extraction used in the beet-sugar industry have been carried to a point where it has been definitely determined that the results are complete and economically sound.

Eye-protective blue glass.—The use of goggles or glasses for protecting the eyes of workmen engaged in electric or acetylene torch welding and cutting, reduction furnace work, and the like, is mandatory. The glass used for protecting against the invisible ultra-violet ray is usually brown, which does not afford metallurgical furnace workers satisfactory contrast between the melt and the furnace walls, hence they are likely to remove the glasses at critical times. The bureau has developed a blue glass which affords the proper contrast and at the same time cuts out the ultra-violet radiation.

Improvements in aerial mapping.—Surveying by aerial photography is a war-time activity of supreme importance. Peace-time surveying by the same method, for the purpose of mapping areas and contours of watersheds, woodland, etc., has become an important commercial activity. One of the greatest difficulties to overcome is the distortion which the best photographic lenses introduce, especially the lenses used for enlarging the original photograph. The bureau has succeeded in practically eliminating this distortion without introducing other harmful aberrations, by inserting at the proper place in the camera a plate of glass of proper thickness. This device reduces the flying time in taking aerial photographs to about one-half that necessary before.

Reduction of interference.—On the general problem of reduction of radio interference the bureau's work during the year has been directed largely to the holding of broadcasting and other transmitting stations exactly on their assigned frequencies. Marked progress in the actual operation of the country's radio stations in this respect has been made possible primarily through increasing the accuracy of the bureau's frequency standards and certain procedures adopted for their dissemination and application.

Propagation of radio waves.—Several contributions were made to the knowledge of the vagaries of radio-wave propagation. A study on a nation-wide scale of the effects of high-power broad-

casting was directed by the bureau. This definitely established that certain deleterious effects that had been anticipated through the use of many kilowatts of power did not exist, and also that high power does not bring with it a cure for radio fading. The fading or fluctuation of received signal intensity remains as the principal obstacle to radio development, and the bureau, with the cooperation of 20 laboratories in universities and other places, has made a concerted attack on this problem. In connection with this, studies of the peculiar behavior of very high frequencies or short waves were also made.

Radio direction finder.—A number of advances were made in the technique and applications of the radio direction finder, one of the main reliances of the future for both marine and air navigation. Special developments extended the frequency range in which it is possible to do accurate direction finding. Direction finders of special design for several types of service were developed for the Coast Guard, the Navy, and the Signal Corps.

Strength of brickwork.—Special attention is being given at present to the measurement of the strength of brickwork under compression. Test walls are built and aged, and then subjected to a slowly increasing load in the testing machine until they fall. The machine used in this work has a capacity of 10,000,000 pounds in compression, and is the largest testing machine in the world. The program is being carried out in cooperation with the Common Brick Manufacturers Association.

Specifications for dental materials.—The work on dental materials has made possible the writing of definite specifications for dental amalgams, and has also been of material assistance to the Veterans' Bureau and other Government departments in securing high-grade gold alloys for dental purposes.

Industrial metallurgical problems.—Heat-resisting alloys have been studied with improved and considerably augmented equipment, and a paper on flow in a low-carbon steel published. This work is carried on in cooperation with the American Society of Mechanical Engineers and the American Society for Testing Materials.

Through the Bureau of Mines the department has encouraged further work in the elimination of waste of mineral resources and saving of life and limb in mining. Investigations conducted by the bureau have resulted in producing a larger percentage of lump coal by better use of explosives; a larger percentage of helium from natural gas at a lower cost and better methods of repurifying helium; methods of preventing scale in boilers, thus reducing waste of fuel; increase in recovery from zinc ores by improved milling and metallurgical practices; a reduction in evaporation losses in the petroleum industry; making use of certain complex ores heretofore

unresponsive to methods of beneficiation; and processes for treatment of high silica iron ores low in iron content.

Waste of property and life due to mine explosions and other accidents has been reduced by a more general use of rock-dusting in coal mines as a preventive of widespread explosions, and of permissible electric devices approved by the bureau, to reduce the possibility of ignition of gases.

COOPERATIVE MARKETING

Two years ago the Department of Commerce, in an exhaustive report on Pacific coast perishables, laid down certain principles essential to more stable marketing and the elimination of the great wastes in marketing which were a burden upon both the producer and consumer. An extremely important experiment is now in progress in the development of cooperation in a much larger sense in an endeavor to cure the evils there pointed out. Under the leadership of the American Railway Association, a joint committee has been created embracing representatives of the growers, bankers, shippers, and railway executives and others having to do with the grape crop of California. The Department of Commerce, the Interstate Commerce Commission, and the Department of Agriculture are also cooperating with this committee. The object is to develop a control of the shipment and marketing of the annual crop of some 70,000 carloads of grapes to the end that more stable returns may be secured to the growers and great wastes eliminated in transportation and marketing. If this experiment can be developed to the degree hoped for, it will represent a new departure, not alone in transportation but in an enlarged service of cooperative marketing as well. It will give stability in the grape industry—an industry in which there is an investment of over $125,000,000 of capital aside from something over $100,000,000 of specialized equipment for transportation—and there is promise of a solution for handling other perishable crops throughout the country in a fashion enormously beneficial to the farmer and consumer primarily, and secondarily of value to the railways in more orderly transportation.

COMMERCIAL ARBITRATION

The settlement of business disputes by arbitration instead of litigation has made important progress since 1921, progress being more particularly marked in the past fiscal year. The department has held that commercial arbitration eliminates waste by removing ill will, by saving costs of litigation, by preventing undue delays in business transactions, and by strengthening contractual relations.

New York, New Jersey, Massachusetts, and Oregon have adopted commercial arbitration laws. On January 1, 1926, the Federal arbitration law came into effect. By this act the Federal courts are

given jurisdiction to enforce such agreements whenever they would normally have jurisdiction under the judicial code. The department, a large number of trade associations, chambers of commerce, and other organizations cooperated in the support of this legislation. An information service has since been set up in the Bureau of Foreign and Domestic Commerce to report future progress in arbitration practice.

NATIONAL COMMITTEES ON UTILIZATION OF WOOD AND METALS

Since 1921 a large number of cooperating committees have been set up in various industries and trades to work in conjunction with the Department of Commerce. In the past fiscal year there were 343 of these committees. To them and their predecessors is due in considerable measure the success of the department's activities.

As a result of the experience gained by these committees the wood and the metal using industries proposed to the Secretary that there be set up special organizations to develop programs for the elimination of waste in their fields. The first of these, the National Committee on Wood Utilization, is composed of manufacturers, distributers, and consumers of lumber and wood products and it works in close cooperation with official and private agencies.[5] Its headquarters are in the Department of Commerce. It has for its object the utilization of wood in any form which, at present, is either wasted or not properly used.

The work of the committee entails new or improved methods of converting wood, better methods of seasoning and handling the product, and the most economical methods of using forest products. This work also includes a comprehensive project of standardization so that the raw material required by each wood-using industry may be manufactured to the greatest possible extent at the source. In this manner the consumers will be enabled to use wood with the minimum amount of waste.

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[5] Up to the present time the following groups and their respective associations are represented on the committee: Loggers and lumbermen, by the National Lumber Manufacturers Association, its affiliated associations, the National Hardwood Lumber Association, and other lumber organizations; tie producers, by the National Association of Railroad Tie Producers; plywood and veneer by the Plywood Manufacturers Association; wood preservers, by the American Wood Preservers Association; cooperage, by the Associated Cooperage Industries of America; paper and pulp, by American Paper and Pulp Association; wood chemicals, by the National Wood Chemical Association; railroads by the American Railway Association; shipbuilders, by the Council of American Shipbuilders; and the construction industries, by a subcommittee composed of architects, engineers, contractors, builders, real-estate boards, and building and loan associations.

Purchasing agents are represented through the National Association of Purchasing Agents, while the wholesale and retail distributers of lumber are represented by the National American Wholesale Lumber Association and the National Retail Lumber Dealers Association, and farmers are represented by the National Grange.

Other manufacturers' groups represented include the producers of millwork, small dimension stock manufacturers, container manufacturers, manufacturers of furniture, automobile bodies, agricultural implements, musical instruments, and others.

This elimination of waste in all branches of the lumber industry and trade, and a closer utilization of the standing timber, will increase the value of timberlands without making the raw materials more costly to the consumers. By converting a larger percentage of the tree into marketable products, it will greatly aid in putting reforestation on a commercial basis, thereby insuring the Nation a permanent timber supply.

The National Committee on Metals Utilization, organized in 1926, is composed of manufacturers, distributers, and consumers of metal and metal products.[6] The committee is an impartial body made up of all branches of industry and trade interested in closer metal utilization, better manufacturing, distributing, and metal-using practices. It is the purpose of the committee to carry the principles of simplified practice more deeply into the metals-using field. Unification of specifications and the discontinuance of certain undesirable trade practices are also included in the scope of the work.

A permanent staff, located in the Department of Commerce conveniently near the facilities of the division of simplified practice and other governmental services, is in a position to establish a oneness of purpose in the minds of the manufacturers, distributers, and users in any single industry, and to act as a clearing house in bringing together the various elements in several industries that share the same problem. The work of the National Committee on Metals Utilization is an extension of the service of the division of simplified practice, with emphasis placed on a consideration of metals and metal commodities, and with the effort broadened to include specifications and trade practices.

NATIONAL CONFERENCE ON STREET AND HIGHWAY SAFETY

In the spring of 1924, the American Automobile Association, American Electric Railway Association, American Mutual Alliance, American Railway Association, Chamber of Commerce of the United States, National Association of Taxicab Owners, National Automobile Chamber of Commerce, National Bureau of Casualty and Surety Underwriters, and the National Safety Council were invited by the Secretary of Commerce to cooperate with him in an investigation

[6] The National Committee on Metals Utilization is composed of representatives of the American Electric Railway Association, the American Engineering Council, the American Engineering Standards Committee, the American Federation of Labor, the American Foundrymen's Association, the American Institute Electrical Engineers, the American Iron and Steel Institute, the American Railway Association, the American Society of Mechanical Engineers, the American Zinc Institute (Inc.), the division of simplified practice of the Department of Commerce, the Hollow Metal Door and Trim Manufacturers Association, the National Association of Farm Equipment Manufacturers, the National Association of Manufacturers of the United States, the National Association of Purchasing Agents, the National Automobile Chamber of Commerce, the National Founders Association, the National Machine Tool Builders Association, the National Metal Trades Association, the National Retail Hardware Association, and the United States Chamber of Commerce.

into the steadily increasing number of fatalities and serious personal injuries due to street and highway accidents throughout the United States.

In December, 1924, the first National Conference on Street and Highway Safety was called by the Secretary of Commerce. It was attended by approximately 600 delegates representing railroads, insurance companies, street railways, automobile manufacturers, organized commerce and industry, taxicab companies, safety councils, State highway officials and motor vehicle commissioners, local police and traffic administrators, organized labor, organized motorists, women's and welfare organizations, engineers, educators, and the general public. This conference adopted a report embodying an important series of recommendations for State legislation, street and highway regulations, suggestions for cooperative work, and a program of future activities.

A second National Conference on Street and Highway Safety was called by the Secretary in March, 1926. To this conference President Coolidge requested the governors of the States to send official State delegations. The governors of 43 States responded and the conference was attended by approximately 1,000 delegates, including representatives of all of the organizations and groups which had sent delegates to the first conference.

The committee on uniformity of laws and regulations presented a proposed uniform vehicle code consisting of a uniform motor vehicle registration act, a uniform motor vehicle antitheft act, a uniform motor vehicle operators' and chauffeurs' license act, and a uniform act regulating the operation of vehicles on highways. This code, with some amendments, was adopted by the conference and has since been indorsed by the National Conference of Commissioners on Uniform State Laws and the American Bar Association. At the close of the conference a resolution requesting the members from each State to serve as an organization committee for their respective States to promote the adoption of the conference recommendations through State legislation and local conferences or other appropriate organizations was unanimously adopted.

The work of the National Conference on Street and Highway Safety is nation-wide in its scope. The mounting curve of human, material, and the financial loss due to street and highway accidents, more particularly those involving motor vehicles, is one of the most conspicuous examples of waste in modern life. During the past calendar year 23,900 persons were killed, approximately 600,000 suffered serious personal injury accidents, while the total economic loss due to the destruction of property, congestion, and other causes incident to inadequate traffic facilities is estimated to be not less than $2,000,000,000 annually.

Part II.—FOREIGN TRADE

GENERAL PROGRESS AND TENDENCIES

[By JULIUS KLEIN, Director, and E. DANA DURAND, Chief of Division of Statistical Research, Bureau of Foreign and Domestic Commerce]

One of the main functions of the Department of Commerce is promoting foreign trade. International trade has become a vital part of the whole modern economic system. The war brought into high relief the utter dependence of the life of nations upon it. In peace time our exports and imports are the margins upon which our well-being depends. Export enables us to use our resources and energy to the full; by creating a wider range of customers it gives to each production unit greater stability in output and greater security for the workers. Exports, together with return upon foreign investment, are what enable us in the long run to purchase those goods and raw materials which we can not produce ourselves. Our standard of living is absolutely dependent upon certain import commodities. It is true that the United States is exceptionally self-sufficing. It finds a larger proportion of its total market within its own borders, and imports a smaller proportion of its consumption, than most countries. Nevertheless, without foreign trade, our industries would break down and we should have to go without much which contributes to the comfort of life, and even without some highly necessary commodities such as rubber, certain metals, and certain textile fibers.

Finding foreign markets is thus a major task both of American business and of the American Government. The success so far attained is remarkable. Our total foreign sales in 1925–26 were 120 per cent greater in value than on the average from 1910 to 1914. After allowing for the lower buying power of money, they were approximately 50 per cent greater in quantity than before the war. In the past five years the quantitative increase has been about 26 per cent. Imports show even more marked gain both as compared with pre-war levels and as compared with four or five years ago.

We have expanded our export trade in the face of the cut into the world's buying power caused by the tremendous upheaval of war.

Our position, therefore, contrasts sharply with that of most other countries. Adjusted for the change in the buying power of money, exports from the United States in 1925 were 37 per cent greater than in 1913. In the aggregate all other countries showed a decrease of about 5 per cent in exports, Europe as a whole a decrease of about 24 per cent, England a 22 per cent, and Germany a 35 per cent decrease. American foreign trade (exports and imports combined) represented 11 per cent of the world's total trade in 1913 and 16 per cent at the present time.

Comparative changes in the trade of United States and of other countries

[Millions of dollars]

	Actual values			Per cent increase (+) or decrease (−), 1913–1925	
	1913	1921	1925	Actual value	Quantity (approximate)
EXPORTS					
All countries	20,265	20,352	31,215	+54	±0
United States	2,484	4,485	4,910	+98	+37
All other countries	17,781	15,867	26,305	+48	−5
Europe	12,072	9,165	14,440	+20	−24
United Kingdom	3,089	3,119	4,238	+37	−22
Germany	2,405	1,106	2,094	−13	−35
IMPORTS					
All countries	21,855	22,876	33,435	+53	±0
United States	1,793	2,509	4,226	+136	+66
All other countries	20,062	20,377	29,209	+46	−6
Europe	14,135	12,615	18,712	+32	−13
United Kingdom	3,741	4,178	6,236	+67	+8
Germany	2,565	1,425	2,958	+15	−16
TOTAL TRADE					
All countries	42,120	43,228	64,650	+53	±0
United States	4,277	6,994	9,136	+114	+49
All other countries	37,843	36,244	55,514	+47	−6
Europe	26,207	21,780	33,152	+26	−18
United Kingdom	6,830	7,297	10,474	+53	−7
Germany	4,970	2,531	5,052	+2	−25

The large volume of forced exports of agricultural products during the war was bound to decline with the recuperation of European agriculture and the reentry into world markets of producing centers isolated by the war. Consequently, if we were to maintain our purchasing power for import materials it was necessary that we increase our manufactured exports, the most competitive group. We could not rely on advantages in natural resources or on expansion of sales

of noncompetitive goods or on any fortuitous cause. Our factories pay the highest real wages in the world, yet we must needs export their products increasingly in the face of lower paid labor and depreciated currency abroad.

The success with which this export problem has been attacked by the American people and the American Government is witnessed by the fact that the value of our exports of finished and partly finished manufactures in the fiscal year 1925–26 reached the huge sum of $2,572,000,000. This was an increase of 160 per cent over the pre-war average and of 59 per cent over 1921–22. These classes constituted 47 per cent of our total exports from 1910 to 1914 and 60 per cent in 1925–26. Finished manufactures show even greater growth than partly manufactured goods.

At the same time there has been no relaxation in effort to promote the export of products of American farms. New markets have been found and new uses developed which have contributed greatly to mitigate what would otherwise have been great shrinkage in demand. This department has given the greatest attention to the disposal of surplus agricultural products. The exports have held up remarkably well considering the situation.

The tendency toward greater relative importance of manufactured goods in our export trade will unquestionably continue. This tendency points neither to any lack of efficiency in our agriculture nor to injury to the farmers' interests. It reflects expansion of domestic markets and for domestic consumption of farm products. As our country fills up with population it must naturally consume a larger and larger proportion of the foodstuffs and raw materials it produces and must pay for its foreign requirements more and more with manufactured commodities. It is vital to the farmer that we maintain our buying power for raw materials which we do not ourselves produce if he is to enjoy many of the articles which now enter his daily life.

Growth of foreign trade of the United States

[Millions of dollars]

	Years ended June 30—				Per cent increase 1926 over—	
	1910–1914 average	1922	1925	1926	1910–1914	1922
EXPORTS						
Total (domestic and foreign)	2,166	3,771	4,865	4,753	120	26
To—						
Europe	1,350	2,068	2,660	2,334	73	13
All other, total	816	1,704	2,205	2,420	197	42
Canada and Newfoundland	320	551	658	709	122	29
Latin America	302	536	845	879	191	64
Asia	121	480	458	538	344	12
Oceania	48	84	167	201	322	140
Africa	25	52	77	94	281	82
Total exports of domestic merchandise	2,130	3,700	4,778	4,654	118	26
Foodstuffs	421	1,144	1,061	780	85	−32
Raw materials	713	933	1,401	1,301	82	39
Semimanufactures	342	412	646	635	86	54
Finished manufactures	654	1,211	1,670	1,937	196	60
IMPORTS						
Total	1,689	2,608	3,824	4,466	164	71
From—						
Europe	836	831	1,171	1,275	52	54
All other	853	1,778	2,654	3,192	274	80
Foodstuffs	398	635	903	931	134	47
Raw materials	595	927	1,452	1,906	220	106
Semimanufactures	307	407	701	795	159	95
Finished manufactures	389	639	767	835	115	31
QUANTITATIVE INDEXES						
Growth of trade, eliminating price changes (1913=100):						
Domestic exports	89	116	133½	137	54	18
Imports	94	137	161	170	81	24

The growth of our manufactured exports is reflected in the marked expansion of our trade with those parts of the world outside of Europe. To European countries we sold in 1925–26 goods to a value only 62 per cent above the pre-war average, representing a quantitative increase probably little more than 10 per cent. But our exports to non-European countries, in the aggregate, had nearly trebled, increasing 197 per cent. The gain was 344 per cent in the case of Asia, 191 per cent for Latin America, 321 per cent for Oceania, and

281 per cent for Africa. Rapid advance in our sales to practically all non-European countries has occurred even since 1921–22 in the face of Europe's progress in regaining her export trade. It may be noted that the slower growth in our shipments to Asia in the last few years is due to the stationary position of our trade with Japan and China, exports to the rest of the continent having gained heavily. Exceptional conditions explain the situation in regard to these two countries.

The causes of the growth of American exports of manufactured goods are of a basic and cumulative character. Herein lies high promise for the future. We owe this expansion by no means to the war. The war did more than check the steady expansion which is the normal thing in international trade; it cut deep into the world's aggregate buying power. Outside of the United States the ability of the peoples to absorb commodities has not even yet regained the level of 12 years ago.

In an address in New York on March 16, 1926, Secretary Hoover made the following statement as to the reasons why we were expanding our exports of manufactured goods:

If we examine the reasons why we should have been almost unique among nations in foreign trade recovery, I believe we can justly claim that it has been due to certain distinctively American accomplishments, and that in these accomplishments lies the confidence for the future. Our expansion of foreign trade is a part of our domestic progress, both socially and economically. And in this progress I would first mention the accumulative value of the intensified education, both elementary and higher, which we have been dinning into the American youth over the last 35 years. In this time we have multiplied our students in institutions of higher learning by 400 per cent. To-day we have more than all the rest of the world put together. We have trained technical personnel in every avenue of production and distribution upon a scale vastly larger than that possessed by any other nation. We have realized from this and many other causes a great advance in business organization and a great adaptability to new ideas and to shifting demand.

Our workpeople have increased in education and skill. Above all they are largely free from the economic fallacy that restriction of individual effort increases the number of jobs. Our national unions have long since declared against such theories. We are reaping the benefits of some 600 industrial research laboratories, mostly established in the last 10 years. They are ceaselessly searching for invention and for every economy in the use of materials and method. Under the pressure of high wages we have ruthlessly revised our industry with every new invention. Beyond this there is great and cooperative movement in American industry and commerce for cutting out waste in a thousand directions through improved business practice, through simplification of processes and methods. Furthermore, we have had a great advantage, which we must not deny, in that by volume production, made possible through a great domestic market, we have been able by repetitive processes to apply or focus every advance into standard commodities of high quality and low cost of production.

The cumulation of these forces has increased our national efficiency to a degree which I hesitate to express statistically lest we appear to exaggerate. But I might observe that, by and large, while we have increased our population 16 or 17 per cent in a dozen years, we have swelled productivity of the Nation by something like 30 or 35 per cent. Our farms produce 13 per cent more with the same number of farmers as 12 years ago; our railways carry 22 per cent more traffic with about the same number of men. We have tamed the kilowatt into the friend of man. We have now domesticated some 68,000,000,000 kilowatt-hours annually where we used 23,000,000,000 12 years ago. They increase output and decrease sweat.

These are the reasons why we are able to sell goods of high quality, produced under the highest real wages in the world, in competition with goods produced under lower standards of living. These methods are no secret. They are open to the world. But they are rooted not alone in technology, which can be adopted by all intelligent people; they are rooted in social conceptions which penetrate far deeper and which not only promise greatly for the future in our standards of living at home, but, of more pertinent interest on this occasion, provide the basic assurance of our continuing growth in foreign trade, both exports and imports. These are the fundamental forces which promise for us our share of the world's increasing demands even of competitive goods—if we keep them in motion.

The future expansion of our trade, especially in manufactured goods, depends on conditions outside, as well as within, the United States. Past experience and analysis of the causes now at work alike indicate that if the world can maintain peace the foreign markets for our goods will expand. World demand for commodities tends normally to grow. The same causes which make for greater production and greater buying power in the United States are present in varying measure in every land. In the newer and more backward countries the investment of foreign capital—American and other—and the participation of foreign experts and business managers join with the internal forces at work. With gain in productive efficiency comes some increase in consumption of foodstuffs and other basic necessities, but a far greater increase in that of manufactured articles. Even the establishment of manufacturing industries in countries formerly almost exclusively agricultural does not check their demand for manufactured goods from abroad; on the contrary, the consequent advance in their purchasing power and standards of living adds to it.

Nor need this country fear that the recovery of Europe, so greatly to be desired from every other point of view, will interfere with the growth of our own foreign trade. Such recovery means greater direct buying power of Europeans for our goods. Still more, by making Europe a better market for the products of Latin America, the Far East, and Africa it adds to the ability of those regions to buy not only from Europe but also from America. The experience of the last five years is sufficient evidence on that point.

Vigorous competition will always exist in international commerce. It does not behoove our producers and exporters to take their job lightly. But, in the broader view, world commerce represents world cooperation. The gain of any one country is not promoted by the loss of any other, but rather by the gain of all.

While chief credit for the growth of our foreign commerce in recent years is due to the American people—the farmer, the wage earner, the business manager, the technical expert, the trader and exporter—the activity of the Government has contributed very materially.

In 1922 Congress, realizing the great task before American industry and American merchants in the reconstruction of our foreign trade from the disastrous and fundamental shifts of the war, accepted the recommendations of Secretary Hoover and authorized the enlargement and reorganization of the foreign trade service of the department that it might give the fullest possible service. The Bureau of Foreign and Domestic Commerce was reorganized upon "commodity" and "special service" divisions. There are now 37 divisions in the bureau. The number of branches in the United States, either district or cooperative, has been increased from 28 to 46 and the number of foreign offices increased from 23 to 42. The number of representatives abroad has risen from 86 to 291. The requests for assistance from American manufacturers, merchants, and farm cooperatives have increased from 505,000 during the year 1921–22 to 2,032,825 during the year 1925–26. Aside from direct replies to these requests the number of trade circulars and other forms of information sent out increased from around 500,000 in 1921–22 to over 4,000,000 in 1925–26.

FOREIGN GOVERNMENT PRICE FIXING OF OUR IMPORT RAW MATERIALS

[By Everett G. Holt, Chief of Rubber Division, Bureau of Foreign and Domestic Commerce]

In 1922 the department first called public attention to the growth of foreign government controls of price and distribution of our import raw materials as likely to develop great dangers to the American consumer. In March, 1923, Congress directed the department to investigate and report upon the subject. Exhaustive investigations were made in the areas of production and the reports of findings have been published in various brochures during the years 1924, 1925, and 1926. There are at present governmentally controlled foreign combinations in nine raw materials: Long-staple cotton, camphor, coffee, iodine, nitrates, potash, mercury, rubber, and sisal. Our imports of these materials during the fiscal year amounted to $1,031,555,097. There are some other virtual monopolies indirectly sup-

ported by benevolent policies of the interested governments rather than by direct and constant price control.

Some of these controlled commodities are of small dimensions, others of vast importance, but the very number of these controls indicates a trend. There are some 20 or 30 other commodities in the world for which we are at present dependent on import, and which could likewise be controlled by action of one government or by agreement between two governments. In fact, it is possible thus to control a very large portion of the raw materials which we do not ourselves produce. Unless some deterrent arises, the enormous profits of some of the controls already in operation will not only stimulate unreasonable prices for other controlled products but will serve to encourage attempts upon other commodities. It is the belief of the department that this development will be retarded by the demonstration of practicable defense action in the case of rubber during the last fiscal year.

The object of these controls is universally asserted to be to stabilize prices to both producers and consumers at fair rates; and we would probably not be considering the question to-day if all these combinations had been content with fair returns, no matter how much we might object to them as fundamentally a restraint of industrial progress.

The economic objection to these controls is the stifling of production through forced restriction combined with price fixing, which entirely deflects the producer's objective from decreasing costs of production—under competitive pressure—to arbitrary high prices. Thus there is a suspension of the fundamental progress of industry which can come only in increased volume of consumption and decreased costs of production. The high prices artificially imposed stifle consumption, lead to use of inferior substitutes, stimulate production in areas of inferior economic adaptation and higher costs, and thus place the commodity on an entirely fictitious basis of both production and consumption. Furthermore, in most cases the controls have resulted in periodic speculative operations by which large sums are abstracted from industry and consumers without any service rendered. Every manufacturer and distributer of these raw materials must carry large quantities in transit and in stock for his operations. His investment in materials becomes so great at these artificial price levels that if he is to be subjected to changing policies, with any ill wind or any shift in the views of governmental officials, then the whole of the savings invested in his business is in constant peril.

The public relations resulting from governmental controls are even more objectionable than the economic losses. Our consumers, instead of trading with fellow merchants in the open market, bar-

gaining with their respective views of supply and demand, find themselves confronted by governments whose whole course is in disregard of the economics of production and trade and whose policies are often enough determined by matters entirely foreign to the industry. No industrial consumer of these commodities can rely upon his own judgment as to the conduct of his business when the policies of government officials in some foreign land dictate his destinies.

The result has been, and always will be, that the just complaint of consumers drags our Government into relations which should be left to the higgling of the market. This injection of the Government inevitably results in the arousing of national feeling. It may safely be said that if governments were not involved and the prices rose equally high, there would be no national feeling aroused, because under such conditions the consumer realizes that high prices are stimulating production and that relief is sure to come; but with governmentally restricted production these forces do not operate or operate but feebly and slowly. It is equally safe to say that if the conduct of industry is left in the hands of private individuals they will not cut the throats of their consumers.

There is a world of difference in economic and international relations where industries, on one hand, acting under private initiative, restrict production to cure temporary gross overproduction, and, on the other hand, where governments restrict production for the purpose of fixing unreasonable prices. The former carries no implications of lessened effort to reduce costs, no stifling or hardship on the consumer, no price fixing, and no implications of international friction or governmental interference in the normal policies of trade. The governmental action in rubber advanced the price of a commodity costing 13 to 18 cents a pound to produce to a price of as high as $1.21 per pound. If cotton be restricted until the price ascends to $1.21 per pound, or even to 40 cents a pound, where rubber now is, the consumers of the world would complain far more bitterly than the American rubber consumers.

Each and every one of these objections to such controls has been demonstrated as valid by actual experience. Decreased consumption, substitutions, stimulation to uneconomic production, great losses to industry and consumer, international friction have been the only real products of these governmental controls, except extravagant profits to a few producers and speculators.

As has been said, if these governmental controls had been content with moderate profits, it is improbable that the question would have had other than academic interest. But the action of the rubber control in artificial advancement of prices to uneconomic levels, and the attempt of other controls to borrow money in the American market with which to strengthen their position against

the American consumer, brought these matters to a crisis in demands from the American manufacturers and public consumers for action by our Government. An investigation by the Committee on Interstate and Foreign Commerce of the House of Representatives in January, 1926, resulted in a unanimous report entirely confirming the views of the department.

During discussions concerning these controls various measures for protection of our consumers were put forward from different quarters. It was suggested that these controls are inevitable and that we as a Government should bargain with them for the establishment of fair prices. This would probably involve our Government in guaranties to buy the commodities at some certain price, and, even were this avoided, it would make our State Department a bargainer in the commodity market and would add a thousand frictions to all those which it is the business of our Government agencies to allay. It was suggested that our industries should themselves collectively bargain to establish fair prices. This raised the question as to whether we wish these controls to become fixed in international life; such a plan also would probably involve Government supervision of these bargains. Alternatively, it was suggested that our Government might set up such combinations in our own country over materials which we control either singly or jointly with one or two other major producers, thus getting our share of the profits in this game. Not only would any such policy involve us in countless frictions in international relations but we would be doing injustice to other consuming countries. The department has been opposed to all these suggestions as of the nature of offensive trade war or retaliation, and has recommended that relief should be sought in cases of unreasonable prices by the organizing of purely defensive measures, such as (*a*) conservation in the use so as to meet the artificially decreased production and high prices by decreased consumption; (*b*) stimulation of production in countries not parties to the control; (*c*) synthetic production at home and the development of our own resources as in the case of chemicals; (*d*) voluntary cooperation of our bankers to prevent the financing of these controls with American capital against the American consumer.

Rubber.—The most pronounced exhibition of the difficulties arising from these government controls during the past fiscal year has been the British East Indian rubber control. The British East Indies control the production of about 70 per cent of the world's rubber, while the United States consumes about 70 per cent of the amount used in the world annually. This control was established by the Stevenson Act in November, 1922, providing for restriction of exports (and, therefore, of production) if rubber was below the "fair price" of 30 to 36 cents per pound and for increasing production and exports if prices rose above these limits. Assurances

were given to the consuming trades that prices would not exceed this "fair" basis. The investigation of the industry by the agents of this department showed that the average cost of production ranged from 13.5 to 18 cents per pound; that profits of from 15 to 25 per cent would be earned by the rubber planters at the 30 to 36 cents level; that the industry had suffered less from the world slump than agricultural industries elsewhere in the world, particularly those of the United States. No bankruptcies had occurred and even at the slump prices the majority of plantations had earned profits. Despite the threatened dangers, the American consuming public would probably have raised no great question had the "fair price" not been exceeded. An advance sharply above the "fair price" began in March, 1925, however, with large speculative activities, and steadily continued until prices reached an average of 103 cents per pound for spot rubber during the month of July. In the meantime, the American consuming trades earnestly urged the rubber-control officials to end the artificial famine and make good their assurances of maintained "fair price" by relaxing the restriction upon production. These requests were denied and finally, after six months of unavailing private negotiations, it was determined in October that measures must be inaugurated to protect the American consumer. In the meantime, spot prices had risen as high as 121 cents per pound in July, 1925, and averaged 104.8 cents per pound for November, 1925. As our imports are at the rate of 900,000,000 pounds annually, the increase of about 70 to 75 cents per pound over the "fair price" threatened to impose a supercharge upon the American consumer of from 625 to 675 million dollars per annum.

The Rubber Association of America, representing the rubber manufacturers, the National Automobile Chamber of Commerce, representing the manufacturers of automobiles, and the American Automobile Association, representing the users of automobiles, with the cooperation of the Department of Commerce, undertook a campaign for conservation in use of rubber as a method of balancing the restricted production by a restricted consumption. The object was not only to secure relief in prices, but to demonstrate the soundness of this method of defense as a means of protection from similar action of other government price-fixing controls in the future. The result of this campaign of conservation was to break the spot price of rubber from the average of 104.8 cents for November to an average of 59 cents in March, 1926, and 40.2 cents from June to September, inclusive. Parallel with rubber prices, the wholesale prices of tires and inner tubes, which had risen by 57 per cent in 1925, returned to within 12 per cent of the former record low level in July, 1926. During the fiscal year the imports of rubber cost $603,000,000 or

$270,000,000 in excess of the "fair price," but by the effective results of conservation we avoided far larger penalties.

How successful has been America's use of conservation as a defense against rubber control is well demonstrated not alone by the amelioration in price but by the actual reduction in the consumption of rubber for the fiscal year. Estimates of saving may be approached from two angles—either from manufactured production, or from actual consumption. During the fiscal year 1924–25 the consumption of imported rubber was about 375,832 tons. With the increased number of automobiles for the fiscal year 1925–26 we should have absorbed about 401,000 tons in normal trade. The actual amount taken into manufacturing processes was 366,892 tons during the fiscal year, or a decrease from the above normal of 34,271 tons; but in addition to this, the stocks of casings in the country increased during the year by over 4,700,000, and that of inner tubes by 9,800,000, representing an effective addition to stocks of about 25,660 tons of rubber. Even the combined total of these two figures, 60,000 tons, does not portray the full effect of rubber conservation, for owing to increased production of automobiles in the last over the preceding fiscal year, it is estimated that nearly 17,000 tons more rubber were required for original tire equipment purposes than in the former year, as these represent a part of further reserve. This reduction in use was accomplished by consumers' savings, by better manufacture, and by substitutes. The net imports of rubber were 395,145 tons, or 28,253 tons larger than the 366,892 tons taken into manufacture, the difference being represented by an increase in crude-rubber stocks in the United States.

The volume of savings can be confirmed by the movements in the retail trades. The sales of tire-repair materials in the past fiscal year increased by 37 per cent. Sales of automobile casings for replacement purposes were 4,333,000 lower than for the preceding year, a decrease of 16.6 per cent, and sales of inner tubes were lower by 8,710,000, or 22.6 per cent. These figures are more striking in view of the fact that 2,360,000 more automobiles were running in the past than in the preceding fiscal year, which added number of cars should normally have required about 7,000,000 more tires and 10,000,000 more inner tubes for replacements. The reduced consumption of crude rubber represented by these statistics, coupled with savings effected through increased use of reclaimed rubber and other substitutes, again confirms the estimate of total savings given above.

That tires were actually run more miles in the last fiscal year is shown by official gasoline-consumption statistics—10,034,021,000 gallons for 1925–26, compared to 8,617,807,200 gallons for 1924–25, an increase of 16.4 per cent, although gasoline consumption per car declined slightly.

As a net result of these defensive measures, stocks of crude rubber in the United States increased from a low point of 34,085 long tons at the end of October, 1925, to 60,870 long tons at the end of August, 1926, according to the Rubber Association of America. Visible stocks in the United Kingdom increased during the same period from 5,855 long tons to about 31,700 long tons, and small increases in stocks are reported in other trading centers. The total increase in world stocks of crude rubber is, however, less than the amount saved in the United States, and but for the defensive measures employed here, stocks of rubber would now be lower and the rubber situation even more critical than at this time last year.

Some criticism was directed at the rubber manufacturers over profits earned during the last half of 1925. It may be said at once that manufacturers must advance prices of products parallel with increased spot prices for rubber, and thus in a rising market the manufacturer who is so fortunate as to have stocks and forward purchases of rubber makes an additional profit from these sources; but in a falling rubber market the exact reverse takes place, and the manufacturer loses equally if not more than these extra profits on the rise. This has been the actual result during the first half of 1926. No one more vitally needs stable prices of raw material than the manufacturer. He is seldom able to pass fluctuating prices wholly on to the consumer.

As important as these protective measures have been to the rubber consumer, the department considers that they are of far greater importance as an example of what can hereafter be done to offset unreasonable prices resulting from governmental price-fixing and speculation in imported raw materials.

Part III.—ECONOMIC REVIEW

The fiscal year 1925–26 has been one never surpassed in our history in the volume of production and consumption, in the physical quantity of exports and imports, and in the rate of wages. There has been practically no unemployment. Further progress has been made in the efficiency of management and labor and in scientific research and invention. As in the preceding year, there were a few points where conditions were less satisfactory, as in the New England textile industry, two or three sections of the agricultural industry, and the bituminous coal industry. On the whole, however, the country was able to maintain the highest standard of living in its history, a standard far above that in most other countries of the world at this or any other time. This represents a remarkable recovery from the great losses incurred by the Nation in the World War.

GENERAL INDEXES

The general progress of industry and trade during the past four years is indicated by the following table of major economic indexes. Without exception these indexes for the fiscal year 1925–26 stood higher than during the preceding year, and, with the single exception of mineral production, where the difference was insignificant, higher than in any other year covered by the table. As a matter of fact, although there are no complete statistics as to some of the items for the war period, there is reason to believe that every one of these indexes stood higher in 1926 than ever before, except that of the value of wholesale sales, the higher figures for which in certain previous years were primarily due to much higher price levels.

Of special significance is the fact that manufacturing production, considered as a whole, showed a gain of 7 per cent, even as compared with the highly prosperous year 1924–25. The improvement was general through almost every branch of manufacturing industry. Although conditions in the cotton industry are somewhat unsatisfactory, especially in New England, the gain in consumption of raw cotton and in spindle activity, which appeared early in the calendar year 1925, has since been well maintained. Wool consumption, however, was less in the last fiscal year than in the year before. The rapid expansion of the output of electric power continues, with con-

sequent lowering of operating costs in the many industries which are increasingly using electricity as motive force.

Although the prices of commodities in the fiscal year 1925–26 were practically no higher than in the preceding year, the value of sales of retail stores and mail-order houses showed a considerable increase. These figures are particularly significant as showing an advance in the already high volume of consumption sufficient to take care of the constantly greater output of our industry. The fact that the sales of mail-order houses were more than one-third greater than in the fiscal year 1922–23 is a clear evidence of the gradual improvement in buying power among the farm population.

Major economic indexes

[Based upon calendar year 1919=100]

	Years ended June 30—			
	1923	1924	1925	1926
Volume of business (quantities, not value):				
Manufacturing production	116	115	118	126
Mineral production	119	133	129	132
Forest products, production	117	122	121	124
Freight, railroad, ton-miles	109	110	110	120
Electric-power production	136	148	158	179
Building contracts let, square feet	107	108	112	142
Value of sales:				
Department stores	118	125	126	133
Five-and-ten-cent stores	152	173	196	219
Mail-order houses	91	100	110	122
Wholesale trade	80	82	83	85

PRICES

Very little change has taken place in the general level of wholesale prices during the past four fiscal years. The absence of any sharp upward movement has shown the healthy character of our business activity and its freedom from the dangerous boom psychology. On the other hand, no sharp declines have reflected business depression or a general change in the relation between the volume of currency and credit and the volume of business. With a single exception no one of the nine great groups of products showed a change of more than 4 per cent between the price average for the fiscal year 1925 as a whole and that for the fiscal year 1926; the exception was the "Miscellaneous" group, in which the sharp advance in rubber prices was a dominant factor. There was more change in the general wholesale price index during the course of the fiscal year than as between the annual average and that of the

year preceding. A maximum of 160 appeared from July to September, 1925, while from March to June, 1926, the index stood at from 151 to 152. Consequently, the maximum variation was less than 6 per cent.

The more satisfactory relation between the prices of farm products and those of other commodities, which was gradually brought about between 1922 and 1925, continued substantially unchanged in the fiscal year 1926. The index of prices of farm products during that year averaged 52 per cent above the 1913 level as compared with an increase of about 59 per cent for nonfarm products.

Farm prices receded in the latter part of the fiscal year and down to August, but this was accompanied by recession in prices of other commodities. In September both recovered part of the decline. The index number in September was 141 for farm products and 150½ for the average of all commodities.

A slight advance appeared in the general level of retail prices during the fiscal year, the cost of living index averaging 175 (1913 taken as 100), as compared with 171 in each of the two preceding fiscal years. The advance was due to higher food prices, as other elements in the cost of living, taken as a group, showed practically no change.

Price indexes

[Based upon calendar year 1913=100]

	Years ended June 30—			
	1923	1924	1925	1926
Wholesale prices:				
General average	156	150	155	156
Farm products	139	140	153	152
Food	142	143	153	156
Cloths and clothing	193	194	189	184
Fuel and lighting	220	175	169	175
Metals and metal products	139	141	130	128
Building materials	188	182	174	174
Chemicals and drugs	129	129	133	133
House-furnishing goods	181	178	171	166
Miscellaneous	122	116	124	134
Retail prices:				
Food	143	146	150	162
General cost of living [1]	168	171	171	175

[1] Figures are averages of indexes for 3, 4, or 5 months distributed through the fiscal year, including in each case June of the previous year.

CONSTRUCTION

Construction volume during the past fiscal year surpassed the former high record made during the preceding 12 months. The number of square feet of floor space and the value involved in the

new contracts let were each close to one-fourth greater than the year before. The actual volume of construction work carried out increased by smaller proportions, showing that the industry had a larger volume of unfinished work on hand than the year before.

Notwithstanding this immense building program, building costs remained relatively stable. Both the construction industry and the owners of buildings have cooperated in the movement, to which the efforts of this department have materially contributed, for keeping building activity more even throughout the year. This movement has reduced operating expenses and afforded more stable employment to building-trades workers.

Construction activity was well distributed throughout the different regions of the country. The leading class of building construction continues to be residential.

We are not merely keeping pace with the needs of expanding population but meeting the demand for better housing which comes with the general advance in living standards. The past fiscal year, however, witnessed a very considerable increase in contracts for new industrial and business buildings and for public works and utilities. There was little to suggest extravagant additions to industrial plants, which characterized the boom of 1920, the new buildings representing rather a steady growth of production and trade and the meeting of needs for more efficient, comfortable, and attractive factories, stores, and office buildings.

The heavy and increasing expenditures for construction during the past five years have been an essential factor in maintaining and augmenting the activity of many of our most important industries, including not only production of building materials but also various other types of manufacturing, metal mining, and railway transportation. There is indeed a close and mutual interaction between construction and other industries. The prosperity of the latter makes possible the savings which go into construction, while construction activity helps keep other branches of industry prosperous.

An increasing proportion of the housing construction during the last two or three years has been of the less expensive types needed to relieve the shortage which arose during the war, and to supply the demands of workers whose advancing earnings enable them to afford better quarters than ever before. Improvement in the methods of financing dwellings is still needed, especially for families of the lower income groups. In particular it is desirable that interest rates and other charges on second mortgages should be placed on a more reasonable basis.

Operating statistics of Class I railways

	Years ended June 30—					Per cent change 1925 to 1926
	1922	1923	1924	1925	1926	
Freight ton-mileage (millions)	351,536	431,035	436,737	437,387	470,912	+7.7
Carloads of all commodities (thousands)	40,658	47,193	48,992	49,678	51,917	+4.5
Net tons per train	656	704	706	731	752	+2.9
Net tons per loaded car	26.8	27.7	27.2	27.0	27.0	----------
Average daily car surplus	272,756	36,399	187,554	252,410	218,779	−13.3
Average daily car shortage	2,410	74,689	4,793	295	435	(1)
Bad-order cars, average	339,369	241,218	170,546	194,519	172,252	−11.4
Bad-order locomotives, average	15,764	16,089	10,838	11,514	10,478	−9.0
Number of employees	1,643,000	1,770,000	1,850,000	1,765,000	1,783,000	+1.0
Total operating revenues (1,000 dollars)	5,508,169	6,104,274	6,120,646	6,011,864	6,318,622	+5.1
Net operating income (1,000 dollars)	818,345	873,777	924,674	1,033,766	1,192,453	+15.4

[1] Not computed; numbers are insignificantly small in both years.

MOTOR TRANSPORT

An outstanding development of the year is the increasing use of the motor truck and motor bus in conjunction with other forms of transportation. Transportation experts are beginning to comprehend the possibilities of the motor vehicle as a cooperative instead of a competitive factor. Over 50 railroads in the United States and Canada are now using motor trucks to supplement their shipping service; nearly as many more are availing themselves of the motor bus. Quite a number of railroads are experimenting with store-door delivery, some 30 or more use the truck in terminal operation, and several have now replaced way freight trains with the motor truck. One of our largest railroads has replaced local freight trains on 1,000 miles of line and is serving 500 stations with the motor truck. Furthermore, over 14,000 miles of motor-bus routes are operated by electric railways. Developments such as these warrant increasing attention to the possibilities of the use of the motor vehicle as an adjunct to other forms of transportation.

WATER TRANSPORTATION

The situation with respect to ocean shipping throughout the world is still unsatisfactory to ship operators. The balance between ship capacity and available cargoes has not yet been restored. The world tonnage of seagoing steel and iron steam and motor vessels, swollen by the stimulus of war requirements, is nearly 40 per cent greater than in 1913. Although a considerable amount of this shipping is obsolete, there is still an excess of capacity, in view of the fact that

the volume of ocean traffic is as yet little if any greater than before the war.

Comparatively little change took place in the ocean shipping situation during the fiscal year. Idle tonnage in the United States, and also that in the world as a whole, fell off about one-tenth. The total tonnage of seagoing vessels increased slightly in the world as a whole, but that of the United States declined by 5 per cent. In contrast with the decline in American vessels engaged in foreign trade, there was a gain of nearly 4 per cent in the tonnage in coastwise and internal trade. The percentage of the volume of our oversea foreign trade carried in American ships, which had risen slightly in the calendar year 1924, fell off considerably in the calendar year 1925, the proportions being, respectively, 41 per cent and 37 per cent. Further progress was made in the transfer of American ships from Government to private operation.

BANKING AND FINANCE

The calendar year 1925 showed many new high records in American financial activities—in volume of the capital, deposits, loans and discounts and investment holdings of banks, in the amount of foreign loans placed (save, of course, as compared with certain of the war years), in new corporate securities issued, and in insurance written. Bank clearings and debits to individual bank accounts each for the first time exceeded $500,000,000,000. The fiscal year 1925–26 has similarly been a record-breaking period in our financial activities, although up to the present time certain important statistics relating to the year are not available. In every month of the fiscal year the debits to individual bank accounts were notably larger than in the corresponding month of the previous fiscal year. A striking expansion in banking operations is shown also by the statistics of reporting member banks of the Federal reserve system, which reported larger totals for loans and discounts, investments, and deposits, as of June 30, 1926, than as of the corresponding date of 1925.

This enormous expansion in financial activities was accomplished without dangerous tension of commercial credit, without any perceptible increase in merchandise stocks, with a smaller stock of money than in any other recent year, and without any appreciable advance in the level of wholesale prices. The upward trend in credit operations appears, therefore, to represent a steady growth, reflecting the general progress of industry and commerce rather than any temporary inflationary expansion.

There was, however, during the fiscal year a sharp up-and-down movement in security prices. February, 1926, marked a temporary termination of the greatest "bull" market in the history of Wall

Street. Until March 31, security prices dropped at a somewhat alarming rate. A strong reaction followed, and by the close of the fiscal year the general level of security prices was not much below the previous peak. Nevertheless, the setback had served as a timely corrective to speculative psychology. Moreover, the fear that general business depression might follow served the useful purpose of checking any tendency to pile up merchandise stocks and to speculate in commodities. The end of the fiscal year consequently found the Nation's business in an unusually liquid condition with ample credit for all legitimate purposes.

Our operations as a lending Nation during the fiscal year 1924–25 had towered far above those of any previous year since the war, the total amount of foreign capital issues publicly offered in the United States having been no less than $1,382,000,000. Foreign investment operations continued at practically the same high rate during the fiscal year now under review, the total reaching $1,302,000,000. Of this sum $335,000,000 consisted of German capital issues.

During the fiscal year the interest-bearing debt of the Federal Government was reduced by some $827,000,000. Although there were certain reductions in tax rates, the total yield for the year from the income tax, from miscellaneous internal revenue, and from customs duties increased. A very slight increase occurred in the ordinary expenditures of the Government, amounting to a little over 1 per cent.

Financial improvement abroad was almost general. Previous gains in public finance and currency stabilization were consolidated in most countries, and further progress was made toward limiting the fluctuations in exchange rates, hitherto so destructive in international trade and finance. The Hungarian and East Indian exchanges were stabilized at new parities, and the Danish and Uruguayan exchanges have been virtually at par for many months. Belgium has attacked its exchange problem with resolution. On the other hand, the new Polish currency, the zloty, sank rapidly beginning with July, 1925, though with partial subsequent recovery. Likewise the French franc, with many sharp fluctuations, dropped from its approximate 5-cent level to below 3 cents. The difficulty of the great French Nation in solving the problem of its currency remains the most unsatisfactory spot in international finance. Financial recovery in Germany was aided in some degree by the so-called flight of capital from the franc.

FOREIGN TRADE

The value of exports declined slightly, 2.3 per cent, in the fiscal year as compared with that preceding, but this was due to the lower average prices of export commodities, a quantitative increase of

2 or 3 per cent having taken place. The physical volume of exports thus marked a record scarcely, if at all, exceeded even at the height of the postwar boom. The increase would have been much more marked but for the poor wheat crop of 1925, which cut down greatly the exports of that commodity.

The value of imports showed an exceptionally great increase, 17 per cent. This was in large part due, however, to higher prices, the phenomenal rise in rubber alone accounting for an addition of about $300,000,000 to the value of imports. Nevertheless, even in quantitative terms the imports were of record volume, reflecting the high prosperity of the country with the consequently strong demand for foreign raw materials and exotic foodstuffs.

While, largely owing to lower prices but to some extent also to smaller quantities, exports of crude materials, foodstuffs, and semimanufactures were of smaller value in 1925–26 than the year before, the loss was nearly offset by the marked increase in exports of finished manufactures, which were 16 per cent greater, continuing the steady gain of recent years. In the case of imports all of the economic classes except manufactured foodstuffs increased in value, and the decline in the latter was due entirely to the lower price of sugar, the principal item.

Exports to all of the continents of the world except Europe were greater in 1925–26 than the year before. The decline in the case of Europe was due to smaller shipments of wheat and the lower price of cotton. Exports to South America increased 16.6 per cent; to Asia, 17.5; to Oceania, 20.5; and to Africa, 21.6 per cent. Imports from every continent showed an increase, the most conspicuous being in our purchases from Asia, which were greatly affected by the abnormally high price of rubber.

By reason of the slight decline in exports and the unusually large increase in imports—both due, as already indicated, to special and presumably temporary causes—the excess of exports over imports was much less than in most years, and during two or three months in the spring of 1926 there was an excess of imports. Nevertheless, a small net importation of gold occurred during the year. That this should have happened in the face of the diminished excess of merchandise exports, the large new foreign investments, and the continued heavy expenditures of our tourists abroad, indicates that there must have been a considerable shifting of banking and commercial credits and also a very considerable purchase of American securities by foreigners. It is believed that the so-called flight from the franc was a factor of some importance in such purchase of American securities.

Foreign trade of the United States

[Millions of dollars]

	Years ended June 30—				Per cent change 1926 from 1925
	1910–1914	1924	1925	1926	
Exports, merchandise	2,166	4,312	4,865	4,753	−2.3
Imports, merchandise	1,689	3,554	3,824	4,466	+16.8
Excess of exports (+) or of imports (−):					
Merchandise	+477	+758	+1,040	+288	
Gold	+18	−407	+115	−97	
Silver	+20	+19	+37	+29	
Quantitative index eliminating the effect of price variations (1913=100):					
Domestic exports	89	122½	133½	137	+2.6
Imports	94	158½	161	170	+5.6

Part IV.—AERONAUTICS

[By WILLIAM P. MACCRACKEN, Jr., Assistant Secretary of Commerce for Aeronautics]

The air commerce act of 1926 (approved May 20) established a Federal policy with reference to commercial aeronautics and placed its administration under the Department of Commerce.

In general terms the act provides that the same essential services shall be given to navigation of the air which have been provided for over a hundred years in navigation of the water. The department is charged with the duty of registering eligible aircraft, certifying to their air worthiness, examining the operating personnel and air navigation facilities, also of establishing air traffic rules. It is authorized to lay out airways, provide for lighting, mapping, and emergency landing fields and in other directions furnishing assistance to aviators such as radio-direction fog-protection facilities, weather information, and other aids to navigation. The department is further charged with the general development and promotion of commercial aviation.

The purpose of the Government has been threefold—first, to secure better development of this new form of transportation for commercial purposes; second, to create private commercial services which can relieve the post office of its direct expenditure upon air mail; and third, by the creation of a large commercial air fleet with its accompanying personnel and its background of the manufacturing industry to give a fundamental military reserve to the country.

On January 1, 1926, there were 369 miles of air transport services in operation by private enterprises, and there were 2,665 miles operated by the Post Office Department. Assurance of congressional action and the official passage of the act have resulted in considerable preparatory activities by private enterprise. Little commercial aviation could be organized until the fundamental services above mentioned were assured, as no commercial concern could undertake to provide these aids to navigation at its individual expense, not only because of the large preliminary outlay but because such facilities would be equally available to competitors.

The work of the department in development of the new aviation division has during the past fiscal year been of preparatory order like that in the industry. It may be said, however, that already commercial operations have been undertaken in reliance on the pro-

visions of the air commerce act in a number of directions, and it seems certain that the Post Office Department will be able to let contracts which will relieve it of all transportation of the air mail during the present fiscal year. It will thus convert a very large postal loss into a certain postal profit.

Already between 6,000 and 7,000 miles of airways are under actual operation. We hope this may be extended by another 5,000 miles during the present fiscal year, and that most of the important centers of the country will be interconnected by this new form of transportation carrying mail, express, and passengers.

Part V.—LEGISLATIVE RECOMMENDATIONS

The law requires that the Secretary of Commerce shall include in his annual report "such recommendations as he shall deem necessary for the effective performance of the duties and purposes of the department." Since March 4, 1921, the department has made recommendations which have been accepted by Congress and legislation enacted directly or indirectly effected the results desired:

Revision of taxes upon Americans abroad engaged in commerce.
Establishment of commercial aeronautics in the department.
Regulation of Alaskan fisheries.
Construction of new departmental building.
Compensation for expert employees.
Improvement of the Lighthouse Service.

The following recommended legislation has now passed through one or both Houses:

Reorganization of the foreign commerce service of the Bureau of Foreign and Domestic Commerce.
Revision of radio regulation.

The following are recommendations for new legislation:

Revision of navigation laws.
Transfer of certain merchant-marine functions to the Department of Commerce and their consolidation under an assistant secretary for merchant marine.

Part VI.—CONDENSED REPORTS OF BUREAUS

ADMINISTRATIVE DIVISIONS OF THE OFFICE OF THE SECRETARY

DEPARTMENT OF COMMERCE,
OFFICE OF THE CHIEF CLERK,
Washington, July 1, 1926.

Hon. HERBERT HOOVER,
Secretary of Commerce.

DEAR MR. SECRETARY: In response to your request I furnish the following condensed report of the work of the various divisions of the Secretary's office during the past year:

This organization consists of the immediate offices of the Secretary, Assistant Secretary, and the Assistant Secretary for Aeronautics; the Solicitor, the Chief Clerk and Superintendent; the disbursing office, the division of appointments, the division of publications, the division of supplies, the stock and shipping section, the traffic manager, the department library, the telegraph office, telephone exchange, the motor equipment, and the department garage.

The divisions and sections enumerated above are service units for the department as a whole. They are headed by specialists in their respective lines, and I desire to testify to their ability and the loyal cooperation of their assistants, who have at all times cheerfully responded to the demands of the service.

SCATTERED ACTIVITIES

An outstanding problem, as in the past, has been the need for more space. It was necessary during the year to resort to numerous makeshifts, and working conditions were anything but pleasant and far from satisfactory. Exclusive of the Bureau of Standards, the department is quartered in 10 different buildings, as follows: The office of the secretary and various divisions thereof, the office of the solicitor, part of the Bureau of Foreign and Domestic Commerce, the Bureau of Navigation, the division of simplified practice, and the division of building and housing, in the Commerce Building; the Bureau of Lighthouses, the statistical division of the Bureau of Foreign and Domestic Commerce, and the United States Section of the Inter American High Commission, in the Hurley-Wright Building; the Bureau of Fisheries at Sixth and B Streets SW.; the Bureau of the Census in Building D, Sixth Street and Missouri Avenue SW.; the Coast and Geodetic Survey at 205 New Jersey

Avenue SE.; the Patent Office at Seventh and F Streets NW., and part of the old General Land Office Building; the Bureau of Mines in the Winder Building and annex; the Steamboat Inspection Service and the international radio accounting section of the Bureau of Navigation in Tempo Building No. 5.

It is needless to enumerate the disadvantages of such a scattering of activities, and a new building now in prospect, adequate in size to house the department, is looked forward to as the solution of one of our greatest problems.

COOPERATION WITH FEDERAL AGENCIES

The divisions of the Secretary's Office during the year assisted in effecting economies and improved methods of administration throughout the Government service by representation upon many coordinating boards and committees. The Chief Clerk is chairman of the Association of Chief Clerks of the Executive Departments, member of the executive committee, Board of Simplified Office Procedure, and chairman subcommittee on forms, Board of Simplified Office Procedure. The chief of the appointment division is president of the Appointment Clerks' Association (composed of personnel officials of departments and independent establishments), chairman of the departmental Classification Board and acts as classification officer for the department, and a member of the oral examining board of the Bureau of Foreign and Domestic Commerce. The chief of the division of publications represents the department on the Permanent Conference on Printing, the first coordinating agency organized under the direction of the Bureau of the Budget. He is chairman of the committee on standardization of forms, a member of the executive committee, and chairman of a special committee appointed by the conference to consider the uniform preparation of graphs for photographic reproduction. The disbursing clerk represents the department on the Advisory Committee on Fiscal Accounting Forms and Procedure under the office of the Comptroller General. The chief of the division supplies serves as chairman, departmental board on contracts and adjustments; chairman, auditing committee of financial clerk's record, Patent Office; chairman, board of survey of the department; department's representative, interdepartmental board of contracts and adjustments, Federal purchasing board and Federal real estate board. The traffic manager serves as the department's representative on the Federal Traffic Board and chairman of the legislative committee of that board; member water freight committee, classification committee, accounting committee, and advisory committee, all of the Federal Traffic Board; and as member of a special committee of the Bureau of the Budget on regulations.

DISBURSING OFFICE

The itemized statement of the disbursements from the contingent fund of the department and the appropriation for "General expenses, Bureau of Standards," for the fiscal year ended June 30, 1926, required to be submitted to Congress by section 193 of the Revised Statutes of the United States; the itemized statement of ex-

penditures under all appropriations for propagation of food fishes during the fiscal year ended June 30, 1926, required by the act of Congress approved March 3, 1887 (24 Stat. 523); and a statement showing travel on official business by officers and employees (other than special agents, inspectors, and employees who, in the discharge of their regular duties, are required to travel constantly) from Washington to points outside of the District of Columbia during the fiscal year ended June 30, 1926, as required by the act of Congress approved May 22, 1908 (35 Stat. 244), and a statement showing typewriters, adding machines, etc., exchanged by this department during the fiscal year ended June 30, 1926, as required by section 5 of the act of March 4, 1915 (38 Stat. 1161), will be transmitted to the Congress in the usual form.

The table following shows the total amount of all appropriations for the various bureaus and services of the Department of Commerce for the fiscal year ended June 30, 1926:

Bureau	Annual appropriation acts	Deficiency act	Executive order	Special act
Office of the Secretary	$497,380.00			
Bureau of Foreign and Domestic Commerce	2,994,064.00			
Bureau of the Census	1,974,000.00	$230,000.00		
Steamboat Inspection Service	1,057,470.00			
Bureau of Navigation	523,240.00			$6,572.05
Bureau of Standards	1,750,410.00	30,000.00		
Coast and Geodetic Survey	2,327,650.00	708.00		
Bureau of Lighthouses	9,702,980.00	59,234.25		85.00
Bureau of Fisheries	1,724,140.00	25,000.00		
Patent Office			$2,828,000.00	
Bureau of Mines		130,000.00	2,673,161.19	445,000.00
Printing and binding	500,000.00		880,000.00	
Total	23,051,334.00	474,942.25	6,381,161.19	451,657.05

Bureau	Allotments by other departments	Total	Transferred to retirement fund	Net amount available for expenditure by this department
Office of the Secretary		$497,380.00	$3,500.00	$493,880.00
Bureau of Foreign and Domestic Commerce		2,994,064.00	21,225.00	2,972,839.00
Bureau of the Census		2,204,000.00	30,878.00	2,173,122.00
Steamboat Inspection Service		1,057,470.00	22,605.50	1,034,864.50
Bureau of Navigation		529,812.05	7,614.17	522,197.88
Bureau of Standards	$152,750.00	1,933,160.00	32,330.00	1,900,830.00
Coast and Geodetic Survey		2,328,358.00	12,897.25	2,315,460.75
Bureau of Lighthouses		9,762,299.25	11,500.00	9,750,799.25
Bureau of Fisheries		1,749,140.00	12,000.00	1,737,140.00
Patent Office		2,828,000.00	63,042.50	2,764,957.50
Bureau of Mines	93,675.61	3,341,836.80	30,852.81	3,310,983.99
Printing and binding		1,380,000.00		1,380,000.00
Total	246,425.61	30,605,520.10	248,445.23	30,357,074.87

The disbursements by the authorized disbursing officers of the department during the fiscal year ended June 30, 1926, arranged according to items of appropriation, are as follows:

Office of the Secretary:

Contingent expenses, Department of Commerce, 1923	$227.84
Contingent expenses, Department of Commerce, 1924	51.75
Contingent expenses, Department of Commerce, 1925	40,552.37
Contingent expenses, Department of Commerce, 1926	185,492.74

Office of the Secretary—Continued.	
Increase of compensation, Department of Commerce, 1924	$6.10
Printing and binding, Department of Commerce, 1924	6,678.06
Printing and binding, Department of Commerce, 1925	207,940.68
Printing and binding, Department of Commerce, 1926	325,859.29
Rent, Department of Commerce, 1925	5,783.33
Rent, Department of Commerce, 1926	61,683.29
Salaries, office of the Secretary, 1925	9,724.05
Salaries, office of the Secretary, 1925–26	213,151.31
Total	1,057,150.81
Bureau of Foreign and Domestic Commerce:	
Commercial attachés, 1923	31.65
Commercial attachés, 1924	292.56
Commercial attachés, 1925	12,323.30
Commercial attachés, 1926	289,299.75
Compiling foreign-trade statistics, 1923–24	43.25
Compiling foreign-trade statistics, 1925	27,628.62
Compiling foreign-trade statistics, 1926	315,175.75
Directory of foreign buyers, 1925	736.93
District and cooperative office service, 1924	7.61
District and cooperative office service, 1925	15,388.36
District and cooperative office service, 1926	212,155.48
Domestic commerce, Department of Commerce, 1926	105,120.84
Enforcement of China trade act, 1925	577.48
Enforcement of China trade act, 1926	22,161.50
Export industries, 1925	28,397.98
Export industries, 1926	562,748.85
Investigating sources of crude rubber, 1923–24	1,514.26
Investigating sources of crude rubber, 1925	2,219.47
Investigation of foreign-trade restrictions, 1925	946.79
Investigation of foreign-trade restrictions, 1926	26,762.09
Lists of foreign buyers, 1926	10,968.20
Promoting commerce, Department of Commerce, 1923	22.50
Promoting commerce, Department of Commerce, 1924	209.36
Promoting commerce, Department of Commerce, 1925	21,786.13
Promoting commerce, Department of Commerce, 1926	407,052.12
Promoting commerce in the Far East, 1923	6.00
Promoting commerce in the Far East, 1924	45.10
Promoting commerce in the Far East, 1925	11,671.32
Promoting commerce in the Far East, 1926	235,597.06
Promoting commerce, South and Central America, 1925	10,131.70
Promoting commerce, South and Central America, 1926	233,735.66
Raw-material investigations, 1924	800.00
Raw-material investigations, 1925	3,286.36
Salaries, Foreign and Domestic Commerce, 1925	10,391.79
Salaries, Foreign and Domestic Commerce, 1926	248,376.81
Transportation of families and effects of officers and employees, 1925	2,396.80
Transportation of families and effects of officers and employees, 1926	18,651.48
Total	2,838,660.91
Bureau of Standards:	
Advisory Committee for Aeronautics (transfer to Bureau of Standards, act of May 28, 1924), 1925	3,789.79
Advisory Committee for Aeronautics (transfer to Bureau of Standards, act of Feb. 27, 1925), 1926	28,939.06
Air Service, Army (War transfer to Bureau of Standards, act of Jan. 5, 1923), 1924	13.68
Air Service, Army (War transfer to Bureau of Standards, act of May 21, 1920), 1924	241.20
Air Service, Army (War transfer to Bureau of Standards, act of May 21, 1920), 1925	415.09

Bureau of Standards—Continued.

Air Service, Army (War transfer to Bureau of Standards, act of May 28, 1924), 1925	$702.65
Air Service, Army (War transfer to Bureau of Standards, act of Feb. 27, 1925), 1926	5,866.13
Automatic rifles (War transfer to Bureau of Standards, act of May 21, 1920), 1923–24	625.62
Automatic rifles (War transfer to Bureau of Standards, act of May 21, 1920), 1924–25	1,399.26
Automatic rifles (War transfer to Bureau of Standards, act of Feb. 27, 1925), 1926–27	1,769.63
Aviation, Navy (Navy transfer to Bureau of Standards, act of May 21, 1920), 1924	7,223.19
Aviation, Navy (Navy transfer to Bureau of Standards, act of May 21, 1920), 1925	303.07
Aviation, Navy (Navy transfer to Bureau of Standards, act of May 28, 1924), 1925	3,662.04
Aviation, Navy (Navy transfer to Bureau of Standards, act of Feb. 27, 1925), 1926	45,273.06
Coast Guard (Treasury transfer to Bureau of Standards, act of May 21, 1920), 1925	1,657.50
Color standardization, 1925	1,187.03
Color standardization, 1926	7,958.01
Compensation of employees, Bureau of Engraving and Printing (Treasury transfer to Bureau of Standards, act of Feb. 27, 1925), 1926	5,281.20
Conference on oil pollution of navigable waters (State transfer to Bureau of Standards, act of Mar. 4, 1925), 1925–26	5,416.95
Construction and repairs, Bureau of Construction and Repair (Navy transfer to Bureau of Standards, act of May 21, 1920), 1925	714.54
Construction and repairs, Bureau of Construction and Repair (Navy transfer to Bureau of Standards, act of May 28, 1924), 1925	1,903.57
Construction and repairs, Bureau of Construction and Repair (Navy transfer to Bureau of Standards, act of Feb. 27, 1925), 1926	3,673.93
Engineering, Bureau of Engineering (Navy transfer to Commerce, act of May 21, 1920), 1925	891.30
Engineering, Bureau of Engineering (Navy transfer to Commerce, act of Feb. 27, 1925), 1926	1,678.83
Equipment, 1918	55.69
Equipment, 1919	43.02
Equipment, 1925	11,528.80
Equipment, 1926	49,439.88
Export industries, Department of Commerce (transfer to Bureau of Standards, act of May 28, 1924), 1925	211.25
Export industries, Department of Commerce (transfer to Bureau of Standards, act of Feb. 27, 1925), 1926	3,939.01
Field artillery, armament (War transfer to Bureau of Standards, act of May 21, 1920), 1924	19.26
Gauges, dies, and jigs for manufacture (War transfer to Bureau of Standards, act of May 21, 1920), 1926	276.26
Gauge standardization, 1925	3,999.91
Gauge standardization, 1926	34,721.18
General expenses, Bureau of Entomology (Agriculture transfer to Bureau of Standards, act of May 28, 1924), 1925	372.82
General expenses, Bureau of Entomology (Agriculture transfer to Bureau of Standards, act of Feb. 27, 1925), 1926	2,634.30
General expenses, Lighthouse Service (transfer to Bureau of Standards, act of May 28, 1924), 1925	2,871.28
General expenses, Lighthouse Service (transfer to Bureau of Standards, act of Feb. 27, 1925), 1926	8,880.35

Bureau of Standards—Continued.	
General expenses, Bureau of Standards, 1924	$40.18
General expenses, Bureau of Standards, 1925	13,670.60
General expenses, Bureau of Standards, 1926	30,221.66
High-temperature investigations, 1925	605.24
High-temperature investigations, 1926	8,965.68
Improvement and care of grounds, 1925	523.74
Improvement and care of grounds, 1926	10,470.02
Incidental expenses of the Army (War transfer to Bureau of Standards, act of May 28, 1924), 1925	4,796.89
Incidental expenses of the Army (War transfer to Bureau of Standards, act of Feb. 27, 1925), 1926	9,255.98
Industrial research, 1921	170.00
Industrial research, 1924	15.75
Industrial research, 1925	11,309.68
Industrial research, 1926	158,182.68
Investigation of automotive engines, 1925	4,294.01
Investigation of automotive engines, 1926	26,231.39
Investigation of clay products, 1925	2,154.31
Investigation of clay products, 1926	23,630.73
Investigation of fire-resisting properties, 1925	2,025.60
Investigation of fire-resisting properties, 1926	26,660.16
Investigation of mine scales and cars, 1924	2.80
Investigation of mine scales and cars, 1925	10.00
Investigation of mine scales and cars, 1926	13,390.02
Investigation of optical glass, 1925	1,953.65
Investigation of optcial glass, 1926	18,505.75
Investigation of public utility standards, 1925	9,172.34
Investigation of public utility standards, 1926	88,760.91
Investigation of radioactive substances, 1925	659.18
Investigation of radioactive substances, 1926	9,821.43
Investigation of textiles, etc., 1925	2,473.02
Investigation of textiles, etc., 1926	24,267.59
Manufacture of arms (War transfer to Bureau of Standards, act of May 28, 1924), 1924–25	163.32
Metallurgical research, 1925	5,355.62
Metallurgical research, 1926	37,383.22
Mineral mining investigation, Bureau of Mines (Interior transfer to Bureau of Standards, act of May 28, 1924), 1925	325.57
Ordnance and ordnance stores, Bureau of Ordnance (Navy transfer to Commerce, act of May 21, 1920), 1924	307.43
Ordnance and ordnance stores, Bureau of Ordnance (Navy transfer to Bureau of Standards, act of May 21, 1920), 1925	3,756.83
Ordnance and ordnance stores, Bureau of Ordnance (Navy transfer to Bureau of Standards, act of May 21, 1920), 1926	10,710.94
Ordnance stores, ammunition (War transfer to Bureau of Standards, act of May 21, 1920), 1923–24	19.05
Ordnance stores, ammunition (War transfer to Bureau of Standards, act of May 28, 1924), 1925–26	2,464.56
Party expenses, Coast and Geodetic Survey (transfer to Bureau of Standards, act of May 21, 1920), 1924	801.84
Proving grounds, Army (War transfer to Bureau of Standards, act of May 21, 1920), 1925	234.00
Radio research, 1925	2,566.73
Radio research, 1926	42,183.49
Rope investigation, 1925	742.75
Salaries, 1924	19.50
Salaries, 1925	20,887.37
Salaries, 1926	482,570.39
Signal Service of the Army (War transfer to Bureau of Standards, act of May 28, 1924), 1925	187.77
Signal Service of the Army (War transfer to Bureau of Standards, act of Feb. 27, 1925), 1926	1,635.25

Bureau of Standards—Continued.	
Sound investigation, 1925	$75.57
Sound investigation, 1926	5,479.52
Standardization of equipment, 1925	10,284.31
Standardization of equipment, 1926	99,565.31
Standardizing mechanical appliances, 1925	1,511.63
Standardizing mechanical appliances, 1926	24,542.58
Standard materials, 1925	534.82
Standard materials, 1926	9,491.10
Sugar standardization, 1925	4,085.71
Sugar standardization, 1926	37,494.21
Sugar standardization, 1926–27	1,235.15
Tanks (War transfer to Bureau of Standards, act of May 21, 1920), 1923–24	264.82
Testing machines, 1925	5,906.41
Testing machines, 1926	35,062.05
Testing miscellaneous materials, 1925	4,349.82
Testing miscellaneous materials, 1926	44,395.66
Testing railroad scales, 1925	2,990.57
Testing railroad scales, 1926	33,825.77
Testing structural materials, 1924	.66
Testing structural materials, 1925	19,547.63
Testing structural materials, 1926	211,519.10
Washington-Alaska military cable and telegraph system (War transfer to Bureau of Standards, act of May 28, 1924), 1925–26	1,452.27
Total	1,917,750.63
Steamboat Inspection Service:	
Clerk hire, 1925	11,425.55
Clerk hire, 1926	136,326.47
Contingent expenses, Steamboat Inspection Service, 1923	4.62
Contingent expenses, Steamboat Inspection Service, 1924	258.00
Contingent expenses, Steamboat Inspection Service, 1925	21,775.58
Contingent expenses, Steamboat Inspection Service, 1926	108,853.98
Salaries, office of Supervising Inspector General, 1925	1,204.71
Salaries, office of Supervising Inspector General, 1926	25,072.28
Salaries, Steamboat Inspection Service, 1925	58,699.98
Salaries, Steamboat Inspection Service, 1926	710,675.93
Total	1,074,297.10
Bureau of Navigation:	
Admeasurement of vessels, 1925	289.76
Admeasurement of vessels, 1926	4,178.04
Clerk hire, shipping service, 1925	7,232.57
Clerk hire, shipping service, 1926	79,054.33
Contingent expenses, shipping service, 1925	835.11
Contingent expenses, shipping service, 1926	8,908.06
Enforcement of navigation laws, 1925	5,160.69
Enforcement of navigation laws, 1926	74,091.87
Enforcement of wireless communication laws, 1925	18,311.58
Enforcement of wireless communication laws, 1926	205,621.15
Preventing overcrowding of passenger vessels, 1925	2,912.55
Preventing overcrowding of passenger vessels, 1926	16,254.03
Refunding moneys erroneously received and covered into the Treasury	6,490.21
Refunding penalties or charges erroneously exacted	81.84
Salaries, Bureau of Navigation, 1925	2,231.65
Salaries, Bureau of Navigation, 1926	59,540.96
Salaries, shipping service, 1925	2,828.14
Salaries, shipping service, 1926	32,021.49
Total	526,044.03

Bureau of Fisheries:	
Fisheries of Alaska, 1924–25	$31,158.65
Fish hatchery, Nashua, N. H., 1926–27	1,949.02
Fish rescue station, Mississippi River, 1925	4,339.00
Investigation damages to fisheries	1,059.71
Miscellaneous expenses, 1924	86.40
Miscellaneous expenses, 1924–25	1,192.38
Miscellaneous expenses, 1925	102,595.84
Miscellaneous expenses, 1926	501,348.86
Pay, officers and crew of vessels, Alaska fisheries service, 1925	4,450.50
Pay, officers and crew of vessels, Alaska fisheries service, 1926	41,750.83
Protecting seal and salmon fisheries of Alaska, 1924	54.49
Protecting seal and salmon fisheries of Alaska, 1925	7,237.24
Protecting seal and salmon fisheries of Alaska, 1926	261,281.76
Salaries, 1925	41,230.74
Salaries, 1926	549,396.16
Upper Mississippi River fish refuge	5,998.96
Total	1,555,130.54
Bureau of the Census:	
Census of agriculture, 1925–26	530,174.48
Census of agriculture, 1925–27	56,917.70
Collecting statistics, 1924	550.26
Collecting statistics, 1925	56,140.32
Collecting statistics, 1926	777,479.97
Salaries, 1925	43,389.49
Salaries, 1926	905,189.72
Tabulating machines, 1925	2,593.73
Tabulating machines, 1926	35,543.83
Total	2,407,979.50
Bureau of Lighthouses:	
Aids to navigation, Chesapeake Bay, Md. and Va	3,447.36
Aids to navigation, Delaware Bay Entrance	33,580.37
Aids to navigation, Florida coasts	818.24
Aids to navigation, Lighthouse Service	608,152.04
Aids to navigation, St. Johns River, Fla	2,581.66
Cape Charles Light Vessel, Va	77,930.86
Claims for damages, act of Dec. 28, 1922, Department of Commerce	520.00
Claims for damages by collision with lighthouse vessels	472.62
Detroit Lighthouse Depot, Mich	53.20
Detroit River lights, Mich	18,700.88
Judgments, United States courts, Department of Commerce	7,097.55
Light-keepers' dwellings	850.00
Point Vincente Light Station, Calif	7,092.80
Radio installations on lighthouse tenders	1,289.62
Repairing and rebuilding aids to navigation, Atlantic coast	11,553.16
Repairing and rebuilding aids to navigation, Gulf of Mexico	1,678.60
Repairing and rebuilding aids to navigation, seventh and eighth lighthouse districts	3,095.60
Sand Island Light Station, Ala	8,972.89
Tender for third lighthouse district	306.50
Vessels for Lighthouse Service	225,304.84
General expenses, Lighthouse Service, 1918	1.34
General expenses, Lighthouse Service, 1919	10.50
General expenses, Lighthouse Service, 1920	2.00
General expenses, Lighthouse Service, 1922	14.50
General expenses, Lighthouse Service, 1923	352.09
General expenses, Lighthouse Service, 1924	6,137.96
General expenses, Lighthouse Service, 1925	583,124.34
General expenses, Lighthouse Service, 1926	3,457,449.41
Salaries, Bureau of Lighthouses, 1925	3,627.76

Bureau of Lighthouses—Continued.	
Salaries, Bureau of Lighthouses, 1926	$82,944.60
Salaries, keepers of lighthouses, 1925	48,206.05
Salaries, keepers of lighthouses, 1926	1,895,818.50
Salaries, Lighthouse Service, 1925	5,421.67
Salaries, Lighthouse Service, 1926	532,263.61
Salaries, lighthouse vessels, 1924	12.34
Salaries, lighthouse vessels, 1925	66,842.39
Salaries, lighthouse vessels, 1926	2,127,479.09
Retired pay, Lighthouse Service, 1925	2,945.82
Retired pay, Lighthouse Service, 1926	152,672.63
Total	9,978,825.39
Coast and Geodetic Survey:	
General expenses, Coast and Geodetic Survey, 1924	.78
General expenses, Coast and Geodetic Survey, 1925	19,587.56
General expenses, Coast and Geodetic Survey, 1926	56,141.67
Geological Survey (Interior transfer to Commerce, act of May 21, 1920), 1926	71.26
Party expenses, Coast and Geodetic Survey, 1924	4,258.49
Party expenses, Coast and Geodetic Survey, 1925	155,504.50
Party expenses, Coast and Geodetic Survey, 1926	476,392.77
Pay and allowances, commissioned officers, Coast and Geodetic Survey, 1924	64.00
Pay and allowances, commissioned officers, Coast and Geodetic Survey, 1925	44,094.09
Pay and allowances, commissioned officers, Coast and Geodetic Survey, 1926	415,594.03
Pay, etc., officers and men, vessels Coast Survey, 1924	73.13
Pay, etc., officers and men, vessels Coast Survey, 1925	109,017.77
Pay, etc., officers and men, vessels Coast Survey, 1926	544,878.60
Repairs of vessels, Coast Survey, 1924	1.56
Repairs of vessels, Coast Survey, 1925	16,869.39
Repairs of vessels, Coast Survey, 1926	57,906.33
Salaries, Coast and Geodetic Survey, 1925	26.64
Salaries, Coast and Geodetic Survey, 1926	397,817.65
Claims for damages, act of June 5, 1920, Coast and Geodetic Survey	708.00
Total	2,299,008.22
Patent Office:	
Additional employees, 1924–25	17,525.92
Additional employees, 1926	160,391.28
Contingent expenses, Patent Office, 1925	397.97
Contingent expenses, Patent Office, 1926	6,319.38
Disposition of Patent Office models, 1925–26	3,478.88
Furniture and filing cases, 1925	12,246.95
Furniture and filing cases, 1926	14,808.59
Photolithographing, 1925	20,133.41
Photolithographing, 1926	179,265.37
Printing and binding, Patent Office, 1925	93,302.46
Printing and binding, Patent Office, 1926	906,976.01
Public use of inventions and defending suits, 1925	165.44
Public use of inventions and defending suits, 1926	389.92
Rent and storage of Patent Office models, 1925	150.00
Salaries, 1925	95,082.93
Salaries, 1926	2,194,361.24
Scientific library, 1924	69.48
Scientific library, 1925	2,495.05
Scientific library, 1926	5,400.57
Stationery, Patent Office, 1925	2,780.77
Stationery, Patent Office, 1926	11,870.25
Storage of Patent Office models, 1926	2,400.00
Total	3,730,011.87

Bureau of Mines:	
Air Service, Army (War transfer to Bureau of Mines, act of May 21, 1920), 1925	$33,119.84
Air Service, Army (War transfer to Bureau of Mines, act of June 5, 1924), 1925	712.25
Armament of fortifications (War transfer to Bureau of Mines, act of June 5, 1924), 1925	500.00
Aviation, Navy (Navy transfer to Bureau of Mines, act of May 21, 1920), 1923	80.00
Aviation, Navy (Navy transfer to Bureau of Mines, act of May 21, 1920), 1924	290.31
Aviation, Navy (Navy transfer to Bureau of Mines, act of May 21, 1920), 1925	9,129.78
Aviation, Navy (Navy transfer to Bureau of Mines, act of June 5, 1924), 1925	1,651.77
Aviation, Navy (Navy transfer to Bureau of Mines, act of Jan. 24, 1923), 1924	1,399.56
Care, etc., buildings and grounds, Bureau of Mines, Pittsburgh, Pa., 1925	2,694.17
Care, etc., buildings and grounds, Bureau of Mines, Pittsburgh, Pa., 1926	60,256.44
Contingent expenses, Bureau of Mines, 1926	5,240.61
Enforcement of mineral leases, 1925	5,374.87
Engineering, Bureau of Engineering (Navy transfer to Bureau of Mines, act of June 5, 1924), 1925	1,546.01
Expenses, mining experiment stations, 1925	9,764.43
Expenses, mining experiment stations, 1926	181,242.45
General expenses, Bureau of Mines, 1925	2,742.24
General expenses, Bureau of Mines, 1926	75,998.29
Helium, conservation production and exploitation, Bureau of Mines, act of Mar. 24, 1925, 1926	369,725.06
Helium reserve, 1926	50,000.00
Investigating mine accidents, 1924	.57
Investigating mine accidents, 1925	18,560.33
Investigating mine accidents, 1926	418,592.15
Investigations, lignite coals and peat	395.58
Investigations of petroleum and natural gas, 1918	8.88
Maintenance and operation fuel yards, District of Columbia, Bureau of Mines, 1925–26	1,588,459.62
Mineral mining investigations, Bureau of Mines, 1924	15.70
Mining mining investigations, Bureau of Mines, 1925	23,579.68
Mineral mining investigations, Bureau of Mines, 1926	135,450.65
Mineral resources, Bureau of Mines, 1926	113,639.63
Mining investigations in Alaska, 1924	15.00
Mining investigations in Alaska, 1925	1,342.96
Mining investigations in Alaska, 1926	9,691.01
Oil, gas, and oil shale investigations and leasings, Bureau of Mines, 1924	8.20
Oil, gas, and oil shale investigations and leasings, Bureau of Mines, 1925	26,657.78
Oil, gas, and oil shale investigations and leasings, Bureau of Mines, 1926	191,601.35
Oil shale investigations, Bureau of Mines, 1925–26	56,343.15
Operating mine rescue cars, Bureau of Mines, 1924	136.67
Operating mine rescue cars and stations, Bureau of Mines, 1925	15,811.67
Operating mine rescue cars and stations, Bureau of Mines, 1926	249,687.29
Ordnance and ordnance stores, Bureau of Ordnance (Navy transfer to Mines, act of June 5, 1924), 1925	33.05
Printing and binding, Bureau of Mines, 1924	1,558.20
Printing and binding, Bureau of Mines, 1925	21,718.86
Printing and binding, Bureau of Mines, 1926	29,419.32
Purchases and equipment, Bureau of Mines, 1925	8.17
Stationery, Bureau of Mines, 1926	17,310.84
Testing fuel, Bureau of Mines, 1918	1.00
Testing fuel, Bureau of Mines, 1924	1.39

Bureau of Mines—Continued.	
Testing fuel, Bureau of Mines, 1925	$5,083.19
Testing fuel, Bureau of Mines, 1926	141,556.33
Total	3,878,096.30
Grand total	31,262,955.30

The miscellaneous receipts for the fiscal year are shown below, by bureaus.

Coast and Geodetic Survey: Sale of charts, publications, old property, etc	$64,601.32
Bureau of the Census: Sale of publications, etc	687.00
Bureau of Fisheries:	
Sale of fur-seal skins	161,029.71
Sale of fox skins	16,667.66
Sale of otter skins	375.41
Meals furnished employees at isolated stations	1,319.24
Sale of seal oil	505.74
Sale of old property, etc	1,437.94
Bureau of Standards:	
Sale of old property, etc	27.03
Test fees	30,670.77
Steamboat Inspection Service: Sale of old property, etc	288.82
Bureau of Lighthouses:	
Earnings on radiograms	34.79
Sale of old property, etc	160,943.29
Reimbursement for loss and damage to Government property	4,664.14
Reimbursement by private concerns for work done	2,563.64
Rentals	4,190.32
Miscellaneous refunds	284.41
Bureau of Foreign and Domestic Commerce:	
Photostatic work done	20.80
Registration fees, etc., China trade act	3,450.00
Miscellaneous refunds	920.54
Office of the Secretary:	
Certification fees (37 Stat. 497)	189.75
Miscellaneous refunds	169.10
Patent Office: Patent fees, etc	3,429,774.53
Bureau of Mines:	
Analysis samples	4,104.25
Rentals	582.50
Miscellaneous refunds	279.94
Bureau of Navigation:	
Tonnage tax	1,825,719.39
Navigation fees	227,079.09
Navigation fines	127,872.98
Total	6,070,454.10

The following unexpended balances of appropriations were turned into the surplus fund June 30, 1926, in accordance with the act of June 20, 1874 (18 Stat. 110–111):

Salaries, office of the Secretary of Commerce, 1924	$2,814.13
Increase of compensation, Department of Commerce, 1923	.67
Increase in compensation, Department of Commerce, 1924	89,083.96
Contingent expenses, Department of Commerce, 1924	4,679.79
Printing and binding, Department of Commerce, 1924	74.56
Rent, Department of Commerce, 1924	.02
Salaries, Bureau of Census, 1924	15,446.53
Collecting statistics, Bureau of Census, 1923	26.57
Collecting statistics, Bureau of Census, 1924	26,587.70
Expenses of the Fourteenth Census, 1920–1922	600.00
Tabulating machines, Bureau of Census, 1924	512.77

Salaries, Bureau of Foreign and Domestic Commerce, 1924	$6,669.74
Commercial attachés, Department of Commerce, 1922	2,782.75
Commercial attachés, Department of Commerce, 1923	1,556.93
Commercial attachés, Department of Commerce, 1924	18,236.69
Compiling foreign trade statistics, Department of Commerce, 1923–24	607.36
Compiling foreign trade statistics, Department of Commerce, 1924	13,322.45
Directory of foreign buyers, 1924	97.09
District and cooperative office service, Department of Commerce, 1924	685.37
Enforcement of the China trade act, 1924	13,746.30
Export industries, Department of Commerce, 1922	87.42
Export industries, Department of Commerce, 1923	1.37
Export industries, Department of Commerce, 1924	23,054.03
Investigating sources of crude rubber, 1923–24	34,279.80
Investigation of foreign trade restrictions, 1924	2,398.54
Promoting commerce, Department of Commerce, 1920	37.97
Promoting commerce, Department of Commerce, 1921	450.01
Promoting commerce, Department of Commerce, 1922	175.18
Promoting commerce, Department of Commerce, 1923	760.60
Promoting commerce, Department of Commerce, 1924	15,506.78
Promoting commerce, South and Central America, 1918	384.71
Promoting commerce, South and Central America, 1919	347.83
Promoting commerce, South and Central America, 1920	148.38
Promoting commerce, South and Central America, 1923	1,559.62
Promoting commerce, South and Central America, 1924	21,034.68
Promoting commerce in the Far East, 1919	7.07
Promoting commerce in the Far East, 1920	263.30
Promoting commerce in the Far East, 1921	74.57
Promoting commerce in the Far East, 1922	1,835.29
Promoting commerce in the Far East, 1923	129.46
Promoting commerce in the Far East, 1924	10,744.53
Raw-material investigations, 1924	12,422.12
Transportation of families and effects of officers and employees, Bureau of Foreign and Domestic Commerce, 1924	1,948.29
Transporting remains of officers and employees, Bureau of Foreign and Domestic Commerce, 1924	1,500.00
Books and publications, Bureau of Mines, 1924	86.83
Care, etc., of buildings and grounds, Bureau of Mines, Pittsburgh, Pa., 1924	64.65
Enforcement of mineral leases, Bureau of Mines, 1924	7,859.32
Expenses, mining experiment stations, Bureau of Mines, 1924	1,357.75
General expenses, Bureau of Mines, 1924	2,400.80
Investigating mine accidents, 1924	3,743.00
Mineral-mining investigations, Bureau of Mines, 1924	3,683.18
Mining investigations in Alaska, Bureau of Mines, 1924	1,311.97
Oil, gas, and oil shale investigations and leasing, Bureau of Mines, 1924	6,236.19
Operating mine rescue cars, Bureau of Mines, 1924	1,592.32
Printing and binding, Bureau of Mines, 1924	.64
Testing fuel, Bureau of Mines, 1924	1,394.83
Salaries, office of Supervising Inspector General, Steamboat Inspection Service, 1924	596.10
Salaries, Steamboat Inspection Service, 1924	3,569.86
Clerk hire, Steamboat Inspection Service, 1924	2,540.67
Contingent expenses, Steamboat Inspection Service, 1921	3.94
Contingent expenses, Steamboat Inspection Service, 1923	1.60
Contingent expenses, Steamboat Inspection Service, 1924	19,522.34
Salaries, Bureau of Navigation, 1924	597.12
Salaries, shipping service, 1924	1,516.27
Clerk hire, shipping service, 1924	593.43
Contingent expenses, shipping service, 1924	207.88
Admeasurement of vessels, 1924	32.00
Preventing overcrowding of passenger vessels, 1924	14.52
Enforcement of navigation laws, 1924	48.81
Enforcement of wireless communication laws, 1924	242.43

Salaries, Patent Office, 1924	$27,214.63
Furniture and filing cases, Patent Office, 1924	16.52
Photolithographing, Patent Office, 1924	10,414.49
Public use of inventions and defending suits, Patent Office, 1924	362.44
Scientific library, Patent Office, 1924	677.74
Salaries, Bureau of Standards, 1923	2.71
Salaries, Bureau of Standards, 1924	10,038.12
Equipment, Bureau of Standards, 1923	50.85
Equipment, Bureau of Standards, 1924	888.12
General expenses, Bureau of Standards, 1924	4,298.72
Improvement and care of grounds, Bureau of Standards, 1924	231.16
Automotive power plants, Bureau of Standards, 1924	250.86
Color standardization, Bureau of Standards, 1924	95.34
Gauge standardization, Bureau of Standards, 1924	3,470.67
High-temperature investigations, Bureau of Standards, 1924	534.42
Industrial research, Bureau of Standards, 1924	3,213.99
Investigation of clay products, Bureau of Standards, 1924	1,735.48
Investigation of fire-resisting properties, Bureau of Standards, 1924	304.51
Investigation of mine scales and cars, Bureau of Standards, 1924	5,949.25
Investigation of optical glass, Bureau of Standards, 1924	117.63
Investigation of public utility standards, Bureau of Standards, 1923	1.00
Investigation of public utility standards, Bureau of Standards, 1924	1,419.26
Investigation of radioactive substances, Bureau of Standards, 1924	97.84
Investigation of textiles, etc., Bureau of Standards, 1924	726.07
Metallurgical research, Bureau of Standards, 1924	101.81
Radio research, Bureau of Standards, 1924	167.55
Replacement of altitude chambers, Bureau of Standards, 1924	670.18
Rope investigation, Bureau of Standards, 1924	271.47
Sound investigation, Bureau of Standards, 1924	127.89
Standardization of equipment, Bureau of Standards, 1923	8.00
Standardization of equipment, Bureau of Standards, 1924	924.14
Standardizing mechanical appliances, Bureau of Standards, 1924	440.66
Standard materials, Bureau of Standards, 1924	654.92
Sugar standardization, Bureau of Standards, 1924	618.19
Testing machines, Bureau of Standards, 1924	260.49
Testing miscellaneous materials, Bureau of Standards, 1924	135.81
Testing railroad scales, etc., Bureau of Standards, 1924	593.60
Testing structural materials, Bureau of Standards, 1923	665.52
Testing structural materials, Bureau of Standards, 1924	9,828.50
Pay and allowances, commissioned officers, Coast and Geodetic Survey, 1922	981.17
Pay and allowances, commissioned officers, Coast and Geodetic Survey, 1923	2,137.20
Pay and allowances, commissioned officers, Coast and Geodetic Survey, 1924	108,857.74
Salaries, Coast and Geodetic Survey, 1924	7,674.93
Party expenses, Coast and Geodetic Survey, 1924	36,723.27
General expenses, Coast and Geodetic Survey, 1924	6,706.63
Pay, etc., of officers and men, vessels, Coast Survey, 1924	28,838.69
Repairs of vessels, Coast Survey, 1924	6,773.04
Salaries, Bureau of Lighthouses, 1924	4,083.59
Retired pay, Lighthouse Service, 1924	499.64
General expenses, Lighthouse Service, 1920	91.95
General expenses, Lighthouse Service, 1922	32.05
General expenses, Lighthouse Service, 1923	134.18
General expenses, Lighthouse Service, 1924	28,624.95
Salaries, keepers of lighthouses, 1924	46,849.54
Salaries, lighthouse vessels, 1924	19,621.07
Salaries, Lighthouse Service, 1924	3,318.91
Light-keepers' dwellings	1,226.87
Repairing and rebuilding aids to navigation, Atlantic coast	536.42
Aids to navigation, Hudson River, N. Y.	942.70
Diamond Shoal Light Vessels, N. C.	3,562.71

Aids to navigation, St. Johns River, Fla	$5.28
Repairing and rebuilding aids to navigation, seventh and eighth lighthouse districts	85.22
Repairing and rebuilding aids to navigation, Gulf of Mexico	642.93
Detroit Lighthouse Depot, Mich	21.88
Spectacle Reef Light Station, Mich	2.17
Salaries, Bureau of Fisheries, 1924	21,795.96
Miscellaneous expenses, Bureau of Fisheries, 1922	6.20
Miscellaneous expenses, Bureau of Fisheries, 1923	7.00
Miscellaneous expenses, Bureau of Fisheries, 1923–24	2,010.16
Miscellaneous expenses, Bureau of Fisheries, 1924	1,097.70
Pay, officers and crew of vessels, Alaska fisheries service, 1924	184.67
Protecting seal and salmon fisheries of Alaska, 1923–24	684.28
Protecting seal and salmon fisheries of Alaska, 1924	2,774.49
Total	811,017.12

In the last nine years the Department of Commerce has turned back unused into the Treasury the following amounts:

June 30, 1918	$149,009.51	June 30, 1924	$1,072,835.58
June 30, 1919	476,045.10	June 30, 1925	1,005,909.02
June 30, 1920	1,149,363.28	June 30, 1926	811,017.12
June 30, 1921	4,042,434.38		
June 30, 1922	546,440.71	Total	9,983,451.97
June 30, 1923	730,397.27		

APPOINTMENT DIVISION

The following table shows by bureau, nature of appointment, and sex, the strength of the personnel of the department at the end of the fiscal year 1926:

Bureau	Permanent		Temporary		Total permanent and temporary		Grand total
	In District of Columbia	In field	In District of Columbia	In field	Male	Female	
Office of the Secretary	117		1		69	49	118
Bureau of the Census	714	775	333	901	1,967	756	2,723
Bureau of Foreign and Domestic Commerce	607	600	19	2	699	529	1,228
Bureau of Standards	709	29	18	7	665	98	763
Bureau of Fisheries	73	344		205	582	40	622
Bureau of Lighthouses	42	5,402	1	183	5,335	293	5,628
Coast and Geodetic Survey	206	691	3	85	953	32	985
Bureau of Navigation	52	172	1	14	183	56	239
Steamboat Inspection Service	15	340			306	49	355
Patent Office	1,186		1		864	323	1,187
Bureau of Mines	252	551	15	162	797	183	980
Total	3,973	8,904	392	1,559	12,420	2,408	14,828

The following table shows the changes in the department's personnel during the last fiscal year:

Bureau	Appointments [1]									
	Permanent						Temporary		Total	
	Competitive		Excepted		Unclassified					
	District of Columbia	Field	District of Columbia	Field	District of Columbia	Field	District of Columbia	Field	District of Columbia	Field
Office of the Secretary	41		2				1		44	
Bureau of the Census	64						374	2,191	438	2,191
Bureau of Foreign and Domestic Commerce	191	50	13	33			35	6	239	89
Bureau of Standards	80	4	2	2	8		38		128	6
Bureau of Fisheries	7	56		14		5	2	32	9	107
Bureau of Lighthouses	3	276		6		1	4	115	7	398
Coast and Geodetic Survey	33	26		3			18	3	51	32
Bureau of Navigation	8	6	1	30			6	21	15	57
Steamboat Inspection Service	4	24					2	10	6	34
Patent Office	165						24		189	
Bureau of Mines	53	72		42	3	1	59	86	115	201
Total	649	514	18	130	11	7	563	2,464	1,241	3,115
Grand total	1,163		148		18		3,027		4,356	

Bureau	Separations [2]									
	From permanent positions						From temporary positions		Total	
	Competitive		Excepted		Unclassified					
	District of Columbia	Field	District of Columbia	Field	District of Columbia	Field	District of Columbia	Field	District of Columbia	Field
Office of the Secretary	45								45	
Bureau of the Census	143				2		1,176	1,334	1,321	1,334
Bureau of Foreign and Domestic Commerce	124	68	1	1	1		66	8	192	77
Bureau of Standards	108	2			1		34	1	143	3
Bureau of Fisheries	3	70		1			3	29	6	100
Bureau of Lighthouses	7	314					2	97	9	411
Coast and Geodetic Survey	20	25				1	39		59	26
Bureau of Navigation	6	16					4	49	10	65
Steamboat Inspection Service	7	23		1			1	5	8	29
Patent Office	202						17		219	
Bureau of Mines	40	98		7			24	73	64	178
Total	705	616	1	10	4	1	1,366	1,596	2,076	2,223
Grand total	1,321		11		5		2,962		4,299	

[1] Includes appointments of the following character: Presidential; by selection from civil-service certificates; under Executive order; to excepted positions; by reason of transfer within the department, or from other departments or independent establishments; and by reinstatement.

[2] Includes separations by reason of resignation, discontinuance, retirement, removal, death, transfer within the department, and transfer from the department to other departments or independent establishments.

Bureau	Other changes						All changes		
	Promotions		Reductions		Miscellaneous changes [1]				
	District of Columbia	Field	District of Columbia	Field	District of Columbia	Field	District of Columbia	Field	Grand total
Office of the Secretary	81				3		173		173
Bureau of the Census	591		3		555		2,908	3,525	6,433
Bureau of Foreign and Domestic Commerce	644	306	8		87	31	1,170	503	1,673
Bureau of Standards	416	2	1		55	6	743	17	760
Bureau of Fisheries	9	294	1	4	6	17	31	522	553
Bureau of Lighthouses	15	1,270	4	116	1	91	36	2,286	2,322
Coast and Geodetic Survey	107	62	2		75	16	294	136	430
Bureau of Navigation	32	13	1		11	31	69	166	235
Steamboat Inspection Service	14	112			2	12	30	187	217
Patent Office	996		46		121		1,571		1,571
Bureau of Mines	127	239	1		38	135	345	753	1,098
Total	3,032	2,298	67	120	954	339	7,370	8,095	15,465

[1] Includes reappointments by reason of change of station, name, designation, extensions of temporary appointments, and temporary promotions and reductions.

The customary annual survey of the leave records of the department's employees in the District of Columbia indicates that the extent of the utilization of the leave privileges continues steadily to decrease. To those who accept as axiomatic the statement that the average Federal employee takes 30 days' annual and 30 days' sick leave each year it may be surprising to learn that during the calendar year 1925 such was done by only 3½ per cent of the department's employees in the District of Columbia.

The following statement shows, by bureaus, the total and average amount of annual and sick leave, stated separately and together, taken by the employees of the department in the District of Columbia, arranged according to sex, during the calendar year 1925:

[NOTE.—In the count of leave all periods of one-half day or over were counted as a whole day; periods of less than one-half day were omitted.]

Bureau	Number of employees	Annual leave		Sick leave		Total leave		Average, 1924
		Days	Average	Days	Average	Days	Average	
MALE								
Office of the Secretary	53	1,372	25.89	220	4.15	1,592	30.04	31.79
Bureau of the Census	275	7,879	28.65	1,655	6.02	9,534	34.67	33.26
Bureau of Foreign and Domestic Commerce	270	7,051	26.11	1,424	5.27	8,475	31.39	30.66
Bureau of Standards	574	15,900	27.70	2,421	4.22	18,321	31.92	31.76
Bureau of Fisheries	47	1,192	25.36	233	4.96	1,425	30.32	29.12
Bureau of Lighthouses	23	673	29.26	180	7.83	853	37.09	36.46
Coast and Geodetic Survey	162	4,495	27.75	704	4.34	5,199	32.09	31.92
Bureau of Navigation	19	486	25.58	50	2.63	536	28.21	28.41
Steamboat Inspection Service	6	103	17.17	48	8.00	151	25.17	32.20
Total and average	1,429	39,151	27.40	6,935	4.85	46,086	32.25	31.89
FEMALE								
Office of the Secretary	36	993	27.58	212	5.89	1,205	33.47	37.54
Bureau of the Census	425	12,471	29.34	3,987	9.38	16,458	38.72	38.83
Bureau of Foreign and Domestic Commerce	225	6,424	28.55	2,438	10.84	8,862	39.39	39.18
Bureau of Standards	78	2,227	28.55	609	7.81	2,836	36.36	36.37
Bureau of Fisheries	22	630	28.64	226	10.27	856	38.91	39.10
Bureau of Lighthouses	9	267	29.67	81	9.00	348	38.67	38.82

Bureau	Number of employees	Annual leave		Sick leave		Total leave		Average, 1924
		Days	Average	Days	Average	Days	Average	
FEMALE—continued								
Coast and Geodetic Survey	22	649	29.50	207	9.41	856	38.91	40.00
Bureau of Navigation	23	664	28.87	167	7.26	831	36.13	35.30
Steamboat Inspection Service	7	199	28.43	47	6.71	246	35.14	37.38
Total and average	847	24,524	28.95	7,974	9.41	32,498	38.37	38.55
TOTAL								
Office of the Secretary	89	2,365	26.57	432	4.85	2,797	31.43	34.05
Bureau of the Census	700	20,350	29.07	5,642	8.06	25,992	37.13	36.58
Bureau of Foreign and Domestic Commerce	495	13,475	27.22	3,862	7.80	17,337	35.02	34.55
Bureau of Standards	652	18,127	27.80	3,030	4.65	21,157	32.45	32.35
Bureau of Fisheries	69	1,822	26.41	459	6.65	2,281	33.06	32.81
Bureau of Lighthouses	32	940	29.38	261	8.16	1,201	37.53	37.20
Coast and Geodetic Survey	184	5,144	27.96	911	4.95	6,055	32.91	32.93
Bureau of Navigation	42	1,150	27.38	217	5.17	1,367	32.55	32.13
Steamboat Inspection Service	13	302	23.23	95	7.31	397	30.54	35.38
Total and average	2,276	63,675	27.98	14,909	6.55	78,584	34.53	34.39

With a view to determining the general trend of conditions pertaining to the personnel under the operation of the classification act and other modified factors, a detailed study was made as to grades, salaries, etc. Interesting developments are deduced from this survey. June 30, 1924, shows conditions under preclassification; July 1, 1924, when classification became effective; January 1, 1926, is the latest date to which the survey has been completed. Between the first two dates salaries for the department as a whole showed an increase of 7 per cent; subsequent to July, 1924, to and including January 1, 1926, the increase had been 2.7 per cent. The distribution of this increase between the District of Columbia force and that of the field service shows for the field corresponding increases of 6.3 per cent and 2.2 per cent; for employees in the District of Columbia, 7.5 per cent and 3 per cent. The average salary of the appointed personnel of the department on January 1, 1926, was $1,906.

During the fiscal year 1926, 81 employees were retired on annuity. Under the general civil service retirement act 21 were retired on an average annuity of $598; under the Lighthouse Service retirement system 32 were retired on account of age, with an average annuity of $880; and 28 by reason of disability, with an average annuity of $923. The total number of retirements under the two systems to date is 518.

The work of the division in connection with the functioning of the civil-service retirement system is an increasing factor. In order to furnish data for a report to Congress by the Board of Actuaries, the Civil Service Commission requested and was furnished detailed statements concerning each employee of the department falling under the classification act, showing the amount of deductions for his or her salary, also individual questionnaires covering 7,300 employees. The modified civil service retirement act of July 3, 1926, by an amendment of the basis for calculating length of service, necessitates much additional work in connection with retirement. The closed retirement cases under the original act must be reopened and readjudicated, resulting in requests on the department for information which can only be furnished by examination of detailed records of leaves of the employees concerned during the period of service. Such records

in many cases have been destroyed and in others can not be located. Hence, the general result of the change will probably be unsatisfactory and not at all compensatory for the labor involved. The work in connection with the 860 applications for refund of contributions in cases of employees who have left the service, and the preparation of abstracts of official records to the number of over 5,000, with several thousand miscellaneous inquiries connected with them, may also be mentioned as a factor in this work.

The duties imposed by the classification act of 1923 are gradually assuming a normal condition. The year's work covered 1,807 reallocations; the receipt of 126 appeals of employees against their allocations, of which 116 have been acted upon by the department and transmitted to the Personnel Classification Board, 93 of which had been reported by the board before the close of the fiscal year.

DIVISION OF PUBLICATIONS

Economy in printing expenditures.—The transfer of the Patent Office and the Bureau of Mines to this department increased its total appropriations for printing and binding, 1926, to $1,849,870, more than one-fifth of the definite appropriations for printing and binding for that year for the entire executive and judicial services of the Government. The Department of Commerce, in harmony with its organic act, renders service through the medium of the printing press. Its activities are fruitful or measurably barren of results in proportion to its appropriations for the printing of its messages to the navigator, the importer and exporter, the manufacturer, and to industry. To meet the constantly increasing demands on it for this service the department, through the centralization of supervision in its division of publications, exercises the most rigid economy in its expenditures for printing and binding.

Summary of expenditures for printing and binding, 1925 and 1926.—The following statement gives for the fiscal years 1925 and 1926 the amounts available to the department for printing and binding, the amounts expended, and the unused balances at the close of each year:

	Fiscal year	
	1925	1926
Services other than the Patent Office and the Bureau of Mines:		
Amount available	$575,000.00	$530,000.00
Expenditures	573,202.03	523,708.99
Unused balance	1,797.97	6,291.01
Patent Office:		
Amount available	975,000.00	1,255,000.00
Expenditures	970,593.61	1,253,598.88
Unused balance	4,406.39	1,401.12
Bureau of Mines:		
Amount available	50,000.00	[1] 64,870.00
Expenditures	49,816.00	63,993.29
Unused balance	184.00	876.71

[1] Includes $17,370 transferred from the appropriation for printing and binding for the Geological Survey.

Expenditures in 1926 and appropriations for 1927.—The following table shows expenditures for printing and binding during the fiscal year 1926 and the allotments made of the appropriation for 1927:

Bureau, office, or service	Expenditures, 1926 [1]	Allotments, 1927
Services other than the Patent Office:		
Office of the Secretary (Secretary, Assistant Secretary, Solicitor, chief clerk, and division of publications)	$18,616.54	$16,500.00
Appointment division	1,890.71	1,000.00
Disbursing office	664.10	1,000.00
Division of supplies	1,868.37	1,500.00
Bureau of the Census	112,401.74	112,000.00
Coast and Geodetic Survey	40,661.68	44,500.00
Bureau of Fisheries	18,277.96	18,270.00
Bureau of Foreign and Domestic Commerce	188,418.40	241,150.00
Bureau of Lighthouses	19,629.26	18,000.00
Lighthouse Service	8,423.68	7,500.00
Bureau of Mines	[3]	66,000.00
Bureau of Navigation	33,366.66	32,000.00
Shipping and Radio Services	5,580.86	9,000.00
Bureau of Standards	48,440.59	56,000.00
Office of the Supervising Inspector General, Steamboat Inspection Service	838.02	1,500.00
Steamboat Inspection Service	14,181.71	15,000.00
Customs Service	10,448.71	9,000.00
Reserve	6,291.01	6,000.00
Total	530,000.00	655,920.00
Patent Office:		
Specifications, Official Gazette, etc	1,185,000.00	977,311.00
Miscellaneous	68,598.88	54,500.00
Reserve	1,401.12	500.00
Total	1,255,000.00	1,032,311.00
Bureau of Mines	63,993.29	[3]
Reserve	876.71	
Total	64,870.00	
Total for department	1,849,870.00	1,688,231.00

[1] Estimated (June 30, 1926); exact figures for 1926 can not be given until all work ordered in that year is completed and billed. Expenditures will approximate the amounts available.
[2] Separate appropriation for 1926.
[3] Included in department's appropriation for 1927.

Sales of publications.—Since the department discontinued, some years ago, the free distribution of its publications, the distribution of its literature on a sales basis has shown a consistent and marked increase annually. Total receipts from sales of the department's publications for the fiscal year 1925 (the latest period for which complete data are available) were $473,591.98, compared with $434,233.29 for 1924. The following table presents the details in comparison for the two years by selling agencies and issuing offices:

Sales	Receipts	
	1924	1925
By the Superintendent of Documents:		
Miscellaneous sales	$70,306.57	$82,476.40
Subscriptions	57,387.40	62,267.01
Total	127,693.97	144,743.41
By Coast and Geodetic Survey: Coast pilots, inside route pilots, tide tables, current tables, and charts	48,800.67	49,850.02
By Patent Office: Specifications of patents, reissues, etc., trade-mark section and decision leaflet of Official Gazette, and classification bulletins and definitions	257,738.65	278,998.55
Grand total	434,233.29	473,591.98

For the fiscal year 1925 the receipts from sales of Government publications by the Superintendent of Documents totaled $487,922.63. Subtracting from this total the receipts from sales by his office of publications of the Department of Commerce, it would appear that publications were sold by the Superintendent of Documents for that period to the extent of $343,179.22 for all Government offices other than the Department of Commerce. It is thus shown that the receipts from sales of printed subject matter emanating from the Department of Commerce ($473,591.98) exceeded the total of such sales by the Superintendent of Documents of all other Government offices combined.

DIVISION OF SUPPLIES

Purchases.—The division of supplies has continued the practice begun in 1923 of maintaining the centralized information pertaining to the department's surplus property, and has acted on all proposals for supplies and materials emanating in its field services in addition to handling such proposals in obtaining clearance through the general supply committee and returning them to the issuing office.

Through the cooperation of the office of the Chief Coordinator of the Bureau of the Budget this office secured without transfer of funds office equipment, clothing, mechanical supplies, etc., valued at approximately $30,000 for different bureaus of the department.

The gross expenditures on the 13,726 purchase orders issued and the freight, travel, and miscellaneous accounts handled by this office amounted to $724,020.50.

During the year 497 typewriting machines were purchased. Deducting a credit of $9,066.50 on exchange of old machines, the total net cost was $24,935.50, or a unit cost of $50.17.

Records of the division show increases approximating 20 per cent in 1926 over the previous year in practically all of the various functions relating to purchases.

Real estate.—The real estate record for the department for the fiscal year 1927, covering leases, is not complete, as a number of leases have not yet been submitted by the bureaus. From the information now at hand it has been determined that there will be an increase of approximately $3,188.05, due to increase of space and increase in rentals, principally in Florida offices, over the fiscal year 1926.

Upon the creation of the Federal Real Estate Board in 1921 the department effected a saving of $20,000 in its expenditures for rental for offices in its field services. Due to the growth of the department's activities and the increase in real estate values, the savings for the current fiscal year over the expenditures for the fiscal year 1922 will be reduced to approximately $5,774.45.

TRAFFIC OFFICE

The work of the traffic manager's office during the past year has been of the usual character since the installation of that system of handling departmental traffic. Its operation continues to result in substantial savings and more prompt and efficient transportation both of personnel and goods.

DEPARTMENT LIBRARY

The year ended June 30, 1926, marked the completion of the twelfth anniversary of the department library. Library work has long been recognized as a science, and the department's library, headed by a capable librarian trained in library science, has kept pace with new and improved methods and daily demonstrates its worth. Since its organization the development has been rapid and the demands have steadily increased until it now ranks as one of the most active Government libraries, and has a collection of books and periodicals on commerce and related subjects that is unsurpassed in Government or other libraries. It is primarily a reference library for the department, but many research workers from other Government departments and persons interested in foreign trade avail themselves of the privileges extended to them.

The functions of the library are to assemble and catalogue all available data relating to the branches of the department to which it gives service; to serve as a central office for locating and filing all printed material bearing upon the work of the department; to catalogue the material so that the pertinent matter may be readily available; to classify and file books and periodicals so that they may be quickly located; to borrow books from the Library of Congress and other libraries and keep a record of borrowers and receipt of their return; to serve as a clearing house and a bureau of information as to sources for research purposes; to anticipate needs for the new activities of the department so that the library will be able to serve efficiently when the occasion arises.

Acquisitions are through several channels, namely, the departments' representatives abroad, the consuls, exchange, purchase, and gift. The library has on file 123,102 books and pamphlets, 6,102 of which were accessions during the year. Books catalogued amounted to 5,302 and 768 books were sent to the bindery. Books discarded numbered 2,710, which made space for new material.

One of the valuable assets of the library is its collection of periodicals, of which 1,611 titles were currently received, recorded, and routed. No record is kept of the amount of reference work done, but year. No record is kept of the amount of reference work done, but that the library has been able to satisfy the many and increasing demands is sufficient proof that it has been efficiently done.

A wealth of material is on file and while it is all catalogued, there are at present an insufficient number of cataloguers to fully analyze the material. This work would enhance the value of the collection and would enable the staff to give more efficient service. An assistant for bibliographical work is also desired.

Another need is for space. Working quarters are cramped and inconveniently located, the stacks are crowded, and reference space wholly inadequate. However, the new building is looked forward to as a solution of this problem.

Adaptability, preparation, enthusiasm, and cooperation are essential to the success of any library staff, and any explanation of the work accomplished would be incomplete without acknowledgment of the service given by the staff which has largely contributed to the development of the library.

WORK OF THE SOLICITOR'S OFFICE

During the fiscal year ended June 30, 1926, 146 contracts, totaling $1,834,642.28, together with 27 contracts of indeterminate amounts; 106 leases amounting to $134,284.46; 29 revocable licenses amounting to $2,663; 4 insurance policies amounting to $563,230; 20 deeds involving the sum of $71,194.99; 104 contract bonds amounting to $836,865.71; 57 official bonds amounting to $501,000 were examined, approved, disapproved, drafted, redrafted, or modified.

The number of legal opinions rendered, formal and informal (memorandum), totaled 133 (a great many verbal opinions, of which no record is kept, were also rendered during the year); legislative matters handled which concern the Department of Commerce (drafting and redrafting of bills, reports relative thereto, etc.) numbered 201. Power-of-attorney cards authorizing agents to execute official and contract bonds for surety companies totaled 3,855. In addition, 10,510 miscellaneous matters, embracing everything submitted for the advice or suggestion of the Solicitor or for the formulation of departmental action, not included in the foregoing items, were handled by this office.

Very truly yours,

E. W. LIBBEY,
Chief Clerk and Superintendent.

BUREAU OF THE CENSUS

DEPARTMENT OF COMMERCE,
BUREAU OF THE CENSUS,
Washington, July 1, 1926.

HON. HERBERT HOOVER,
Secretary of Commerce.

DEAR MR. SECRETARY: I have the honor to submit the following report summarizing the activities of the Bureau of the Census during the fiscal year ended June 30, 1926:

INTRODUCTION AND SUMMARY

During the past few years the activities of the bureau have been greatly extended, and it now collects statistics of value in relation to practically all our social, industrial, and business problems. For some subjects the data are obtained from industrial or business organizations; but the majority of the reports are secured directly from the individual person, business, or enterprise involved. During the year the bureau received reports from or concerning 5,391,452 individuals or enterprises. In addition, more or less tabulation was done on 7,325,563 reports, making a total of 12,717,015 reports handled during the year. The tabulation of the data contained in these reports required the use of electrically-driven machinery and all other known devices for tabulation and computations. The statistics thus collected and tabulated were given to the public in 4,860 mimeographed and printed statements and printed bulletins, with a total edition of 6,799,065. As an incident to its main function of supplying statistics to the public through these published bulletins and reports, the bureau received and answered during the last year 51,870 letters requesting statistical information on a wide variety of subjects.

For business and industry the census reports cover agriculture, manufacturing, forestry, mining, irrigation, drainage, the production and utilization of power, fisheries, and water transportation. The bureau, however, collects no information concerning the number or transactions of establishments engaged in distribution. Distribution is connected directly or indirectly with production, and data concerning it are essential to a complete understanding of business conditions.

The data collected and distributed during the year as shown by the following summary have been of prime importance.

SOCIAL AND VITAL STATISTICS

ESTIMATES OF POPULATION

In connection with the work of the Bureau of the Census it is necessary to make estimates of population as bases for computing rates, such as birth rates, death rates, per capita taxes, per capita governmental receipts and expenses, etc.

The estimate for the United States is based upon births, deaths, immigration, and emigration. In continental United States approximately 2,700,000 births and 1,300,000 deaths occur annually, producing an annual increase in the population of 1,400,000. To this must be added the net increase resulting from immigration and emigration. On July 1, 1926, the population of the United States as thus estimated was 117,136,000.

The bureau also makes estimates for States, cities, and counties; but as there are no statistics concerning interstate or intercity migration, or emigration from rural to urban districts, it is impossible to make these estimates by a method as scientific as that followed in estimating the total population of the United States. The estimates for the States are arrived at by distributing the increase of population for the United States as already determined among the several States in accordance with certain fixed rules. The population of cities and counties is estimated by the so-called arithmetical method, which assumes a constant annual increase equivalent to the average annual increase as shown between the last two preceding censuses. Use is made of State censuses whenever such censuses have been taken. There were eight States which took a census in 1925 and their aggregate population was 22,804,530.

In connection with the estimates it is necessary to keep an up-to-date record of changes in names and boundaries of cities and other political subdivisions of counties, of the incorporation of new municipalities, and of the formation of new counties.

During the year the bureau prepared and distributed estimates of the population for 13,000 political units, including States, cities, and counties. There were approximately 1,200 units in which there was a decrease in the population between 1910 and 1920, and 30 in which there had been such an unusual increase or decrease that satisfactory estimates could not be prepared.

The method of preparing these estimates is now well established, and the results are generally accepted as the best indication of actual conditions that can be made in the absence of an actual enumeration. But in the second half of the decade it becomes increasingly difficult each year to make estimates that are always reliable and above criticism, and the bureau has had complaints from a number of cities which believe that they have a much larger population than the estimate shows. This emphasizes the need for having a census of population taken every fifth year, as I have urged in some of my previous reports.

It is the policy of this bureau to encourage city governments to make actual enumeration of the population, under the supervision of one of the experts of the bureau, and since 1920, 25 cities, with a total population of 1,840,844, have taken a census of this character.

BIRTHS AND DEATHS

Since 1900 the bureau has been endeavoring to have the government of each State adopt and properly enforce a satisfactory registration law. The model law requires each birth to be registered, together with the name, age, nationality, color, and occupation of father and mother. This law also requires each death to be registered, together

with cause of death, and the color, age, sex, occupation, place of residence, and birthplace of decedent. In each State adopting this law the registration of the births and deaths has been systematically tested by experts of the bureau, and when the registration amounted to 90 per cent of the births and deaths the State was admitted to what is known as the registration area. For births this area now comprises 33 States and the District of Columbia, containing a population of approximately 89,021,238, or 76 per cent of the total for continental United States. For deaths the registration area comprises 40 States, 25 cities in other States, and the District of Columbia, the total population included being approximately 104,700,000, or 89 per cent of the total for continental United States. The death registration area includes also the Territory of Hawaii and the Virgin Islands.

The United States is probably the only first-class nation of the world that does not have a complete registration of the births and deaths. We have no national vital statistics, as there remain several States without adequate birth and death registration laws and others without adequate enforcement of such laws. There is no Federal law which provides for the proper registration of births and deaths. This is a function of the State governments, and it is to be regretted that they do not take proper steps to insure the collection of accurate statistics on this important subject. During 1924, the last year for which complete reports have been received in the bureau, there were 1,930,614 births in the birth registration area and 1,173,990 deaths in the death registration area. Therefore actual reports had been made for only approximately 76 per cent of the total births and 89 per cent of the total deaths that occurred in continental United States.

During the year the bureau has been conducting an active campaign in the hope of bringing every State into the registration area before 1930. In this campaign the cooperation has been secured of the Public Health Service, the Children's Bureau, the American Red Cross, the American Public Health Association, the National Tuberculosis Association, the Chamber of Commerce of the United States, important insurance companies, and many others who recognize the importance of statistics on these subjects.

In addition to the compilation of statistics and the publication of the regular annual reports on births, stillbirths, and deaths, the bureau has continued the publication of the weekly health index and of automobile fatalities. These statistics, which are compiled from telegraphic reports received from local registrars, are an index to the infant mortality rate and death rate in the different communities.

The bureau is now preparing a revision of the standard nomenclature of diseases and pathological conditions, injuries, and poisonings for the United States. A standard nomenclature covering these subjects is essential to a proper interpretation of the causes of death reported upon death certificates. Mortality statistics measure not only the ravages of disease but also the fatalities from accidents. There has been a satisfactory decline in the death rate for most forms of accidents; the principal exception to this is the increase in the rate for motor-vehicle fatalities. In order to call attention to this condition the bureau has arranged with city officials to have telegraphic

reports of the automobile fatalities in the principal cities sent to this bureau every week. We have had the hearty cooperation of State, city, and local officials in this work, and it is gradually being extended so as to cover all of the principal centers of population.

During the year the bureau issued 106 mimeographed statements, with a total edition of 348,000, giving summary statistics concerning births, deaths, infant mortality, and automobile fatalities; it also printed two annual reports giving detailed statistics concerning births and deaths for the year 1923.

MARRIAGE AND DIVORCE

Marriage and divorce are social facts of fundamental importance, and statistics regarding them are of great value considered merely as a contribution to our knowledge of social conditions and tendencies. These statistics are now being collected annually, and the bureau has arranged to secure the reports from State governments in 27 States for marriages and in 12 States for divorces; for the other States the statistics are collected from county officials. It is important that all marriages should be adequately and properly registered; it is not proposed, however, that the Census Bureau should take charge of marriage registration; this is a matter which should be left in the hands of the State and local authorities. Nevertheless, regular requests coming from the Federal Government for data regarding marriages and divorces will beyond question tend to promote and improve registration by local authorities, just as the collection of birth and death data has promoted and improved the registration of births and deaths.

The collection of statistics of marriages and divorces for 1925 was begun in January, 1926, and by June 30 the field work was about 80 per cent completed, reports having been received for 916,361 marriages and 153,646 divorces, as compared with a total of 1,178,318 marriages and 170,952 divorces reported for the year 1924. The number of marriages so far reported shows a slight decrease, as compared with the number reported from the same States and counties for 1924, but the number of divorces shows an increase of not quite 3 per cent, or about twice the percentage of increase in the general population of the United States. The statistics published by the bureau show the number of marriages and divorces in each State and a great deal of information that is of prime importance on this subject.

INSTITUTIONS

Under existing law a census of the inmates in governmental and private institutions is taken every tenth year. The last enumeration related to 1923, and on a given date during that year there were 787,484 inmates in all such institutions. The increase in the number committed to these institutions, most of which are supported by Federal, State, or city governments, emphasizes the desirability of collecting the statistics at more frequent intervals. The importance of this was urged by a number of prominent individuals and organizations interested in the improvement of our criminal records, and in response to this appeal you have authorized the annual collection of the data. Final plans for this work have not yet been

formulated, but after a conference with those interested the work is being organized on the theory that the institutions or the State officials charged with their supervision will assemble the information and transmit it to the Census Bureau for consolidation and publication of totals for the United States. The bureau has carried on correspondence and is formulating a questionnaire to be used by institutions and State officials generally throughout the country. At the start the statistics will be confined to State penal institutions and to State institutions for the mentally diseased, feeble-minded, and epileptic.

INDUSTRIAL AND BUSINESS STATISTICS

The bureau now collects and publishes statistics of employment, wages, production, and power for all manufactures each second year, and of stocks, production, consumption, sales, and various other facts concerning the leading key industries annually or at more frequent intervals. The purpose is to show the principal facts regarding all the productive industries of the country. The data are collected largely by correspondence but in part also through the employment of a large field force. During the year ended June 30, 1926, approximately 743,000 reports were received from the 282,954 establishments covered by these statistics, which were published in 134 printed reports and 939 mimeographed statements, making a total of 1,073 publications.

MANUFACTURES

It is probable that there are approximately 800,000 concerns in the United States that should properly be canvassed at a complete census of manufactures. This would include tailor and dressmaker shops, carpenter shops, blacksmith shops, custom gristmills and sawmills, cotton ginneries, machinery and automobile repair shops, etc. The majority of these concerns are very small, and in many cases all the productive work is done by the proprietor, with one or two assistants, but without the use of mechanical power. Such a census could not be taken except by the employment of a large force of enumerators and by personal visits to all or a majority of the factories, shops, and small enterprises to be enumerated. It is needless to say that such a complete enumeration is not contemplated by the act of March 3, 1919, providing for a census of manufactures every second year. In order to cover the entire country at this census it is necessary to limit the enumeration to establishments that, under present conditions, are considered as engaged in manufacturing. This includes practically all factories in which power and machinery are employed. The very small establishments—those that manufactured products valued at less than $5,000 annually—have been excluded. With these limitations there are approximately 210,000 establishments to be enumerated every second year. Many of the manufacturers are dilatory in making their reports, and this causes delay in the tabulation and publication of the statistics. To overcome this it is necessary to secure the cooperation of manufacturers by bringing them to realize the importance of having accurate statistical reports and of making these reports promptly. Industrial organizations, chambers of commerce, and other agencies

that are especially interested in the statistics for certain industries or in all industries in certain communities have been of great assistance in this work.

At the census for 1925, 695 local chambers of commerce and 488 industrial organizations assisted in collecting reports from manufacturers. This cooperation of such organizations in taking a census of manufactures results in more satisfactory statistics and in the establishment, maintenance, and extension of cordial relations between the bureau and business generally. The organizations that have participated in the canvass recognize the importance of statistical information concerning manufacturing industries and are assisting in the presentation of the information in such a way as to appeal to the manufacturers and to impress them with its value. Unfortunately, however, many of the manufacturers do not realize the importance of answering completely and accurately all the census inquiries. A considerable proportion of the reports received at every census are so defective that it has been necessary to carry on an extensive correspondence in order to get them corrected. This correspondence has developed enormously and necessarily delays the tabulation of the returns. It is true that as a result of the adoption of various short cuts and improvements in methods the tabulation is proceeding more rapidly than at previous censuses. But if all the manufacturers would make their returns promptly and would answer all questions on the schedule completely and correctly, the time required for the tabulation would be very greatly reduced. It is hoped, however, that persistence in this method of conducting a census will ultimately react to the benefit of the manufacturers and will at the same time expedite the work of the bureau and reduce the expenditure for field work.

The report of the biennial census of manufactures is an octavo volume of about 1,550 pages, presenting statistics in more or less detail concerning the operations of the establishments engaged in more than 300 manufacturing industries. The statistics for each important industry are printed as a separate report, and these reports, together with other material, are assembled in the volume constituting the final report. Sixty-one reports were printed and issued, each giving detailed statistics for some important industry, and, in addition, 350 mimeographed statements were released for publication, the total edition of these reports and press statements amounting to 962,000.

In addition to the regular biennial census of manufactures, which covers all branches of industry, the bureau collects current data concerning production, and in some cases stocks on hand and distribution, from 64 distinct industries. In this work the bureau received during the year reports from 72,954 establishments. Some of these reports are made monthly, others quarterly, and others semiannually, so that during the year the bureau published 662 separate reports of this character. The tabulation and publication of this vast amount of detailed information necessarily requires a large force of clerks, although a considerable proportion of the data are tabulated by the use of electric machines.

DISTRIBUTION

Many intricate problems arise in connection with the preparation of the reports for the census of manufactures by the large establishments, especially those that are controlled from central administrative offices located at considerable distances from the manufacturing plants. In some instances these administrative offices supervise the conduct of other business enterprises, and it is impossible to classify their office forces so as to make a proper allocation to the manufacturing activities. The establishment of such offices is incident to the development of many industries. Reports for the census of 1925 were obtained from 10,034 central offices which controlled 22,467 plants. The majority of these offices are located in the large cities, and the fact that they administer distribution as well as production and the further fact that many manufacturing concerns sell some part of their output directly to consumers make a separation of production from distribution very difficult if not impossible.

It is probable that there are in the United States over a million independent enterprises engaged in distribution, and many of them distribute their products direct to the consumers. Under these conditions a census of distribution is essential to a proper analysis and understanding of the manufactures data and to a definite knowledge concerning the number and importance of independent enterprises engaged in the two main branches of our industrial and commercial development. I have, therefore, recommended that some preliminary work be done as soon as possible in order to establish the best methods to be followed in a census of distribution and that this work be identified with the census of manufactures.

"SURVEY OF CURRENT BUSINESS"

During the past five years the bureau has issued a monthly publication containing current business statistics. This is called the Survey of Current Business. In the endeavor to cover all representative industrial and business activities, the number of items for which statistics are published in the Survey is constantly being increased. Starting with 200 items, it now contains 1,500, notwithstanding the elimination or combination of many items in order to make room for the most important data. The figures contained in this publication relating to production, stocks, orders, etc., are of great assistance in enabling business men to determine the status of their industry, as well as the condition of the sources of supply and of the consuming markets generally. The bureau has received many congratulatory letters emphasizing the value of this publication in relation to the intelligent planning of business and the determining of a policy to be followed in sales, production, purchases, stocks, credits, financing, etc. The increased activity on the part of both the Government and trade associations in statistical matters has been particularly marked during the past year. This is evidenced by the great demand from all industries for accurate current facts of business conditions.

During the year it has been possible for the bureau to advance the date of the publication of this bulletin and to improve the character of information contained therein. Weekly advance leaflets are issued to furnish the latest figures with the least possible delay. During the year considerable new material has become available. Among this material are statistics concerning paper and wood-pulp production and stocks; common-brick production, stocks, and unfilled orders; Canadian milling statistics; index of ocean charter rates; world ship construction; issuance of real-estate securities; new indexes on construction costs; powdered milk data; registrations of new passenger cars by price groups; acid phosphate production and stocks; plywood data; visible supplies of oats, rye, and barley; prices of naval stores, condensed and evaporated milk, and women's dress goods; cypress lumber data; consumption of butter and cheese; fuel consumption by railroads; book-paper orders; sales of automobile accessories; plate-glass production; purchases and sales of fur; prices and dividends of southern cotton-mill stocks; steel-barrel operations relative to capacity; ingredients consumed in making oleomargarine; coal consumption in coke making; stocks of turpentine and rosin at stills; cold-storage holdings of miscellaneous meats; dividends on New Bedford cotton-mill stocks; steel prices and wages in the Youngstown district; production of track work; cast-iron boiler and radiator production and stocks; electric porcelain and laminated phenolic products shipments; barrel-headings data; cotton-goods production, stocks, and unfilled orders; natural-gas gasoline production; edible gelatine production and stocks; electric-hoist shipments; Grand Rapids furniture data; electric industrial trucks and tractors; methanol refining; and vitreous-china plumbing fixtures.

Although by far the largest part of the items entering into the Survey of Current Business have been taken from reports of other Government departments, of trade associations, or periodicals, in many cases where statistics on an important industry were lacking and no other organization was available to conduct this work it has been necessary for the Bureau of the Census to collect the data directly from the manufacturers. Each such inquiry has been undertaken only at the request of a representative number of firms in the industry concerned, and only upon receipt of their promise to report the data promptly. For all of these inquiries press releases are mailed, immediately upon the completion of the compilation, to the firms supplying the data and to the trade papers. In connection with this publication there were 251 press releases issued during the year, each presenting the current statistics for some important industry or for general business.

COTTON

The collection of statistics concerning the production, consumption, and stocks of cotton and cottonseed is the only branch of business statistics conducted by this bureau for which a permanent field force is maintained. About 775 local special agents are employed throughout the cotton-producing States in the collection of reports fi m 18,262 ginneries and about 8,000 other establishments, including cotton mills, cotton storages, and mills engaged in the crushing of cottonseed and manufacture of products therefrom.

During the year these agents secured and forwarded to the bureau 240,000 reports. In addition, reports were received by mail from the cotton-consuming establishments and warehouses in sections where no agents are employed, making a total of 346,000 individual reports secured relating to cotton and its products. The data contained in these reports were tabulated, and summaries showing the quantity of cotton ginned were published 12 times during the ginning season, each summary giving the number of bales of cotton ginned up to the specified date from the crop of that year. Besides the ginning reports the bureau issued three series of monthly summaries relating to the cotton industry, one giving the amount of cotton consumed, on hand, and imported and exported; another relating to cottonseed and cottonseed products; and a third on the activity in the cotton-spinning industry as indicated by the number of spindles in place and the number of spindle hours. So, in all, the bureau published during the year 48 periodical reports relating to cotton and cottonseed products. In addition to these summaries giving data showing current conditions, the bureau printed and distributed two bulletins on the production and distribution of cotton in the United States, including statistics of cottonseed and products and world statistics of cotton.

Every precaution is taken to verify the statistics reported by the various producing and consuming establishments, and to publish exact information concerning production, stocks, and consumption of this important product.

TOBACCO

Four times during the year the bureau has published the statistics of the quantity of each type of leaf tobacco held by registered dealers and certain classes of manufacturers, together with the quantities held in bonded manufacturing warehouses and in United States bonded warehouses. These quarterly reports have been assembled and printed in a bulletin, which also present certain statistics relative to the tobacco industry which have been compiled from time to time by other bureaus and organizations.

FINANCIAL STATISTICS OF STATE AND CITY GOVERNMENTS

These annual reports provide information in regard to the financial administration of the governments of the States and of cities. They serve as a guide to the officials in planning future operations and in extending or curtailing functions or activities, and enable the public to judge intelligently of the efficiency and economy practiced by the officials. The increase in population is naturally accompanied by an increase in expenditure for the administration of governmental machinery. The census reports permit of a comparison of the expenditures of one city with those of another and of one State with other States. This comparison assists in the solution of certain problems of public finance, and the importance of accurate reports of this character is emphasized by the development of our roads, the establishment of greater facilities for education, sanitation, etc. It would appear that these statistics are of such vital importance to the State and city governments that these governments would arrange to furnish them directly to the Bureau

of the Census for tabulation and presentation for the country as a whole. During the past five years the bureau has been endeavoring to have the local governments make arrangements of this character, but thus far it has been found necessary to send a representative of the bureau to the majority of the States and cities for the purpose of assembling the statistics. The expenditure for the collection of the statistics has been so great that the work has not been extended so as to cover the smaller cities, those having a population of less than 30,000. However, it is hoped that it will soon be possible to extend the work so that we can collect annually the statistics for all governmental activities throughout the United States, and thus present statistics which will be conclusive as to receipts and expenditures for governmental work. With this end in view the National Association of State Auditors, Comptrollers, and Treasurers, representing the State governments, and the National Association of Comptrollers and Accounting Officers, representing the city governments, have arranged to cooperate with the bureau in its efforts to assemble the statistics which are considered of such great importance. At its convention in 1925 the State association adopted the following resolution:

> We believe that the system of accounting, classification, and reporting of the various States and their subdivisions can be made more satisfactorily uniform and beneficial to all concerned, and favor the cooperation of the association with the Bureau of the Census with that end in view.

Each of these associations has appointed a committee of three members to cooperate with the Bureau of the Census in perfecting their schedules and in arranging for the compilation of the essential statistics by the various governmental agencies.

Statistics of this character have been collected by the Bureau of the Census for the past 23 years, and I am glad to be able to report that it was possible for the bureau to make more satisfactory progress in the collection of the statistics for 1925 than has been accomplished for any preceding year. By June 30, 1926, reports had been received from more than two-thirds of the State and city governments. Preliminary statistics had been made public for 28 States and for 155 of the 247 cities having over 30,000 population, and the bureau had made good progress in the preparation of the copy for the printed bulletins and final reports.

The bureau publishes annually mimeographed statements or press summaries, one for each city and each State, giving the summary figures for 247 cities and 48 States, and also two mimeographed statements summarizing the statistics for all States and cities, the total edition of these statements being 433,000. It also prints two preliminary bulletins covering the financial transactions of the governments of the States and cities, and two final reports, octavo size, one presenting in detail the statistics of the financial transactions of the State governments and the other the financial statistics of the cities having over 30,000 population.

CENSUS OF AGRICULTURE, 1925

An additional appropriation of $230,000 was made to enable the bureau to complete the tabulation of the statistics for the census of agriculture of 1925. This makes a total appropriation of $3,730,000

for this work. In addition, a considerable number of the regular employees of the bureau have necessarily been detailed to work on the census of agriculture. On July 1, 1925, there were 1,122 persons (including 561 piece-price punch-machine operators) engaged on this work, and on July 1, 1926, this number had been reduced to 227 clerks. During this time 57,562,216 cards were punched, making a total of 96,387,410 cards punched for the census of agriculture. The summarization of these statistics so as to show the totals for the principal facts in regard to agriculture in the 3,069 counties of the United States made it necessary to pass many of these cards more than once through the various electrical machines. The sorting of these 96,000,000 cards and their tabulation represented the passing of 391,619,539 cards through one machine once. Press announcements giving certain agricultural statistics for counties and States and for the United States have been issued, the total number of these statements amounting to 3,139, with a total edition of 2,168,000.

At the request of the United States Department of Agriculture and the departments of agriculture and colleges in various States, the bureau has prepared special tabulations giving further detailed statistics of agriculture for counties and States and for political subdivisions within the counties concerning the acreage and value of land in farms, livestock, acreage, and production of certain agricultural products, character of ownership of farms, indebtedness, farm population, etc. All of these tabulations have been used in the preparation of special studies to show agricultural conditions in various sections of the country. So great is the demand for information on this subject that a large proportion of these special tabulations have been made at the expense of the United States Department of Agriculture and of the various State bureaus and colleges. In fact, the Bureau of the Census has received from the States approximately $6,400 in payment for special tabulations that appeared to be necessary in order to present the statistics in the most instructive manner. In all, 203 special tabulations and compilations of agricultural data were made by the bureau, 165 of which were for branches of the Federal Government and 38 for organizations and individuals not associated with the Government.

Numerous conferences were held during the year with representatives of the United States Department of Agriculture and of State departments of agriculture with a view to determining what tabulations of the data would have the greatest value. The critical examination of the reports made by the farmers developed some inconsistencies, and it was necessary in some cases to carry on correspondence with the farmers in order to correct apparent defects and put the schedules in shape for tabulation. The statistics covering all the principal facts reported on the schedule adopted for this census are now being included in printed bulletins for each State, these bulletins giving the details for the agricultural activities of each county. By the close of the year such bulletins had been printed and distributed for 12 States. The work of compiling the statistics for the other States is well advanced, and it is believed that bulletins for the remaining States will be printed and distributed by the close of the present calendar year.

RELIGIOUS BODIES

The law provides that there shall be a census of religious bodies every tenth year. The last census covered the year 1916, but it was found necessary for various reasons to delay the completion of the enumeration and the tabulation, so that the final report for 1916 was not printed until 1919.

The preliminary work for this census involves conferences with representatives of the different religious organizations. A number of such conferences were held during the fall of 1925 and resulted in the establishment of a form of schedule to be used and also in perfecting arrangements with the different denominations to furnish lists of the names and addresses of the various church organizations from which reports must be secured. In order to perfect the lists required for this census it is necessary to compare the names and addresses for 1926 with those for 1916. This work involves the preparation of index cards for approximately 240,000 church organizations throughout the country. The work for the 1926 census was well advanced by July 1, approximately 150,000 index cards having been prepared by that date. The schedule to be used in taking the census has been printed, and by the close of the fiscal year arrangements had been made to mail this schedule to the churches for a number of the organizations. The statistical reports cover the operations of each religious organization for the fiscal year closing during the calendar year 1926. It is hoped that by the application of the methods adopted for this census it will be possible to compile the statistics and publish the report before the close of the calendar year 1927.

BUILDING AND LOAN ASSOCIATIONS

The act of Congress of June 7, 1906, authorized the Director of the Census to collect statistics of the operations of building and loan associations. The majority of the State governments collect and publish statistics concerning building and loan associations, and in view of this it did not seem necessary for the Federal Government to compile statistics on the subject. However, at the urgent request of the United States League of Local Building and Loan Associations, the American Savings, Building, and Loan Institute, and various State leagues, and upon the assurance of these organizations that the building and loan associations throughout the country desired to have the statistics assembled for the United States as a whole and would cooperate with the bureau to the extent of furnishing reports by mail, thus obviating the necessity for the Federal Government to assign agents for the collection of the data, the bureau held conferences with representatives of the organizations named and a form of schedule was agreed upon for use in collecting the data for the fiscal year 1925. This schedule was mailed to approximately 12,000 local building and loan associations, together with a letter calling attention to the fact that the statistics were being collected in compliance with the urgent request of the two organizations referred to and asking that the reports be mailed promptly so that the data could be tabulated and published in time to be of service. On July 1, 1926, reports had been received from only a little more than one-third of

the local associations, and the United States League has been notified that if reports are not received from a representative number of these associations no effort would be made to compile the statistics for the industry. However, in the event that practically all of the associations canvassed furnish the information called for by the census schedule, the data will be tabulated and presented in a form to show the extent of the building and loan operations throughout the United States.

WATER TRANSPORTATION

The law authorizes the Director of the Census to collect statistics relating to water transportation every tenth year. Since the publication of the report for 1916 the Board of Engineers for Rivers and Harbors of the War Department has gradually extended the collection of annual statistics concerning the tonnage of the different kinds of freight received in and shipped from the various ports and harbors and carried on the numerous rivers, canals, and other waterways of the United States. Statistics of somewhat similar character relating to our foreign trade are also collected each year by the Shipping Board; and the Bureau of Navigation, of the Department of Commerce, secures annual reports for each steam, sail, or motor vessel, and for each documented unrigged vessel, of 5 net tons or over, showing character of ownership, class, occupation, tonnage, construction, horsepower of engines, etc.

The reports of these bureaus therefore cover the majority of the items required for a census of water transportation for all vessels except undocumented unrigged barges and other craft. In view of this situation it was decided that it would not be expedient to follow the practice of prior censuses and collect independent census reports for each vessel, but rather to assemble the information contained in the reports made to the Board of Engineers for Rivers and Harbors, the Shipping Board, and the Bureau of Navigation.

Conferences were accordingly held with representatives of these offices and with those of other bureaus as well as with representatives of the National Rivers and Harbors Congress. Plans have been made to assemble the statistics required for census purposes, so far as they are collected by these other agencies, and to secure census reports directly from the operators for craft not covered by the reports of any other governmental agency. It is believed that by this method we shall avoid securing duplicate reports and eliminate a great deal of duplication in the compilation of statistics which would have been incidental to the work had the Bureau of the Census followed the methods used at prior censuses.

COOPERATION IN STATISTICAL WORK

The necessity for cooperation not only among the statistical offices of the Federal Government but also among those of the State and city governments and private organizations was referred to in my annual report for 1925. The methods followed in securing this cooperation have been continued and extended. Arrangements for cooperation are now being carried on between practically all Federal statistical offices. There were 1,183 chambers of commerce, boards of

trade, and industrial organizations that cooperated in taking the census of manufactures of 1925.

The Bureau of the Census is endeavoring to furnish statistics and information from its voluminous records to all branches of the Government. It is being constantly appealed to by city and State organizations for analyses of the population of urban and rural districts that assist in the establishment of legal requirements that are essential to the development of the different communities. During the year special tabulations were made for a number of cities as well as for individuals and organizations interested in social and industrial conditions; and in many instances these tabulations were so extensive that it was necessary for the bureau to be compensated for their preparation, the amount paid being expended by the bureau for the employment of experienced clerks to do the work required by the governments or private enterprises. During the year the bureau received approximately $12,300 in payment for these special tabulations.

It is not necessary to cite the various instances in which the State and city governments and private institutions cooperate with the Bureau of the Census in the compilation of statistics; all that is necessary appears to be the assurance that in every branch of activity in which statistical facts are required the Bureau of the Census is in a position to compile them, and as far as possible will do so, provided, of course, that the data are available, or, if they are not available, that the organizations desiring the statistics will cooperate with the bureau in their collection.

CENSUS RECORDS

The Bureau of the Census has a nearly complete record, the only one in existence, of the names and addresses of all persons, or, prior to 1850, of all heads of families, enumerated at each census of population from 1790 to 1920, inclusive. Unfortunately, the records for some of the censuses, notably for 1890, have either been lost in part or partially destroyed by fire, and are therefore not complete. The names of the heads of families enumerated at the census of 1790 have been printed and bound in separate volumes for each State for which the original records have been preserved. These State volumes have been sold for $1 each.

During the year the bureau has, as usual, received numerous requests for specific information contained in the census records, to be used for genealogical purposes and in the settlement of estates or as evidence in criminal prosecution. In compliance with these requests the bureau made, or assisted in making, 6,751 searches of census volumes to obtain the information desired. The records for all of the censuses up to and including 1870 are open for general inspection, and during the year 2,216 persons were permitted to search these records. However, the bureau has established a regulation that the individual reports for the censuses of 1880 to 1920, inclusive, will not be open for general inspection. This rule was adopted because under the census law and regulations the information contained in the census records was furnished on the understanding that it would be treated as confidential.

TABULATING MACHINERY

The correct tabulation of census data, especially those concerning the population, depends upon the perfection of the necessary machinery and electrical devices. The increase in the population, with the corresponding increase in the amount of detail desired, has made it necessary to increase the capacity of the machinery in order to complete the tabulations and publish the data in time to be of current value. Various improvements have been made in these machines which, we believe, will greatly advance the date of completion of the tabulation of returns for the next decennial census to be taken in 1930.

At the close of the year there were in the bureau, owned by the Government, 26 sorting machines and 34 tabulating machines. Each of these sorting machines was capable of sorting 125,000 cards per day and each tabulating machine capable of tabulating 168,000 cards per day, each card presenting numerous statistical facts. Most of the machines are in active use for sorting and tabulating the cards required for the annual reports on births and deaths and the cards required to tabulate the current statistics of production, consumption, and stocks, and various other facts.

By a special arrangement the Bureau of the Census has loaned the State of New York 130 pantograph and 8 hand-gang punching machines to punch the cards required for the State census of population of 1925. These cards are being punched in Albany at the expense of the State. They are then shipped to the bureau in Washington, where they pass through the electrically driven sorting and tabulating machines, the results being given the State for publication. The expense incident to this work is being met by the State of New York.

In addition to the electrically driven sorting and tabulating machines, the bureau has in active use 152 adding machines; 99 calculating machines; 411 typewriters; 6 mimeograph, 3 multigraph, and 4 addressograph machines; and also 527 gang punches, long and short card key punches, and long and short card verifiers. All of this equipment is in use, but it is being gradually extended so as to meet the requirements of the next decennial census.

NATIONAL SESQUICENTENNIAL EXPOSITION

For exhibition at the National Sesquicentennial Exposition in Philadelphia the bureau prepared a large comprehensive electrical statistical map showing the net growth in the population of the United States every 20 seconds, due to the excess of births over deaths and the excess of immigration over emigration. In addition, 19 large wall charts were prepared, graphically depicting census statistics concerning population and industry.

OFFICE AND FIELD FORCE

The office force at the close of June 30, 1926, comprised 694 officials, clerks, etc., 18 experts and assistants in the mechanical laboratory, 6 special agents, and 267 temporary employees engaged on the work of the censuses of agriculture, of manufactures, and of religious bodies. The average number of persons employed in the office in Washington during the entire year was 1,091 as compared with 1,187 for the fiscal year 1925.

The field force at the close of June 30, 1926, numbered 1,676, and comprised 723 special agents employed throughout the Cotton Belt to collect data for cotton reports showing the quantity of cotton ginned to specified dates, cotton consumed and stocks held, bale weights, etc., and 953 temporary local special agents employed in taking the census of manufactures for 1925, and in collecting various other data required in connection with the investigations that were in progress. Of the 953 temporary special agents, 500, mostly persons connected with chambers of commerce, were paid $1 per annum, and 91, employees of other Government departments, served without compensation. The average number of employees in the field class for the fiscal year 1926 was 897 as compared with 3,051 for 1925.

The turnover in the number of temporary employees in the bureau is very great; this is due to the numerous investigations that are made and to the fact that for many of these investigations the persons are employed for only a short time.

Very truly yours,

W. M. STEUART,
Director of the Census.

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BUREAU OF FOREIGN AND DOMESTIC COMMERCE

DEPARTMENT OF COMMERCE,
BUREAU OF FOREIGN AND DOMESTIC COMMERCE,
Washington, July 1, 1926.

Hon. HERBERT HOOVER,
Secretary of Commerce.

DEAR MR. SECRETARY: In response to your request, I furnish the following condensed report upon the work of the bureau during the fiscal year ended June 30, 1926.

The past year has been particularly notable, in the history of our organization, by reason of the unprecedented volume of its concrete dollars-and-cents contributions to the advancement of American commerce. Never before has there been such ample evidence that the bureau is effectively carrying out its fundamental purpose—that of actually bringing business, in most substantial amounts, to the factories, farms, mines, and trading houses of the United States. Merely theoretical considerations in economics or foreign trade are playing a minor and steadily decreasing rôle in its manifold activities. In the minds of the thousands of business men who are coming to rely more and more upon its services, "the bureau" means orders, new connections, exact knowledge, material savings, and ready and vigorous help in time of emergency.

The factor of "savings," to which reference has just been made, has formed a conspicuous element of the bureau's service and is one that will be developed and worked out along many lines, to the end that costly and wasteful practices in trading operations may be done away with so far as possible. The thought and effort of bureau officials and field representatives have been devoted to this problem, to an increasing degree, during the year just ended; special methods have been devised and new plans have been formulated.

There has been greater activity also in the field of domestic commerce, enabling the bureau to justify, more truly, the second part of its title and causing the local retailer or the chain-store executive to feel that governmental information and guidance are available for him, as well as for the great export organization.

The report that is presented in the succeeding pages has been so arranged as to emphasize the points here mentioned. Following a review of recent American trade developments—during the period in which the bureau's services have expanded so rapidly—there is a discussion of the bureau's part in the campaign for the elimination of waste, and this, in turn, is followed by an account of the most noteworthy concrete achievements of the year, particularly by the field offices in the United States and abroad.

AMERICAN TRADE DEVELOPMENT—AID AFFORDED BY BUREAU

The activities and future plans of the Bureau of Foreign and Domestic Commerce are intimately linked with the growth of the foreign trade of the United States, and for this reason it seems desirable to give, in these first few pages, an outline of the developments in our oversea commerce during recent years—with special reference to the salient gains and advances, which, it is believed, the bureau has furthered in no insubstantial way.

It is worthy of note that, in the period between the fiscal years 1922 and 1926, a growth of approximately $1,000,000,000 in the sale of American merchandise abroad has been concomitant with an increase from 505,000 to 2,032,000 in the number of trade-promotive services rendered by this bureau. Direct and unremitting governmental aid for foreign trade, afforded through the many bureau agencies, may fairly be regarded as accounting for an appreciable part of the success that has been attained. The continuance and enlargement of this active service to American export interests will unquestionably be a vital factor in the maintenance of this country's position in world markets, which, as the ensuing discussion will disclose, is a predominantly favorable and satisfactory one.

The conditions of business in the United States and in the world as a whole have now become sufficiently stabilized after the terrific shock of the World War to lend significance to a brief review of the postwar trend of our foreign trade. Until recently it has been impossible to judge whether the changes taking place were merely accidental and temporary or whether they were reflecting a general trend which might be expected to continue. It is now clear that the growth of our foreign trade from the low point of postwar depression in 1921-22 has been of a normal character and due to causes which bid fair to continue.

The retrospect and the prospect are altogether encouraging. When the war closed it was freely prophesied both at home and abroad that peace would be followed by such recovery of European competition in world markets that our exports, particularly of manufactured goods, would fall off heavily. The experience of the past five years has belied these forecasts. Our export of manufactures has increased by leaps and bounds and is far greater than it was before the war. Of course, it was not to be expected that the abnormally great volume of our foreign sales attained during the closing years of the war and for a short time thereafter would continue undiminished. That volume had been largely the result of huge credits granted by our Government and our citizens, of the desperate needs of an impoverished Europe for food, raw materials, and the wherewithal to rehabilitate its disorganized industry, and of the inability of Europe to supply anything like its normal share of the goods demanded by other continents.

This feverish activity in our trade was followed by a short period of severe depression resulting chiefly from the low buying power, not only of Europe but of most other foreign countries. The bottom was reached in the fiscal year 1921–22. Even then, however, our exports remained greater than before the war after allowing for differences in price levels, and the same was true of our imports.

Year by year since this bottom point, our exports of most classes of goods have rapidly increased. Total exports of all articles combined have gained in every fiscal year except the one just closed and this exception was due to accidental and temporary causes affecting a few major crude products, notably the abnormally small wheat crop of 1925 and the decline in the price of cotton.

But those commodities whose exportation is most dependent on the efficiency of American industry and the energy and intelligence of American salesmanship—namely, finished manufactures—have shown an absolutely unbroken and altogether remarkable growth. Exports of this class of goods in 1925–26 were no less than 60 per cent greater in value than in 1921–22. There had been, if anything, a fall in average export prices, so the quantitative gain was equal or greater. Our exports of finished manufactures in terms of money value were nearly three times as great as the annual average in the five-year period preceding the World War. Even after allowing for higher price levels they were more than double. Exports of manufactures have been steadily stimulated by the commodity divisions of this bureau, which, through personal contacts, correspondence, and committee activities, are always in touch with the various American industries.

CHANGES IN TOTAL TRADE SINCE 1921–22

Our aggregate exports for 1925–26 were valued at $4,754,000,000, as compared with $3,771,000,000 in 1921–22 and an average of $2,166,000,000 for the pre-war years 1910–1914. The increase over 1921–22 was thus 26 per cent, and no part of this was due to the advance in prices. After allowing for the diminished buying power of the dollar, the increase over pre-war was in the neighborhood of 35 per cent. Our imports have gained even more. They amounted in 1925–26 to $4,654,000,000, a figure somewhat swollen by the excessive price of rubber. This total was 71 per cent more than four years before, and over two and a half times as much as the average for the period of 1910–1914. Adjusted for the change in the price level, the imports of last year were 65 or 70 per cent greater than before the war. As already stated, special causes checked the growth of our exports and inflated the value of our imports in 1925–26, and for most recent years much less difference appears as between exports and imports in the percentage of increase above pre-war figures.

Notwithstanding the fact that the United States has shifted during the past decade from a debtor to the world's greatest creditor Nation, toward which imports tend to flow in payment of interest on a vast volume of foreign investments, our exports have continued to exceed our imports by a large margin. That the margin in 1925–26 ($287,000,000), as in 1922–23, was comparatively narrow was due chiefly to the temporary causes just mentioned. On the average, for the five years 1921–22 to 1925–26, the so-called favorable balance in our trade was $685,000,000, exports exceeding imports by 18.8 per cent. It is worthy of note in passing that the excess of exports tends to be lower when business in the United States is exceptionally active than when it is depressed. This is due to the fact that in times of high prosperity imports are stimu-

lated by the demand for unusually large quantities of foreign foodstuffs for our tables and for other luxuries as well as raw materials for our factories. Then, too, prosperity in home markets lures many exporters from their oversea business because of the relatively quicker turnover in domestic sales of certain lines.

The continuance of a favorable balance of trade is chiefly due to the fact that we are constantly sending abroad huge sums for new investments. Were it not for such new placements of capital our trade would approximately balance, or there might even be normally an excess of imports. It is true that out of the proceeds of our merchandise exports we have to pay large sums for the remittances of immigrants to friends and relatives abroad and for the expenses of our hundreds of thousands of tourists. These items, however, are approximately offset by the inflow of interest and dividends from the investments already made abroad.

On the average during the last three years our new investments in foreign countries have been nearly $900,000,000 annually. It is estimated that, apart from the obligations of the allied governments to our own Government, the investments of Americans in foreign countries now total over $11,000,000,000 as compared with $2,500,000,000 just before the outbreak of the World War. So long as we continue each year to send vast sums of capital to foreign countries we can maintain an excess of exports. But it is obvious that each new investment tends to increase the income from interest and dividends and thus to diminish the need of paying for our required imports by means of shipment of commodities. It should be equally obvious that an excess of imports over exports is by no means necessarily an injury to a country. It means merely that part of the goods it requires from other lands come to it in payment for services rendered abroad by its capital, shipping lines, etc.

THE STATUS OF AGRICULTURAL EXPORTS

Agricultural products make up practically the whole of the foodstuffs and much the greater part of the raw materials which we export. Cotton normally represents about one-fifth of the total value of all our exports and more than two-thirds of the total value of the class of crude materials. The value of our foreign sales of agricultural products shows much greater variation from year to year than that of forest, mineral, and manufactured products. This results naturally from variations in our own crops and in those of importing and of competing export countries, as well as from the often sharp changes in prices.

Without attempting to trace the ups and downs of our agricultural exports during recent years, it is sufficient to point out that on the average they have materially exceeded the pre-war volume. In the fiscal year 1925–26 they amounted to $1,892,000,000 as compared with an average of $1,038,000,000 from 1910 to 1914. For the calendar years 1921 to 1925, after allowing for change in prices, the exports of agricultural products were about 23 per cent greater than from 1910 to 1914.

On the whole, no general upward or downward tendency is manifest since the close of the war in aggregate agricultural exports.

There is apparently a downward trend in foodstuffs, but this has been counterbalanced by the recovery in our exports of cotton, which, however, are still slightly below the pre-war level. No significant conclusion can be drawn from the fact that our export of crude foodstuffs in the fiscal year 1925–26 was much below the average for the past five years; it resulted simply from the abnormally unfavorable yield of our wheat and rye crops.

THE EXPORT OF MANUFACTURED GOODS

In contrast with agricultural products the export of manufactured goods, particularly those of finished character, is subject to no sharp fluctuations from year to year, and the upward trend is notably marked. The class of semimanufactures (products subjected only to simple transformation and requiring further processes of manufacture) is dominated by the metals copper, lead, zinc, and cruder forms of iron and steel. Copper is by far the largest item. Because, in contrast with most other commodities, copper during recent years has not been higher in price than before the war, this group shows less gain in value as compared with pre-war years than most others. Nevertheless, the exports of semimanufactures in 1925–26, amounting to $635,000,000, exceeded those before the war by 86 per cent, and those of 1921–22 by 54 per cent.

Except when at rare intervals some wholly abnormal event at home or abroad intervenes, sudden variations in world trade in finished manufactures are unlikely. Production of manufactured goods, unlike that of agricultural products, is in great measure subject to human control. A country with a large manufacturing industry is nearly always in a position to meet the demands of foreign consumers. At the same time those demands under normal conditions show no sharp ups and downs. No startling outburst of factory production in importing or competing countries is, in the nature of things, to be expected. Moreover, the natural tendency of exports of manufactures is to grow. Everywhere and at all times the normal tendency is for standards of living to rise. This advance expresses itself much more in greater demand for elaborated articles than in greater demand for the bare necessaries of life. Each experience with the satisfaction derived from some new commodity awakens the desire for others.

While it was thus to be anticipated that American exports of manufactured commodities would show a steady growth, the extraordinary increase as compared with pre-war, or as compared with 1921–22, is a striking commentary on the ever-rising efficiency of American industry and its readiness to follow up and take advantage of foreign trade prospects. Assistance rendered by the Bureau of Foreign and Domestic Commerce in bringing such prospects to the attention of industry has been an important factor in this trade expansion. The total exports of finished manufactures averaged $654,000,000 annually before the war; in 1921–22 they were $1,211,000,000 and in 1925–26 no less than $1,937,000,000. Among the 40 or 50 major articles of this group, only 4 were exported in smaller values in 1925–26 than in 1921–22. In the case of three of these the larger exports in 1921–22 were due either to Government sales of

surplus war supplies or to Europe's pressing need for immediate rehabilitation of her railroads and of the textile industry.

Exports of many major classes of manufactures were from two to nine times as great in the last fiscal year as only four years before. Sales of agricultural machinery gained no less than 343 per cent and the item of tractors more than 800 per cent. Foreign shipments of automobiles, parts, and accessories were more than four times as great last year as in 1921–22, and the gain for motor trucks was over 600 per cent. Shipments of cash registers, adding and calculating machines, and related instruments nearly quadrupled, and those of construction and conveying machinery trebled. American leadership in most classes of machinery, vehicles, and labor-saving devices is strikingly illustrated by the figures. Remarkable as well has been the growth in exports of the advanced manufactures of iron and steel such as cutlery, tools, and hardware; of rubber goods and athletic and sporting goods; and even of such European specialties as chemical products, toys, and musical instruments.

We have every reason to anticipate that the future also will witness steady increase in American exports of manufactured commodities. As population grows and industry develops, manufactures naturally tend to become a larger and larger share of total exports. It is, to be sure, highly desirable that this country should continue to be self-sufficing in the supply of basic foodstuffs and raw materials. It is better that it should be in a position to export these than to be forced to seek them abroad. Nevertheless it is both to be expected and to be desired that our foreign sales of finished manufactures should increase in relative importance. Our people must pay for an ever larger quantity of raw material and luxury imports, and for such increasing "invisible" debit items as tourist expenditures and immigrant remittances. We should meet these payments with those goods which we can produce most efficiently, relatively most cheaply. American inventive ingenuity, well-paid and highly skilled American labor, and mass production sustained by a vast domestic market make this country peculiarly fitted for successful exporting of nearly all classes of manufactured goods. The only important exception is articles in which hand labor predominates and where superior mechanical equipment or executive organization count for little.

CHANGES IN OUR IMPORT TRADE

The changes in the economic character of our import trade are correlative with those in our export trade. With the growth of our exports of manufactures has gone a great increase in our imports of raw materials. Imports of this class in 1925–26 were swollen somewhat abnormally by the exorbitant advance in the price of rubber, which advance alone accounted for over $300,000,000 of the increase over the preceding year. As it was, the value of imports of crude materials in the last fiscal year, $1,906,000,000, was nearly four times as great as the average before the war, and considerably more than double the 1921–22 figure of $927,000,000. Even had there been no change in prices the increase would have been enormous. Raw materials made up 34 per cent of our total imports before the war.

On the average during the past five years the proportion has been about 37 per cent, and in 1925–26 it was nearly 43 per cent.

Our imports of foodstuffs, totaling $931,000,000 in 1925–26, have shown a gradual upward tendency, though the values are affected considerably from year to year by changes in prices, especially of sugar and coffee, the two major items. It is noteworthy, however, that this country is in no sense becoming more dependent than formerly on the outside world for its basic food supplies. Its imports of foodstuffs are tropical and other exotic commodities—not those which we ourselves formerly listed among our exports. It is only because of our very high standards of living that our imports of foodstuffs are so large. Imports of finished manufactures are increasing gradually, but much less than those of crude materials and far less than our exports of manufactures. The value of this class of imports last year was $835,000,000 as against $389,000,000 on the average from 1910 to 1914. The manufactured goods which we import are largely either things made by low-paid labor, or specialties of certain foreign countries.

GROWTH OF TRADE BY CONTINENTS

The fact that expansion of exports is most conspicuous in manufactured commodities brings it about that our gains are most marked in those foreign markets which are chiefly importers of that class of goods. Among the great trade regions of the world, those where the growth of our export trade, as compared with pre-war, has been most striking are Latin America, Asia, Oceania, and Africa. Manufactured goods predominate in our shipments to these areas. Our exports to Europe in 1925–26 amounted to $2,334,000,000, or 73 per cent greater than on the average just before the World War. Our exports to the rest of the world were 197 per cent greater; they had increased from $780,000,000 to $2,320,000,000. To the Latin countries of North America—especially Cuba and Mexico—the gain was 153 per cent, to South America 247 per cent, to Asia 344 per cent, to Oceania 322 per cent, and to Africa 281 per cent. These are altogther extraordinary figures even when allowance is made for the considerable advance in prices. It should be noted that the price level of manufactured goods exported from the United States has advanced less than that of foodstuffs and raw materials, and that consequently the increase in the value of our exports to these regions exaggerates the true gain less than in the case of exports to Europe.

With the sole exception of Asia the increase in our exports to the trade regions just mentioned has likewise been very rapid during the period from 1921–22 to 1925–26. In this short interval our sales to South America and Oceania much more than doubled, those to Africa increased by 80 per cent, and those to the Latin countries of North America by more than one-third. The fact that this latter gain is the least marked is due to two causes. We have long enjoyed the great bulk of the trade of our two leading southern neighbors, Cuba and Mexico, and consequently no considerable increase in our share of their imports was to be expected. In the second place, the low price of sugar in 1925–26 reduced the buying power of Cuba and the

diminished output of petroleum in Mexico, together with internal difficulties, checked the growth of trade with that country. Our trade with Canada shows a steady and healthy growth, but here again such rapid expansion as in South America, Oceania, and Africa is hardly to be expected.

The relatively stationary position of our exports to Asia during the last few years is due to conditions in China and Japan, the two most important markets. Our sales to the other countries of the Asiatic Far East show remarkable gains. There are several factors operating against expansion of our trade with China and Japan. The disturbed political situation in China has its effect. Japan is rapidly developing its own industries and supplying itself with the more essential manufactured commodities. The people of that country and of China are of relatively low per capita purchasing power and can not afford in large volume the highly advanced products which are so characteristic of American exports. Moreover, there is a distinct policy on the part of the Japanese Government to check the importation of luxuries and semiluxuries. Our competitors in Europe, which as the result of the war had lost most of their trade with these oriental countries, are naturally gaining ground again.

American exports to Europe, since they consist very largely of foodstuffs and raw materials, are subject to the sharp fluctuations both in quantities and prices characteristic of the trade in agricultural products. For example, the decline of 12 per cent in total sales to that continent in 1925–26 as compared with the preceding year was due almost entirely to our poor wheat crop and the fall in the price of cotton. Notwithstanding the diminished buying power of Europe resulting from the cataclysm of war, our sales there during recent years have averaged 67 per cent greater than before the war, and even had there been no advance in prices a very considerable gain would appear.

It is a notable tribute to American manufacturing industry that our exports of finished manufactures to Europe, itself a great industrial region, have gained almost as much as those to other continents, even in the face of the depressed state of Europe's economic life. Exports of finished manufactures to Europe in the calendar year 1925 amounted to $525,000,000, being 39 per cent greater than in the calendar year 1922 and two and one-half times greater than the average from 1910 to 1914. Europeans are finding it to their advantage to buy more and more American specialties, notably machinery of all sorts, automobiles, and office appliances.

The most striking fact with reference to the geographic distribution of our import trade is the immense increase in the share of the total furnished by Asia. This is chiefly the result of the tremendous expansion of our imports of rubber, silk, tropical textile fibers, varnish gums, and oilseeds and oils. Before the war Asia furnished us with 15 per cent of our imports; in 1925–26 the proportion was 33 per cent. The actual value of our imports from that continent had multiplied nearly six times. To be sure, the extreme price of rubber last year was an important factor in swelling the value of our imports from Asia, but even on the basis of normal prices they show an immense increase. Another factor to be con-

sidered is that our trade with Asia is more direct than formerly. Imports from all other parts of the world, with the exception of Europe, also show a healthy growth as compared with pre-war. Europe is not yet able to furnish us as much as formerly, but, since the bottom was reached, imports from that continent have risen rapidly; they were 54 per cent greater in 1925–26 than in 1921–22.

EXPORTS TO THE PRINCIPAL INDIVIDUAL COUNTRIES

Surprisingly great increases appear in our exports to many countries even during the short period between 1921–22 and 1925–26. Four years ago our sales to Venezuela amounted to only $7,600,000; they had risen to $31,400,000 last year. Every important South American market shows a great advance. Argentina has long been the biggest South American buyer of our goods, but although the trade was already strong four years ago, it had gained a further 83 per cent by 1925–26. Exports to Colombia and Chile have nearly trebled. A striking instance of the appreciation of our products on the part of our South American neighbors is the remarkable advance in the sale of American automobiles.

Australia and New Zealand, English-speaking countries with standards of living and geographic environment very similar to those of large sections of the United States, find American products peculiarly adapted to their requirements. We sold to them last year goods to the value of nearly $200,000,000, representing not much less than $30 per capita of their population. This figure is the more remarkable when it is borne in mind that our own aggregate imports of all classes of products from the entire world amount to only about $35 per capita. Australia is our biggest market for automobile products. To it and to New Zealand we sell great and rapidly increasing quantities of all sorts of advanced manufactured goods. British South Africa is a country in many ways similar. Our exports to it in the last fiscal year were 168 per cent greater than in 1921–22.

Gains in our sales of manufactured goods to Latin America, Oceania, Africa, and most countries of Asia have taken place despite the growth in their own manufacturing industries. The fear often expressed that the progress of the newer and more backward countries in industry will check the growth of export trade of the more advanced industrial nations finds little support in the statistics. Development of manufacturing industries in a country like Argentina or Australia goes hand in hand with development of agricultural and mineral production and of transportation. All this development demands more machinery, more rails, more equipment generally, and these must be bought chiefly from the older industrial countries. More important, however, in assuring the permanent growth of demand for imports of manufactured articles is the fact that each advance in the efficiency of local production raises the standards of living and the buying power of the people.

The statistics of our trade with the outlying countries of the world in recent years have also disposed largely of the bogy of European competition. The recovery of Europe has helped rather than hampered our trade with Latin America, the Far East, and

Africa. Because they can sell more of their raw materials and foodstuffs to Europe they are able to buy more manufactured goods both from Europe and from the United States.

CAUSES OF THE EXPANSION OF OUR EXPORT TRADE

It is the fashion in some quarters to attribute the great expansion of American exports, especially of manufactured goods, to the misfortunes of Europe, to the great blow dealt by the war to the competitive strength of the leading industrial countries of that continent. The facts by no means justify this opinion.

It is true that, while our exports are at least one-third greater (after allowing for price changes) than before the war, exports of Europe as a whole are considerably below the pre-war level. The exports of Great Britain are still nearly one-fourth less than before the war and those of Germany stand even further below. Of total world exports, the United States contributed in 1913 about 13½ per cent and in 1925 about 17½ per cent.

None the less the expansion of American foreign trade has not checked the recovery of Europe's trade, which is proceeding rapidly. A rough calculation indicates that the total export trade of Europe was approximately 55 per cent greater in 1925 than in 1921. The truth is that increase in the trade of any country tends to increase the trade of every other—not of course in every individual commodity, but in the aggregate. Just as the growth of our exports has not been hampered by this rapid recovery in Europe, so has the recovery of Europe itself not been hampered by our progress.

Unquestionably our share of world trade, especially of manufactured goods, is greater than it would have been if Europe could have continued its normal progress in export trade without the utter disruption of war. But in aggregate amount our trade would probably have been greater had there been no war. The buying power of practically the entire world was cut down by the great conflict and has barely reached its pre-war volume, whereas the normal tendency would have been toward a steady and marked growth. Rapid as has been the expansion of American exports of manufactured goods in the last few years and as compared with pre-war figures, it has not been more rapid than before the war.

The major causes of the steady and rapid expansion of American exports of manufactured goods lie first in that normal growth of world demand for manufactured goods already mentioned, and, second, in the increasing volume of America's own production and the increasing efficiency of her industry. It is not true, as is sometimes supposed, that exports constitute a larger part of our total production, or exports of manufactured goods a larger proportion of the output of our factories at the present time than before the war, or even than a quarter of a century ago. So tremendous has been the growth of our own production and of the domestic market that it has fully kept pace with the expansion of our exports.

The basic causes of the growth in domestic production and consequently in our export capacity are of a continuing and cumulative character. While formerly progress may have rested largely upon the opening up of new resources, the progress of recent years and

decades has been chiefly due to the accumulation of capital and the spread of general education. Our remarkable advance has its springs deep in the life of the people—in the intelligence, contentment, and aspiration of our workers, the spirit of fair play as between employer and employee, the collaborative spirit, as manifested not only in the widespread associated effort among firms and individuals, in any given industry, but also between them and other associations and the governmental trade-promotive agencies. There are also the conscientious and strenuous efforts of technicians and business managers to eliminate waste and to make full use of every forward step of science and research. These and other kindred factors lie at the bottom of the extraordinary development of our foreign trade as of our domestic industry. It is chiefly because of the nature of these factors that the future holds out high promise for the foreign commerce of the United States.

It might not be inappropriate to mention again, as one of the contributions to the progress of our foreign trade, the operations of the Bureau of Foreign and Domestic Commerce, in behalf of sound and far-sighted export effort, as set forth in this report.

BUREAU'S CONTRIBUTIONS TOWARD ELIMINATION OF WASTE

Elimination of waste ranks alongside active trade-promotive work as one of the primary functions of the Bureau of Foreign and Domestic Commerce, and its participation in the department's campaign to reduce the nonproductice effort in American economic life has been noteworthy in many ways.

In promoting foreign trade the bureau furthers the disposal of surplus domestic products and provides continuity of production and sales through the medium of widespread markets.

The great mass of information which it collects and gives out smooths the road to foreign trade, so that costly mistakes are avoided and business is conducted with a minimum expenditure of time and money. Lack of exact knowledge on the part of exporters—much more than in the case of domestic merchants—leads to uncertainty, bewilderment, ill-advised and misdirected action, and consequent complications, trouble, and loss. It is the function of this bureau to eliminate such untoward results by enabling the exporter to proceed confidently and securely by reason of the possession of precise data on foreign conditions and on every phase of the export transaction.

Besides this more general aspect of the service, the bureau's efforts have prevented definitely indicated losses in innumerable specific cases. Its timely, pertinent advice has averted actions that would certainly have proved expensive and possibly disastrous.

It has presented facts that led to a discontinuance of plans for injudicious foreign investments.

It has rescued countless American shipments from customs difficulties abroad.

It has saved American merchants from endeavoring to exploit barren markets and from dealing with irresponsible firms or individuals.

Through tactful representations it has been able, in numerous instances, to ward off (or induce modifications of) local trade prejudices and measures that would have been harmful to American commercial interests.

It has brought large sums into the coffers of American companies by aiding in the adjustment of trade disputes.

It has given warning of foreign conditions rendering sales effort futile or temporarily inadvisable.

It has saved money for Americans by warning them of the dangers of improper export policies and by checking, wherever possible, illegitimate competition.

All these efforts mean elimination of waste. They involve notable savings for American business men. Their value may be shown by citing a letter just received in the bureau in which a middle western motor-car company affirms that the bureau's services have saved it $40,000 during the fiscal year 1926—besides actually obtaining for it a quarter of a million dollars' worth of business.

It seems desirable to mention definite waste-elimination activities by certain of the bureau's divisions at Washington. The commercial intelligence division, for example, furnishes to American exporters lists of potential foreign buyers and detailed sales information regarding importers abroad, so that waste motion in deciding upon agents or sales channels may be eliminated. In its work of helping American exporters to choose thoroughly competent and suitable sales agents in foreign countries, the bureau strives to prevent the lost business, the financial troubles, and the impairment of prestige that often result from unwise selection of such agents. The commercial intelligence division also gives to American banks and companies information about foreign firms resorting to questionable business practices or those that have become bankrupt or gone into liquidation.

The commercial laws division advises counsel of export houses on the preparation of agency contracts so as to avoid loss through carelessly prepared contracts. It has contributed notably to popularizing the idea of commercial arbitration—saving court costs and attorneys' fees. It has assisted in standardizing forms, bills of lading, letters of credit, and insurance policies. It has made studies of double taxation and excessive taxation abroad. One important phase of its waste-elimination work is in protecting American patents and especially trade-marks against infringement or misappropriation overseas. Such improper use has been prevented in a great number of cases. Well-known trade-marks represent vast sums in good will and commercial reputation, and a very appreciable portion of this would have been wasted, as regards certain foreign countries, had it not been for the vigilance and quick action of the bureau in circumventing attempts at unauthorized registration.

The tariff division maintains a service designed to keep the American exporter fully informed as to consular regulations and tariffs and the proper method of making shipment abroad. Hundreds of firms have reported the effectiveness of this service in preventing misunderstandings and losses. The division warns of danger to American shipments from new restrictions or requirements of foreign governments. For example, when Greece prohibited the further

importation of automobiles, the news was immediately disseminated to the American manufacturers and exporters of motor cars so as to enable them to cancel or divert all shipments under way and thus avoid the waste involved in having shipments arrive in Greece only to be refused entry. Subsequent modifications in the prohibitions were disseminated with equal speed.

The rubber division has conducted a semiannual survey of stocks of tires in the hands of dealers. On the basis of these surveys, production schedules can be drawn up intelligently and an approach can be made to the problem of remedying faults in dealer distribution of tires. The rubber division also affords an example of another phase of the waste-elimination work, in its interest in the utilization of waste products—rubber products that are still serviceable in varying ways and degrees but which would ordinarily be discarded.

The textile division has been very effective in advising other Government departments regarding purchase or sale of textiles. The Marine Corps wanted a large quantity of underwear and put out proposals to the open market to purchase it. The Army, on the other hand, had large quantities of underwear on hand, but the sizes were large and did not quite meet the needs of the Marine Corps. After considerable negotiation, involving the Director of the Budget, the Marine Corps took over the necessary quantity of Army underwear and had it cut down to the proper sizes. This whole transaction, effected largely as a result of the textile division's counsel as to the trade situation in this line, saved the Government between $500,000 and $600,000.

The shoe and leather manufactures division has given the War Department valuable advice as to the proper dates for placing contracts for Army shoes. This service has been the means of a large saving to the Government in the purchase of Army footwear.

The hide and leather division, in cooperation with other divisions of the bureau, has been working with the Department of Agriculture on the interdepartmental committee on the conservation of domestic hides and skins. This runs the entire gamut from disease and pest elimination to grading and marketing; it is the basic work that is necessary before the tanners can attempt an elimination of waste in grades, weights, and colors of leather. The bureau finds—and encourages—an increasing agitation in the tanning industry regarding this last-mentioned problem.

The bureau's motion-picture section is constantly striving to save business for American producers by endeavoring to ward off discriminatory measures against American pictures on the part of foreign countries, and also by preventing the "pirating" of American films abroad.

In numerous instances the bureau has cooperated heartily with the department's division of simplified practice in its waste-elimination work. To mention only one typical example, our chemical division interested the chemical industry in the elimination of waste through simplification and standardization in the paint and varnish, fertilizer, linseed-oil, and medicinal trades.

In its standardization work—in the movement toward uniformity of specifications throughout the Americas—the bureau is contributing to the elimination of waste. Multiplicity of standards inevitably

implies a degree of confusion, embarrassment, and unprofitable effort. The publication of Spanish translations of American "Industrial Standards" and the forthcoming issuance of some of the same standards in Portuguese is a work looking toward conformity to recognized norms and the consequent lessening of waste.

The work of the bureau's domestic commerce division is concerned in large part with the endeavor to eliminate waste in the trade that is carried on within the boundaries of the United States. In the field of distribution it has accomplished much toward this end.

One outstanding phase of its work has been in connection with retail merchandising, in which the bureau's studies have included Retail Store Location, Measuring a Retail Market, Retail Store Planning, Budgetary Control in Retail Store Management, The Education of a Retail Sales Force, Cooperative Retail Advertising, Department Leasing in Retail Stores, and Vehicular Traffic Congestion and Retail Business. In the case of most of these studies, 20,000 copies were issued, being placed in the hands of the persons most likely to benefit by them. Not all of these, in their published form, belong to the year just ended—but they illustrate types of problems which the bureau keeps steadily in mind. It is obvious that nearly all of them have a very direct relation to the cutting down of unnecessary expense and the avoidance of fruitless endeavors.

The loss to society of the wasted effort and capital of the many men who fail in the retail business is an economic problem of indisputable importance and is worthy of much research for the purpose of finding means of prevention. In emphasizing and analyzing the vital factor of location, the bureau has concerned itself with one measure that will obviate many of the casualties. Again, realizing that something is wrong with the operating policies of many retail enterprises and that poor management appears to be the root of numerous failures in this field, the bureau takes up the question of establishing a scientific budgetary system—making possible the construction of a more profitable sales program, coordination of sales and purchases, more direct control of expenditure, etc.

If all the distributive markets, from the manufacturer to the consumer, could be accurately determined, the excess production and overbuying might be obviated to a large degree and a real service rendered to the American people. Toward this waste-eliminating objective the attention of the domestic commerce division is consistently directed.

One of the major fields of waste is in the lack of definite knowledge by our distributers of the type and relative value of markets in various sections of the United States. Varying degrees of sales resistance are encountered because of differences in purchasing habits, incomes, occupations, and many other factors which deserve to be considered but on which, hitherto, there has been a dearth of readily available data. To supply this lack, and thus promote efficiency and economy in sales effort, is the purpose of the series of regional market surveys which the bureau now has under way. The Commercial Survey of the Philadelphia Marketing Area is being followed by a more comprehensive study covering the southeastern portion of the United States. Others are already being initiated, as

indicated on page 145. These studies serve to eliminate waste by helping sales executives to set quotas and to plan campaigns on a basis of knowledge rather than of guesses.

The illustrations given in this section—while by no means exhaustive—show plainly that all Washington divisions and foreign and district offices of this bureau are aiding in the economy of business effort, particularly along the lines of intelligent and orderly marketing.

OUTSTANDING DOLLARS-AND-CENTS RESULTS

Possibly the most salient fact, in the matter of actual dollars-and-cents achievements, is that the known business accruing to American exporters as a result of the activities of the bureau's foreign offices during 1925–26 is more than $33,000,000. This figure, it should be noted, is only for the foreign offices, whose cost to the taxpayer, as indicated below, was about $1,120,000; it applies simply to the cases where results are definitely known; and it refers merely to such initial or new business as was obtained up to the close of the fiscal year.

The number of firms served by the bureau's district offices during the past fiscal year was 15,870. Of these, 851 firms have reported actual business from the bureau's services averaging $8,608 per firm—for an aggregate of $7,319,323. A total of 22,000 firms are served by the bureau. If the same average dollars-and-cents benefit per firm may be considered as applying to the bureau clientele as a whole, the total would be $189,376,000 worth of business obtained as a result of the bureau's services.

SPECIFIC EXAMPLES OF SERVICE BY FOREIGN REPRESENTATIVES

As regards the foreign service, there is evidence to justify the belief that the real, ultimate business resulting from its efforts during the year will mount up to several times the figure mentioned above, because, where satisfactory business relations are established through the good offices of a commercial attaché or trade commissioner, these are likely to continue over a period of years—probably with a steadily rising volume of sales. Moreover, the figure of $33,000,000 does not take into account the numerous cases in which the final specific results of his endeavors do not come to the attention of the bureau's representative, who is obviously unable (in view of the great pressure of work) to follow to its dollars-and-cents conclusion every transaction in which his services are enlisted.

In comparison with these actual figures of business secured, what did this foreign service cost the American public? The total amount spent on the 42 foreign offices of the bureau in 1925–26 was $1,120,665; this includes everything—salaries, local employment, travel in territory assigned, travel to and from post, rent, cable service, supplies, and all miscellaneous expenditures.

Our office at Berlin, Germany, cost the Government just $62,825 during the fiscal year—but the known sales of American merchandise

in Germany during the year which came about as a direct result of the services of the Berlin office total slightly more than $10,000,000.

A conservative estimate for the Madrid office reaches the same figure of $10,000,000, and the expense to American taxpayers in this case was only $26,950.

The cost of maintaining the office at Johannesburg, South Africa, through 1925–26 was $24,775. Thirty-six local agencies for American goods established by this office during the year resulted in orders for goods valued at $406,000. The 200 agencies established by this office since its organization in 1920 now do business in American goods valued at $2,250,000 annually. And this agency-securing work represents only one phase of the varied activity of the office.

During the past year the bureau's Canada offices, at Ottawa and Montreal, helped American firms to obtain 81 agencies in Canada which resulted in orders amounting to approximately $600,000. In the course of a visit to western Canada in May and June, 1926, the trade commissioner interested 57 prospective agents and buyers in 165 American lines. Sixty-three "trade opportunities," for 102 commodities, were forwarded to the bureau at Washington by the Ottawa and Montreal offices. Profitable connections were established with 99 Canadian firms. All this—and a great deal besides—was done with a total expenditure of $29,515.

The list of dollars-and-cents results presented in the succeeding paragraphs makes no attempt to be exhaustive; the cases are cited merely as outstanding illustrations.

Some years ago a New England textile manufacturer had annual sales amounting to $150,000 in Canada. Increased competition in the Dominion and changes in the invoice requirements which this firm did not follow closely were responsible for the loss of four-fifths of this business. The bureau's Ottawa office explained to the firm the proper method of preparing Canadian invoices and the best method of arranging its trade discounts, with the result that the firm is now rapidly regaining its former annual volume of Canadian sales and anticipates an increase over any former year.

As a direct result of information furnished by the Ottawa office, a Pennsylvania steel corporation obtained orders from Canadian firms for structural steel totaling $250,000.

Through the efforts of our trade commissioner, a bakery in Ottawa placed orders with American firms for equipment amounting to $25,000.

A hardware manufacturer in Connecticut has sold $35,000 worth of goods in eastern Canada through an agent recommended by the bureau's Ottawa office.

The services of the same office have been responsible for the placing of orders for $4,000 worth of raincoat material by a Montreal firm with two American manufacturers, and $25,000 worth of additional business is reported pending.

Business to the amount of $250,000 during the year resulted from the successful efforts of the Madrid office to obtain distributers for two well-known makes of American automobiles. Assistance was given to American companies in the sale of 15,000 barrels of oil.

An agent was obtained for a brand of American cigarettes, the first year's sales approximating $100,000. Business to the amount of $150,000 was secured for an American machinery manufacturer. Information given by the commercial attaché to an American automobile concern resulted in the sale of 500 cars in excess of previous years.

The bureau's office at Madrid obtained the release of $200,000 worth of automobile products held by the customs officials in Malaga, Spain, on which the representative of the American company had been unable to secure any action after several months of constant effort. With the assistance of the commercial attaché in Madrid, a New York automobile export company succeeded in placing the representation of its car in the hands of a Madrid importer who had been handling a French car. The contract calls for 168 cars per year, valued at approximately $140,000. Valuable assistance was afforded an American firm in its negotiations with a Spanish railway for the sale of 26 electric locomotives and 26 motor cars with trailers; these negotiations have not yet been completed. A permit was obtained for the exportation of 20,000 rabbit skins for an American firm.

A $14,000 claim of an electric and radio corporation in New York against a Spanish firm was considered practically lost when the bureau's representative was called upon to lend his assistance and, as a result of his cooperation, the firm states that it was able to save the whole amount.

Special import licenses obtained for American goods by the bureau's Berlin office during the first three months of the year, before the abolition of the licensing system, resulted in $2,000,000 worth of additional business.

Business obtained by the Berlin office for one American manufacturer of electrical supplies is expected to amount to $25,000 a month.

As a result of the efforts of the Berlin office, an American pea-cleaning machine was introduced in Germany and a pea-canning plant was installed. The initial order amounted to $23,000, and five similar orders are to follow.

A trial order obtained from a German subway company for American automatic door-closing equipment, due entirely to the efforts of the Berlin office of the bureau, has led to plans by the subway company to use this equipment on its entire system at a cost of $1,200,000.

Through the assistance of the bureau's Calcutta and Bombay offices, American firms have obtained during the past year 37 new agents and distributers who have given orders totaling approximately $2,000,000. A partial list of the commodities for which distribution was found includes automobiles, motor cycles, and accessories, oil engines, concrete mixers, optical and scientific instruments, water meters, canned goods, cotton piece goods, shirts and collars, sugar-cane mills, pumps, machine tools, refrigeration equipment, rubber and canvas shoes, pharmaceutical and toilet preparations, radios and radio accessories. A large New York export firm gives credit to the Calcutta office for securing business valued at $240,000.

Through our office at Copenhagen, more than 100 agencies were obtained for American products, resulting in orders amounting to approximately $1,000,000. A connection secured for an American exporter of celotex resulted in sales amounting to $80,000 during the last three months of the fiscal year.

The bureau's office at Melbourne, Australia, has been successful in its negotiations with the various State organizations. During the year the office made possible the obtaining, by American firms, of orders for $783,000 worth of electrical and railway equipment from these organizations.

The known sales of American products brought about by the office at Riga, Latvia, during the year totaled $1,500,000. Two local dealers were induced by the Riga office to handle grain and lard valued at $1,170,000; agencies obtained for American automobile manufacturers resulted in business worth $75,000; and the sale by an American steel manufacturer of munitions to the Latvian Government, effected through the Riga office, amounted to $280,000.

By bringing to the attention of an American firm the requirements of the local Government for accounting and statistical machines, the bureau's office at Batavia, Dutch East Indies, enabled a New York manufacturer to secure orders for 12 such machines valued at $14,000. The Batavia office placed San Francisco exporters of canned goods in touch with a firm in Sumatra, and this service resulted in an initial order valued at $6,500. A Batavia firm in the market for automobile-top material and tire rims was put in touch with American suppliers and business resulted to the amount of $6,000.

Measures recommended by the commercial attaché at Bogota, Colombia, led to the stamping out of the practice of certain large coffee growers of misbranding coffee exported to the United States. This practice was causing a loss of about $500,000 annually to American coffee buyers. As a result of the efforts of the attaché at Bogota, the Colombian Government's requirements for $160,000 worth of highway machinery are being met by American manufacturers.

A shipment of leather offals made by a Boston leather company was refused by the consignees in Constantinople and the American firm was faced with heavy loss. Through the assistance of the trade commissioner another agent was secured who not only disposed of this consignment but placed additional orders amounting to $75,000.

The Hamburg office helped a Pacific coast lumber company to make connections with a German lumber importer, and this service resulted in sales amounting to $25,000. In consequence of a trade opportunity sent in by the Hamburg office, an American exporter of packing-house products obtained sales amounting to $65,000, with prospects of doubling this amount during the ensuing year. A large American firm exporting canned fish, which was facing the entire loss of its German business through a boycott by Hamburg brokers, was restored to its former trade privileges and saved a loss of business amounting to $250,000 annually. A connection was ob-

tained for a rubber company by the Hamburg office, resulting in $200,000 worth of business during the last three months of the fiscal year.

The Hamburg office secured a connection for an American exporter of horse meat which resulted in sales amounting to $250,000, with prospects of $500,000 worth of business annually. This office obtained for an American hosiery company a connection that resulted in sales amounting to $15,000. For an American rice exporter the Hamburg office performed a similar service that eventuated in sales to the value of $75,000.

At Helsingfors, Finland, the bureau's office placed during the year 10 agencies for American automobiles, trucks, and motor cycles resulting in business to the amount of $225,000. Assistance given by this Helsingfors office to an American firm manufacturing electrical equipment resulted in business worth $50,000. Agencies placed for American cotton and hosiery produced initial business to the amount of $60,000.

Illustrating some of the specific services that went to make up the total already indicated for the Johannesburg office, it may be mentioned, first, that the trade commisioner was instrumental in obtaining orders for American lumber valued at $160,000. This office secured representation for an American automobile not previously sold in South Africa, resulting in initial sales amounting to $25,000. A South African wholesale office was brought in touch with an American manufacturer of hosiery and made purchases totaling $60,000. A jobbing firm, which the Johannesburg office placed in touch with a manufacturer of automotive accessories in the United States, made purchases to the amount of $50,000. South African representation, arranged for an American rubber manufacturer, resulted in orders amounting to $35,000. A tractor connection established in East Africa for an American firm resulted in an initial order of $10,000. A lumber firm in New Orleans closed a $100,000 contract with a construction company in Cape Town, South Africa, and states that it would have been impossible to negotiate this sale without the information and assistance provided by the bureau's trade commissioner.

An American cotton exporter shipped 2,300 bales of cotton to Bremen, Germany. The cotton was warehoused in bond and later sold to a firm in France. The French authorities requested payment of a 26 per cent reparation tax levied upon imports from Germany. The Paris office of this bureau explained the circumstances of the case. The cotton was allowed to enter without payment of this tax, and the American firm was saved $60,000.

A change in representation was recommended to an American manufacturer of textiles after investigation by the bureau's Santiago (Chile) office disclosed the inactivity of his agent, and a new agent was found. The recommendations of the office were accepted by the American firm, and orders were obtained amounting to $50,000 on lines previously considered stagnant. The products of an American automobile company were brought to the attention of a dealer in Antofagasta, Chile, and orders amounting to more than $20,000 resulted. A trade opportunity, developed after frequent visits of a

bureau representative to one of the large importing houses in Chile, resulted in the placing of an initial order for automobile accessories amounting to $10,000.

The sale of $20,000 worth of paraffin wax, $10,000 worth of shotgun cartridges, $1,000 worth of bagging machinery, $2,500 worth of aniline dyes, $2,500 worth of steel office furniture, and miscellaneous items such as shoe machinery, chemicals, electric drills, kitchen utensils, etc., totaling $15,000 resulted from trade-promotive efforts of the Santiago office during the past fiscal year. Through the efforts of this office a large American firm was relieved of a municipal tax assessed against it amounting to $25,000. Catalogues and literature which the Santiago office brought to the attention of a firm dealing in electrical equipment aroused its interest in iceless refrigeration plants, and an initial business resulted to the value of $5,000.

Through the intervention of the bureau's Stockholm office, an American manufacturer of office appliances was saved the loss of orders amounting to $60,000 from an important Swedish cooperative association, which loss was threatened in consequence of a misunderstanding regarding trade discounts. After a presentation of the facts by the commercial attaché the misunderstanding was entirely cleared up and business relations were resumed.

Assistance by the Vienna office in the establishment or continuance of one motor-cycle and six automobile agencies resulted in business worth $100,000.

The office in Lima, Peru, furnished information to a Connecticut electric-boat manufacturer which resulted in sales amounting to $28,000. A Peruvian firm was put in communication with a machinery company in western New York and expects to purchase $12,000 worth of apparatus for producing a "milk powder." The Lima office, through the aid it gave to the representative of an American machinery company, was instrumental in the final securing of an order for machinery worth $360,442. Information furnished by the Lima office led an American motor-car company to appoint a Lima firm as its sales representative for Peru; the Peruvian concern has sold more than 25 of these American cars since then—to a value probably approaching $50,000. The Lima office induced a Peruvian concern to accept a piece of American machinery which was at first regarded as highly unsatisfactory. Had the Peruvians persisted in their original determination to ship the machine back to New York, the loss to the American sellers would probably have reached $50,000 or $60,000. The Lima office placed an Illinois company in touch with a Peruvian firm which has taken the American line and has already sold about $6,000 worth of strapping, seals, and presses.

A European representative of an American motor-car company states that, in consequence of the prompt assistance given by our London office, he was able to close a contract for 128 cars, involving a sum of $204,000.

The bureau's representatives in China gave assistance in connection with the presentation to the Chinese Government of claims by American companies against the Shanghai mint. The Chinese were

persuaded to accept for inclusion, in any consolidation or debt-funding operation, claims of American companies totaling $1,000,000. These claims had been previously excluded by the Chinese from their consolidation plans.

Indebtedness to the bureau's Peking office is acknowledged by a New York corporation for the placing of a contract calling for $402,655 worth of steel rails.

Through the assistance of our trade commissioner, a Los Angeles oil-refining company made a suitable connection in Shanghai, China. Orders for 55,000 cases of kerosene oil, with an approximate value of $100,000, were received during the first six months.

Sixty-seven agencies placed by the bureau's office at Shanghai for American manufacturers and exporters who had previously done no business in this market resulted in orders amounting to approximately $300,000.

Assistance was rendered American creditors who were experiencing difficulty in the collection of claims in Rumania because of the moratorium declared on behalf of private debtors in respect to certain of their obligations to foreigners. A single claim of this nature which was brought to a successful conclusion through the bureau's office at Bucharest amounted to $2,000,000.

An American firm was assisted by the commercial attaché in Bucharest and, in the face of strong European competition, received an order from a Rumanian concern for oil-well equipment amounting to $50,000.

Through the negotiations of the commercial attaché at Prague, Czechoslovakia, arrangements were made that resulted in the sale of 759 American automobiles, representing additional business valued at $500,000.

After failing to locate a distributer in Prague, the European sales director of an Ohio automobile company called on the commercial attaché, who put him in touch with a firm that took on the distributing rights of the car under a contract calling for a $40,000 yearly business.

Payments were defaulted on American cotton shipped to Poland to the amount of $428,000. The commercial attaché at Warsaw worked out a plan for the payment of this sum, by installments, over a period of months; his plan was acceptable and was acted upon by the Polish buyers. The American firm has now received all the money due, plus interest. An American company did a $100,000 business in Poland and states that this business could not have been obtained without the assistance of the commercial attaché at Warsaw.

The trade commissioner at Alexandria, Egypt, is reported by the European representative of an American automobile manufacturer as being responsible for the obtaining of a distributer in Alexandria whose yearly contract involves about $25,000 worth of business for the American concern. An agency obtained for a New York paint manufacturer by the office in Alexandria resulted in orders amounting to $15,000.

The office at Athens, Greece, assisted in bringing about a modification of the Greek restrictions regarding the acidity of imported flour, resulting in a saving of $250,000 worth of business for Amer-

ican flour mills. The Athens office also made possible the entry into the Greek market of 200 American passenger automobiles. This service resulted in a saving of about $150,000 worth of business for American automobile firms.

The commercial attaché at The Hague rendered assistance to a Detroit truck manufacturer with the result that approximately $20,000 worth of trucks were purchased by the Dutch Ministry of War from this firm.

A Pennsylvania manufacturer of steel products obtained business totaling $12,000 through an agent recommended by a trade commissioner.

A Boston export firm reports a rapidly growing business through circularization of bureau trade lists. By this means the firm obtained, in a year's time, 50 accounts—foreign buyers that were previously purchasing from England, Germany, and France—with the result that $40,000 worth of miscellaneous products have been sold thus far.

Business from Stuttgart, Germany, to the amount of $58,000 is reported by a New York manufacturer of paper makers' supplies after this market was brought to his attention through information furnished by the bureau.

"Leads" published by the bureau in behalf of a firm in Malmo, Sweden, resulted in the establishment of agency connections with three American firms, from whom the purchases thus far approximate $80,000.

A New York code-compiling company applied to the bureau for names of foreign firms and reports that it has succeeded in selling 900 codes, valued at more than $22,000, after circularizing the firms whose names were furnished.

An agency in Germany which resulted from bureau information has yielded $20,000 worth of business to a Chicago typewriter manufacturer.

"Leads" furnished by the bureau resulted in the placing of orders for lumber products to the amount of $18,200 with two American firms by a Swedish concern.

A bureau client in New York sold $15,900 worth of flour and sugar to northern European countries by making use of data supplied by our organization.

One active automobile agent obtained by the Rome office did $75,000 worth of business during the year for his American principal.

Orders to the amount of $16,500 resulted from the services of the Manila office in placing a Michigan leather company in touch with a Manila firm. A local Philippine representation secured for a New York brass company brought about an initial order for $7,500 worth of brass and copper sheets.

The foregoing examples illustrate dollars-and-cents services that the bureau's foreign offices have performed during the past fiscal year. Many similar cases might advantageously be cited, but they must, of necessity be omitted because of considerations of space. Other services at the foreign posts—services to which definite dollar values can not readily be attached—are discussed in the section beginning on page 121.

CONCRETE RESULTS ATTAINED BY DISTRICT AND COOPERATIVE OFFICES

The number of trade-promotive services rendered to American firms by the district or domestic branch offices during the year was 1,768,808; 428,069 trade opportunities and 578,452 trade lists were distributed by these offices, while 58,553 visitors applied for assistance in handling export trade problems.

The fiscal year began with 11 district and 36 cooperative offices. These latter—the cooperative offices—are established within commercial bodies in the larger cities. While the expenses are paid by the bodies themselves, the bureau furnishes free practically the same services provided for the district offices. No new district offices were established, but a cooperative office was opened in the Tacoma, Wash., Chamber of Commerce.

During the year a number of foreign trade conferences were arranged for by the district managers in cooperation with the local commercial organizations. The purpose of these conferences was to bring the bureau's service to the attention of business men and to create a further interest in export trade. Such meetings, of varying size and character and uniformly very successful, were held in Seattle, Portland, San Francisco, Los Angeles, Cleveland, St. Louis, Boston, and Providence. The offices have been able to accomplish much in the way of trade promotion, as is amply demonstrated elsewhere in this report.

Besides trade-informational articles that are sent from Washington to the field offices, these offices have prepared items for the press based on material which has been deemed of special interest to the local clientele. As an example of this, the St. Louis district office made public more than 9,000 column inches of commercial information in news and trade papers throughout its district—equivalent to 1½ columns per business day in the year. For the Seattle office, during the period between January 1 and June 30, 1926, the figure was 6,307 column inches.

The cooperative offices were unusually active during the past year, and every effort was made to encourage them to render more specific service to their contacts. They have been urged to form active foreign trade committees and foreign trade clubs.

What are the benefits and advantages accruing to the American business man from the maintenance of these district offices? Briefly, the offices bring a vast fund of information, together with all sorts of more immediate trade-promotive helps, right to the business man's desk—to his telephone receiver. By merely "ringing up the district office," or making a short visit there, or addressing a letter to which he will receive a reply in a day or two, he can establish contact with an organization representing intensive, world-wide commercial effort over a long period of years. It is scarcely figurative to say that, if his is a "phone inquiry," he can be "hooked up" in one minute with the bazaars of Bombay, the mining regions of Peru, the import houses of the International Settlement at Shanghai, the wool markets of Australia, or the customhouses of Barcelona or Constantinople.

Each office keeps its clientele informed regarding foreign conditions and developments that are peculiarly pertinent to the local

industries and characteristic export efforts. Each office offers dependable data and advice on the manifold technical details that may arise in handling an export shipment. How to mark canned salmon for Italy; when the Ecuadorian consular fee of 20 per cent was abrogated; the import duty on gold jewelry to China; the type of steamship service between Curacao and Maracaibo—these are samples of inquiries that such an office is answering every day by telephone or letter.

More than $2,000,000 is the amount of business obtained and savings effected during the past year through the services of our organization in the New York district, according to a compilation of records at the bureau's New York office. The sum of the sales that can be attributed to the bureau's work with more or less definiteness is $1,902,010, while the value of the savings that were made possible through a resort to our facilities is figured at $237,000.

Typical comment on the activities of the New York office is that of a firm exporting firearms which says that the cooperation of the district office "has been the means of increasing our export business to a great extent"—and it figures that "extent" at $40,000 for the year 1925–26.

The results attained in the territory covered by the San Francisco office are notable for the very large amounts of foreign business that are attributed directly to the efforts of the office.

Twenty-two firms in this region report that they obtained new business during 1925-26 totaling $1,225,898 in consequence of the service provided by the bureau, an average of $60,000 per firm.

Eleven firms state that they made 205 trade connections by using trade opportunities disseminated by this office and that the new business resulting from these connections has amounted thus far to $293,483.

The lists of prospective foreign buyers furnished by the office have also been fruitful in enabling Pacific coast companies to establish profitable commercial relations abroad; this is shown in the case of six firms which report 35 connections made through the use of such trade lists and bringing in business to the amount of $39,470.

Two firms state that the work of the bureau organization enabled them to obtain $11,200 more business in old trading areas.

Definite savings as a result of the bureau's services are, from the nature of the case, somewhat difficult to calculate, but five firms are able to give figures totaling $6,339 as the value of the assistance afforded along that line by the San Francisco office.

A well-known American motor-car company in the Middle West, writing to our Chicago office, values at $250,000 the amount of foreign business which it has obtained during the past year through services rendered by the bureau. And, as indicated elsewhere, this company estimates at $40,000 the savings effected during the same period through reports or advice supplied by our organization. "It *may* be more," the export manager says of the estimate of bureau-promoted sales. With much the same feeling, another company which submits a figure of $50,000 makes this notation: "This estimate is extremely conservative, as our mailing lists are made up very largely of information received from the bureau, and the

amount of business we have obtained from these lists is many times the estimate above stated."

A company which reports $20,000 worth of business through the bureau during 1925–26 says: "The foregoing figures do not by any means adequately reveal the benefit which has accrued to us by the service given by the bureau; the connections which have given us the business above mentioned will give us as much business the remaining six months of this year, and new accounts whose names were given us by trade commissioners should swell this total."

One company in the Chicago district says that it has received orders from more than 25 per cent of the new names of foreign dealers supplied by that office. One of the most famous of American manufacturing companies—a firm whose product is literally a household word—gives this significant testimony in a letter to the district manager at Chicago: "We have no hesitancy in stating that much of our business in foreign countries is based on information we have received from the Bureau of Foreign and Domestic Commerce."

One import and export house writes: "The service is improving all the while and is an absolute necessity for the foreign trade of our exporters."

The Chicago office totals more than half a million dollars' worth of business for 1925–26 in the cases where it was possible for firms to assign a definite value to trade obtained through the bureau's efforts, but there is ample evidence to show that the actual figure was probably several times this amount.

"This company has secured approximately $4,000,000 of business in [a South American country]," a New England firm of outstanding prominence writes to the bureau's Boston office, "and your investigations and reports materially assisted us in securing this business."

This is only one of many instances in which, though a precise value can not readily be set on the efforts put forth by the district office, acknowledgment is made that it has contributed substantially to the consummation of very important business undertakings.

In various other cases the companies served do find it possible to evaluate, rather definitely, the results arising from the bureau's local service, and for the New England office the total recorded during the fiscal year 1926 is $634,593. This amount represents business which the office has enabled 40 firms to obtain. These include concerns in most of the typical New England industries, such as textiles and leather products.

Gratifying success has been attained by the bureau's office at Detroit, which has been in operation for a period of only two years. The number of firms currently served by this office is about 550—including, of course, many of the great firms in the automotive industry. Twenty-two firms—representing less than 5 per cent of those who have been helped in one way or another by the bureau's local staff—report business to the amount of $405,895 during the fiscal year as a result of the services of the Detroit office.

This total includes various orders in Greece, for one firm, to the sum of $93,255. Another concern obtained a little more than $50,000 in Australian business during the first six months of 1926 in con-

sequence of teamwork between the bureau's Detroit and Australia offices.

The figures mentioned above do not include large savings effected through advice given by the Detroit office for the purpose of eliminating wasteful methods of exporting. Ten firms advised the office of such savings totaling $74,825.

The concrete achievements indicated here represent, roughly, a 100 per cent increase over the amount of dollars-and-cents results reported for Detroit during the preceding fiscal year.

In comparison with these known commercial benefits mounting nearly to the half-million mark, it is worthy of note that the cost of maintaining the district office at Detroit is less than $15,000 a year.

One firm states that "it would have been physically and financially impossible for us to obtain [elsewhere] the information supplied us by the department." A firm that is still in the early stages of export effort writes that "we could not have made a start at all without the help of the department."

In the territory assigned to the bureau's district office at Philadelphia there are many of the very well-known industrial establishments of the United States. It is interesting to find that, where such concerns are engaged in export trade, they are almost invariably numbered among the clients of the office.

A firm that manufactures track devices attributes "about 80 per cent of its export business" to the direct and indirect assistance of the bureau, extended through the Philadelphia office. It states that the bureau has enabled it to obtain orders from three dealers in South Africa, three in Australia, two in Mexico, and one each in Spain, Holland, Colombia, Porto Rico, Java, and New Zealand.

"Very beneficial first-hand information" on foreign possibilities is obtained at the Philadelphia office by one of the largest of American radio companies, according to a statement by its export department, which adds that "through your service we are kept up to date and abreast of the times, at practically no expense to us." And, showing the actual value of these facilities, this company writes:

> To give an estimate of the business received either directly or indirectly through the Department of Commerce in our first year of foreign sales—exclusive of the service rendered—we would say, in dollars and cents, approximately $30,000. If we could only set a value on the service, the figure would run very much higher.

Another concern, dealing in mineral products, says: "Your reports on some of the South American trade will develop, we believe, into very big business with us."

Twenty-six exporters, out of the hundreds served by the New Orleans office, report an estimated value of the bureau's services, during the past year, amounting to more than $913,000. One company reports two orders received from contacts made through the bureau which resulted in $33,163.82 worth of business; this represented merely trial orders, and the firm states that next year the business which the bureau made possible in these cases will amount to $70,000 at least. This latter figure for prospective future trade is, of course, not included in the sum first given.

For a variety of reasons, several large exporters to whom service has been rendered do not find it feasible to place a figure on the

results attained. Careful calculation from various statistics and estimates at hand in the New Orleans office clearly indicate that, if it were possible to get an expression from every exporter in the district, it would be found that the actual total value, for the year, of the bureau's service in this territory was well over $2,000,000.

"The reports which we have received from you have been used as an important factor in the making of plans for the operation of our foreign department," a very well-known beverage company writes to the Atlanta office of the bureau, and it is added that "this service, if judged only on the basis of its cost to us had we been compelled to secure it by means of our own personnel, is worth many thousands of dollars to us."

This letter is typical of many which testify to the importance of the assistance afforded to manufacturers and exporters in the southeastern part of the United States. Actual dollars-and-cents results traceable to such service during the fiscal year 1926 have been tabulated to a total of $196,276, reported by 12 firms.

Certain excerpts from a letter addressed to the bureau's office at Portland, Oreg., by the Portland Chamber of Commerce serve to emphasize typical services that are characteristic not only of this but of all the other offices. "One of the most important services which could be rendered," the chamber writes, "is bringing men interested in foreign trade and the products of Oregon to this territory for first-hand acquaintance." And it continues as follows:

Your office is continuously bringing to us trained men from your department who have specialized in the requirements of some foreign territory or in some special commodity or commodities. They discuss the practical problems with our traders. This is of inestimable value.

Actual contacts have been made by your office for traders in our State directly. Information and cooperation in other ways has materially aided in furthering contacts and connections.

Your department furnishes, through your office, dependable reports compiled by experts on the ground, from all the principal countries, covering all the principal commodities that make up our foreign trade. It would be impossible for a chamber of commerce or commercial organization to get reports such as you furnish. You furnish the most reliable information our traders can procure on their particular commodities or in regard to their specific problems.

Your office furnishes detailed and dependable information as to lists of buyers in foreign markets, market surveys on our traders' particular goods abroad, the best and most successful methods being employed by American foreign traders as regards packing, shipping, credits, trade customs and practices, statistics on exports from and imports into the United States, as well as statistics on exports and imports in foreign countries by commodities, etc. This is of tremendous worth to our business men.

We are able to get from you reports on the standing and business integrity of foreign firms with whom American traders might wish to form connections. This service is furnished promptly by you, entirely free of charge.

You furnish a further service of special value in the form of the duties and tariff regulations on American goods abroad.

Your office gives a quick and general distribution of information regarding pending matters of moment in time to be of value—in other words, while it is still news. As a concrete example of this, reference might be made to the information furnished this chamber regarding the proposed increase in duty on grain and other Pacific coast commodities which was under consideration by the Japanese Diet in Tokyo at its last session.

The interest which our Government is showing in the development of foreign trade through your bureau is stimulating interest in foreign trade in our State and city, the value of which is, of course, cumulative and will be materially realized upon in the future.

This statement shows conclusively why the Portland office has been able to bring about actual dollars-and-cents results for the traders of its district in a great number of specific instances.

Many firms that have been served by the Seattle office of the bureau have not yet been able to estimate the concrete value of these services, but it is worthy of note that thus far 10 firms report business totaling $308,000 during 1925–26 as a result of information and help which this organization provided. Five other firms testify that decidedly worth-while savings were made possible.

"Our estimate of the business we have received through your bureau would be $15,000 to $20,000 annually," a lumber company in the central Mississippi district writes to the St. Louis office. Another firm, manufacturing an article of universal use, says: "We are showing this year, up to the present time, more than 30 per cent increase in our export business, and we feel sure that a great deal of it is due to the efforts of consuls and trade commissioners as well as the service we have secured from the Department of Commerce."

A company in this district which makes metal articles says that its export business has been increased between 700 and 800 per cent as a direct or indirect consequence of various bureau services.

VARIED PHASES OF TRADE-PROMOTIVE ACTIVITY ABROAD

In a preceding section of this report there have been cited the outstanding dollars-and-cents achievements by the bureau's foreign offices during the past fiscal year. In the paragraphs that follow, various other aspects of their work will be considered.

At the beginning of the fiscal year 1925–26 the bureau was maintaining foreign offices at Alexandria (Egypt), Athens, Batavia (Java), Berlin, Bogota (Colombia), Bombay, Brussels, Bucharest, Buenos Aires, Calcutta, Constantinople, Copenhagen, Habana, The Hague, Hamburg, Helsingfors (Finland), Johannesburg, Lima, London, Madrid, Manila, Melbourne, Mexico City, Montevideo, Montreal, Ottawa, Paris, Peking, Prague (Czechoslovakia), Riga (Latvia), Rio de Janeiro, Rome, San Juan (P. R.), Santiago (Chile), Sao Paolo (Brazil), Shanghai, Stockholm, Tokyo, Vienna, and Warsaw. During the year the bureau established two new foreign offices—one at Sydney, Australia, and the other at Barcelona, Spain (subordinate to Madrid)—making a total of 42 offices maintained in 35 foreign countries. The American personnel of these offices totals 22 commercial attachés, 40 trade commissioners, 43 assistant trade commissioners, and 20 American clerks.

The services rendered by the foreign offices have grown rapidly both in number and variety. The items in the succeeding pages—comprising merely some typical examples—afford a conception of the practical and highly diversified activities. Emphasis is here placed on concrete services in particular cases, and relatively little attention is given to the more routine functions, which, if space were available, might profitably be accorded extensive consideration.

Such a function, for example, is the great volume of commercial reporting by the bureau's offices—covering every phase of trade, industry, and economics—through which the American business community is kept intimately in touch with developments abroad that

have a vital relation to all our export interests. During the past year, 10,915 reports and 42,723 trade letters were received from the bureau's foreign service. This and similar aspects of the work are familiar, by now, to nearly all Americans concerned with foreign trade.

It is probable that no work of the field officers is more important than the so-called missionary work which these representatives do in the United States after they have served several years abroad. During the fiscal year 1926, 45 field officers returned to the United States. While in this country they visited 264 cities, delivered 170 addresses on markets for American goods abroad, and held more than 2,000 individual conferences with business men interested in developing markets abroad for their products.

SECURING EFFECTIVE FOREIGN REPRESENTATION FOR AMERICAN GOODS

One of the important functions of the bureau's foreign representatives has been that of establishing connections between American exporters and capable, reliable agents or prospective purchasers abroad.

The bureau's London office is recognized by the British commercial community as the center for information regarding American-made goods, and many and varied inquiries from British buyers regarding the sources of particular American manufactures and raw materials are received daily. These inquiries the London office sends not only to the bureau at Washington but also to the 4,000 agents of American firms in London. This service of bringing members of the British commercial community in touch with American suppliers or their London agents is one of the most productive activities of the London office. In this manner new distributers for American goods are constantly being obtained, and sales resulting from this service run into several millions of dollars annually.

During the past year the Paris office gave direct help to 52 American manufacturers in finding suitable agents for their products.

Of particular interest among the achievements of The Hague office during the year was its success in obtaining local agents for such American commodities as automobiles, tractors, electrical appliances, grinders, hickory golf shafts, etc.

The office at Helsingfors, Finland, handled more than 100 business opportunities, directly placed 20 representations for American firms, and assisted in placing 10 additional agencies. Considerable assistance was given to the agencies in solving their problems of distribution.

At Vienna agency connections were established on abrasive machinery, asbestos, automobile accessories, automotive machinery, rubber balloons, paper bags, motors, culverts, paints and varnishes, and canned goods.

Many inquiries regarding little-known American products, addressed to the bureau's Sydney office by Australian business houses, have resulted in the establishment of new agencies for American goods. These inquiries have ranged all the way from paper drinking cups and rubber aprons to refrigeration machinery and tractors.

Initial and repeat orders resulting from agency connections obtained for American firms by the Stockholm office during the past

year totaled several hundred thousand dollars. The commodities included automobiles, pianos, paraffin, soldering salts, office appliances, tobacco, tools, drugs, electrical appliances, etc.

The Athens office was instrumental in obtaining for American firms 75 local representatives to handle various American commodities.

The importance of the Johannesburg office as a central clearing house of commercial information for American firms and representatives established in that territory has increased steadily. More than 2,000 persons called at the office for commercial information during the year. Trade lists carrying thousands of names of American manufacturers were furnished to inquirers, while, on the other hand, assistance was given to American importers of noncompetitive raw materials.

The Bogota office has afforded much valuable assistance to American commercial travelers passing through Colombia, and a large number of local representatives for American firms were obtained through the direct efforts of this office.

A number of agency connections established for American firms through the efforts of the Habana office have resulted in substantial orders for such commodities as machinery, paper, and construction materials.

At Montevideo, Uruguay, local representatives were obtained for American firms on commodities ranging from passenger automobiles and motor busses to cold-storage poultry and horseshoe nails.

At Riga, Latvia, suitable agents were found for a large number of American products—from toy balloons and stationery supplies to transportation equipment.

Agencies established through the activities of the office at Alexandria, Egypt, resulted in initial orders amounting to many thousands of dollars. In several instances temporary local agencies were secured for American firms bidding on Egyptian Government contracts.

The Buenos Aires office furnished an American company the connections necessary to enable it to establish factories in Argentina which will utilize from 5,000,000 to 10,000,000 pounds of buttermilk annually.

During the past year the Berlin office canvassed thoroughly several thousand German firms as possible purchasers of American goods. World Trade Directory reports on 800 of these firms were sent to the bureau, and 240 specific trade opportunities were submitted. A card-index file of actual and prospective German customers, classified according to commodities handled, has been built up in the Berlin office. This work has been carried so far that now an American representative coming to Germany for the first time can within a few minutes be given a comprehensive list of the most likely purchasers and agents for his products.

The instances just cited will serve to illustrate the character of the work which each of the foreign offices is accomplishing along this line.

AID IN CONNECTION WITH LARGE CONTRACTS, GOVERNMENTAL LOANS, ETC.

Successful efforts by the bureau's India offices to keep intimately in touch with a number of large development projects have meant

much in the furtherance of American interests. Close contact has been maintained with the Indian Stores Department, and a number of important inquiries for tenders have been handled.

At Sao Paulo, Brazil, help was given to several American firms bidding on the $18,000,000 water contract and loan.

Among the outstanding achievements of the Bogota (Colombia) office is an informal arrangement effected with the Colombian Ministry of Public Works whereby all its plans for expenditures on railway equipment and construction work are submitted to the commercial attaché to insure that American manufacturers will have a fair chance to compete for the business. The budget of the Ministry of Public Works calling for such enterprises is upward of $12,000,000 annually.

The most important reporting work of the Habana office during the past year was done in connection with the comprehensive construction program, undertaken by the Cuban Government, which includes a complete highway system, new Government buildings, aqueducts, and a large number of school buildings. In addition to numerous reports to the bureau on this construction program, a large number of American representatives in Cuba were given accurate data on the business opportunities offered and were advised regarding the intricacies of the new tax system which is expected to make such an extensive construction program possible.

The Montevideo office rendered much valuable assistance to a group of American bankers in their successful negotiations with the Uruguayan Government regarding the recently concluded $30,000,000 loan.

At Helsingfors much time and effort were given by the bureau's office to assisting in the negotiations between the Finnish Government and a large American company supplying power-plant equipment in an endeavor to obtain a large contract in connection with a $10,000,000 power project. Price considerations caused the negotiations to fail, but much valuable basic work was done which will greatly facilitate similar negotiations with the Government in the future.

At Riga, Latvia, much of the commercial attaché's time was devoted to assisting in negotiations between the Latvian Government and a group of American bankers relative to the placing of a $10,000,000 loan for Latvia in the United States. The same financial group interested in this loan also carrried on negotiations through the Riga office with the directors of the two largest car and railway accessory plants in northeastern Europe with the intention of purchasing them. Should these plans materialize the sale of American machinery and equipment in this part of Europe would be enormously increased.

ADJUSTMENT OF TRADE DISPUTES AND DIFFICULTIES

The bureau's office at Athens brought to a successful conclusion important trade disputes involving a total of $105,000.

Trade complaints which were satisfactorily adjusted by the Montevideo office saved American firms considerable expense in legal fees. In one instance a large account was saved for an American firm

which, had it not been for the intervention of the commercial attaché, would have lost its Uruguayan client.

An official of an important New York bank was successfully aided by the bureau's Stockholm office in the collection of a claim of several years' standing against a Swedish firm. Similar assistance was rendered an American linoleum company.

An example of the trade-dispute services rendered by the Lima office is the settlement of a case involving about $5,000, where a local importer had refused payment and the agent of the company had started suit. The suit was withdrawn and all charges paid.

Numerous trade complaints were adjusted through the efforts of the Rio de Janeiro office, effecting substantial savings for American exporters, both in legal fees and in time.

An investigation of claims arising from questionable conduct of local representatives of American firms was carried out by the bureau's Calcutta office, and the reputation of American manufacturers with local business houses was thus protected.

In a number of instances, at the request either of a shipper or of the local importing house, the Santiago (Chile) office made surveys of merchandise arriving in a defective condition. The intervention of the office in this manner prevented one of the largest importing houses in Chile from severing connections with an American exporter from whom several thousand dollars' worth of merchandise is purchased annually.

PROTECTION OF AMERICAN TRADE-MARKS AND COPYRIGHTS

An outstanding feature of the work of the Tokyo office was its activity in protecting American trade-marks. During the past year a considerable number of American trade-marks were saved from misappropriation by persons who had made improper application for their registration. This was accomplished through a careful weekly scanning, by members of the Tokyo staff, of the Japanese Patent Office publication that contains data on trade-mark applications; cases of trade-mark infringement appearing therein were immediately taken up with the Japanese Government.

The Mexico City and Buenos Aires offices, among others, were also active in defending American trade-marks against threatened infringements. Steps were taken which effectively protected the word "rayon" against use by unauthorized private parties in Mexico.

At Stockholm a prominent American drug house was materially assisted in obtaining permission to register its trade-mark after the expiration of the time during which application could normally be made.

At Warsaw, Poland, substantial assistance was rendered American film companies in securing protection for their films in the absence of a copyright convention; for example, one pirated film which was about to be run in all of the leading motion-picture houses was held up by the authorities for a period of two months in order that the legitimate owners might have time to bring in a copy of the film and save the market.

FURNISHING INFORMATION USEFUL IN DEBT NEGOTIATIONS

A number of the bureau's offices in Europe made elaborate studies of the economic and financial condition of the respective countries so as to provide needed information in connection with the debt settlements negotiated between the United States and the foreign governments.

As an example of this, the case of Italy may be cited. An outstanding feature of the work of the bureau's office at Rome was the exhaustive report by the commercial attaché on "Italy's capacity to pay," for the use of the American Debt Funding Commission, and his special assignment to Washington for active participation in the negotiations which resulted in the Italian debt settlement. By reason of his long residence in Italy and intimate knowledge of economic conditions in that country the commercial attaché was able to make an important contribution to the success of the negotiations. Following the conclusion of the debt agreement, he returned to Italy and subsequently was of the greatest assistance to American investment houses whose loans in Italy during the six months following the conclusion of the debt settlement totaled $40,000,000.

SECURING EQUITABLE TREATMENT FOR AMERICAN GOODS UNDER LOCAL REGULATIVE MEASURES

An outstanding feature of the work of the Habana office was its activity with respect to certain contemplated Cuban measures which would affect American commercial interests. Results obtained in this direction were distinctly gratifying. Pertinent information concerning American industry and production was brought to the attention of the persons having to do with the proposed revision of the Cuban tariff, to the end that equitable treatment, based on full knowledge, might be accorded to American goods.

A study was made of the condensed-milk business in Cuba, this being one of our most important markets. Upon the discovery of a marked discrepancy between United States and Cuban figures on this subject, and with a view of protecting American exporters from unfair competition, an investigation was initiated and an evasion of thousands of dollars in customs duties, by concerns of other nationality, was revealed. This was brought to the attention of the proper authorities, and measures are being taken by the Cuban Government which will protect American interests in this product against further infractions of such Cuban regulations.

As a result of special conditions existing in Mexico, and because of the fact that the United States supplies 70 per cent of Mexico's imports, the activities of the Mexico City office were directed, during the past year, chiefly toward retaining existing business and protecting the American exporter from incurring losses through ignorance of Mexican laws. During the year a large number of organic laws vitally affecting American interests were promulgated, namely, new laws on mining, petroleum, forestry, foreign property ownership, colonization, irrigation, fisheries, credit banks, insurance, labor,

electric and sanitary conditions, etc. All these laws were translated, a thorough study was made of their effect on American property, and reports outlining their important features were forwarded to the bureau.

Much of the time of the Mexico City office was taken up with questions relating to tariff changes, wrong classification of merchandise at port of entry, sanitary restrictions, fines imposed on American firms by local customs officials, and similar situations. The efforts of the office in these matters resulted in the saving of thousands of dollars to American business. One American firm, recently started in the Mexican field, which was helped out of its difficulty in connection with customs classification on parcel-post shipments, is now building up a million-dollar business.

The protection of existing American business has constituted one of the important activities of the Rome office. When restrictions were imposed on Italian calfskins and American leather manufacturers were threatened with a shortage of supplies, the Rome office succeeded in having the American quota of skins increased to a figure which removed the danger.

At Bucharest permission was obtained from the Ministry of Industry to establish in Rumania a bonded warehouse for the storage of oil-well supplies and to bring into the country certain supplies of this character entirely free of duty.

The Berlin office obtained from the German Government Committee on Specifications an agreement to advocate the term "rayon" as a standard designation for artificial silk in Germany.

At Vienna minimum (as against previously differential) insurance rates were obtained for all American shippers from a leading insurance company. An increase was obtained in the sulphur dioxide content permitted in dried fruits. Release was obtained of a cargo of lard valued at $26,000 unduly delayed by the customs, and the shipper was saved contract penalty for late delivery. Permission obtained from the Austrian customs to import Canadian or British built automobiles of American trade name under the British quota instead of the overcrowded American quota, as formerly, has made possible a much larger importation of bona fide American-built automobiles.

These are only a few out of many examples of the way in which our foreign offices "smooth the pathway" for American goods and rescue them, if possible, from difficulties that they encounter.

EXAMPLES OF MISCELLANEOUS TRADE-PROMOTIVE WORK

One of the most important services of the bureau's foreign representatives to the American public is in fulfilling the requirements of American business men who personally visit the offices. In Paris—to cite one aspect of such service—contacts with French officials and business circles have been developed to such an extent that in practically every instance the office is readily able to arrange appointments or supply information in answer to these personal requests. Visitors to the Paris office during the year numbered more than 3,500.

The commercial attaché at Paris officially represented the United States Government at an international conference on automobile and road construction. Largely through the efforts of the American representative a proposed regulation on brakes for automobiles, which would have required expensive changes on most present types of American cars, was altered to cover the existing types. Had the original proposal been adopted many thousands of American cars throughout the world would have had to undergo changes in their braking systems which would have cost approximately $50 per car.

The Chinese customs conference to increase surtax rates and to consider the collateral questions of likin abolition and the consolidation of Chinese unsecured debts began its work in October, 1925, and is still in session. Upon the recommendations of the American minister, the assistant commercial attaché was appointed one of the three technical advisers to assist the American delegates in the conference work. The American delegates to this conference have expressed to the bureau their appreciation of this assistance, especially in connection with the work of obtaining from the various American creditors accurate statements of their accounts and preparing other data for presentation to the conference and to the Chinese Government Commission.

The Hague office represented the interests of the American Jewelers Association at the international jewelers conference held at Amsterdam in April, and also participated in the Thirteenth Netherlands Industrial Fair at Utrecht, where it had a booth among those of the representatives of other foreign governments. Numerous requests for agencies for American goods were received on this latter occasion, and 14 trade opportunities were submitted to the bureau.

During the year the trade commissioner whose post is at Alexandria made a five-weeks trip to the Anglo-Egyptian Sudan which enabled him to gather much valuable information and to aid a number of American firms in increasing their business in that territory. A special visit to Palestine was made in the interest of the American motion-picture producers to investigate film pirating and the proper legal measures for its prevention.

Special attention was given by the Rome office to Italian agriculture, and periodical reports were made throughout the year on the condition of the Italian crops and the markets for American agricultural products, so that the American public was at all times kept informed of current conditions affecting the Italian demand for such American farm staples as wheat and cotton and also the Italian supply of silk, hemp, and olive oil which are imported into the United States in large quantities.

At Johannesburg careful attention was given to constructive publicity as well as to the refuting of anti-American propaganda. Reports of an informative and general nature have been regularly contributed to the press. The aims and purposes of the office have been kept constantly before the commercial community, and carefully prepared articles based on authoritative sources have been furnished to newspapers and the trade press in answer to unfounded charges, of a character detrimental to American products, that had found expression in their columns.

Much effort was expended at Buenos Aires in developing a greater demand for American cattle for breeding purposes, with the result that more cattle were imported for this purpose during the last half of the year than during the three preceding years.

Much valuable aid was given to American banana growers in Colombia in finding profitable markets for their products.

Assistance was also afforded by the Bogota office to American interests engaged in an attempt to start a raw-silk industry in Colombia.

TOBACCO TRADE COMMISSIONER

The bureau's special tobacco trade commissioner visited 18 European countries on behalf of the tobacco interests in America and submitted 289 reports covering the results of this survey. Calls were made upon the leading tobacco buyers, both governmental and private, in the countries visited. Through these contacts the trade commissioner was able to help a number of American tobacco dealers who had gone to Europe, and their requests for samples were forwarded to the bureau. Through the direct efforts of the bureau's representative a new brand of American cigarette and smoking tobacco was introduced into Europe. Valuable information was furnished several American tobacco firms concerning agents they had selected by mail, and in some instances new agents were recommended. Comprehensive and separate lists of tobacco brokers, dealers, and manufacturers were compiled to replace the bureau's old lists, which were too obsolete and confused to be of any real value. A number of reports sent to the bureau containing constructive criticism expressed by European tobacco dealers with respect to American methods of packing and selling export tobacco have already reached the American tobacco exporters and effected a change in their methods.

REGIONAL WORK AT WASHINGTON

Foreign offices of the bureau in the territory covered by the European division numbered 19 on June 30, 1926. This division's field included all of Europe, all of Africa, the Near and Middle East (to and including Turkey and Persia), Asiatic Russia, Canada, and Newfoundland. General economic and trade questions concerning these regions have been discussed with American business men, and a variety of topics have been treated in printed or mimeographed forms. The annual bulletin on budgets of European countries was extended in scope and published in two parts, the first covering western and northern European countries and the second central and eastern Europe. The resources of Siberia formed the basis for two bulletins, the one on forests, the other on iron and alloy metals. A bulletin on the resources of Newfoundland was published in the spring of 1926. A more elaborate discussion of Turkey formed the basis of a handbook which constitutes an exhaustive reference work on that country.

Briefer items of immediate use to American business men have been issued as mimeographed special circulars. A series on living costs for Americans in various European countries has been par-

ticularly well received because of its utility to American business men in planning foreign trips or estimating the expense of living abroad. Among the countries covered thus far are the United Kingdom, France, Germany, Italy, Spain, and Czechoslovakia.

In Commerce Reports, particular attention was given to special articles on live topics, such as "Post-war changes in European trade methods," "Cartels in Germany," "International cartels in Europe," "Yugoslavia as a market for American goods," "Sweden as a trading nation," and "Final form of French budget for 1926," which rounded out the data on this subject given in the trade information bulletin on European budgets.

The division also undertook the preparation of material for a textbook for students of foreign trade on Europe as an export field, making use of the extensive material available in field reports from the bureau's foreign offices.

The services of the economic experts of the division and the statistical material on file were placed at the disposal of the Treasury Department in connection with the negotiations for debt settlements with 13 European nations. Extensive compilations showing financial and economic conditions and forming the basis for an estimate of capacity to pay were prepared for the use of the American Debt Funding Commission.

The Latin American division was not called upon to deal, during the past year, with any unusual or extraordinary event affecting our trade in Latin America. However, numerous situations of importance to traders in that region have been followed closely in order that clients of the bureau might be kept advised of developments. Among these the matters of widest interest were the economic situation in Cuba, political disturbances in Central America, congestion of shipments on the Magdalena River (Colombia) and at the port of Santos (Brazil), financial developments in Brazil, Chile, and Ecuador, the recovery of Peru from the severe economic setback suffered during the preceding year, the extreme drought throughout the Caribbean region, and the petroleum development, with accompanying remarkable increase of trade, in Venezuela.

During the year the Latin American division published 22 mimeographed circulars and 12 trade information bulletins. It also corrected and brought up to date the printer's proof of the revision of the Commercial Travelers' Guide to Latin America.

Among the outstanding accomplishments of the Far Eastern division during the fiscal year 1926 was the completion of the Commercial Travelers' Guide to the Far East and of the revised Commercial Handbook of China. The Commercial Travelers' Guide will, it is believed, supply the most complete, authentic, and up-to-date information on all matters pertaining to sales effort in the Far East that has yet been compiled for the assistance of American manufacturers and exporters. The revised China handbook should provide an invaluable mine of information, not only on questions of direct commercial interest but on all important phases of the social and economic development that is now taking place among the Chinese people.

Moreover, the division has made during the year a special study of trends in Japan's trade and modern industries (issued as Trade

Information Bulletin No. 389), an analysis of the resources and trade of the Philippine Islands (Trade Information Bulletin No. 410), and has directed special attention to the opportunities for American manufacturers and exporters in trading with Malaysia (Trade Information Bulletin No. 377). Special studies were also made of India as a market for American goods (Trade Information Bulletin No. 348) and of Australia's resources and trade (Trade Information Bulletin No. 390).

One of the most exhaustive studies undertaken by the specialists in the division resulted in the compilation of a selected bibliography of the most important books, of both a general and a special nature, on the Far East, including the publications of the Department of Commerce. A series of pamphlets on logical sales territories in far eastern lands was also inaugurated during the year—Indian Sales Territories being already published, and Japan Sales Territories completed, with others to follow.

These are only a few of the salient aspects of the division's activities. The routine work of the division comprised, among other things, the preparation of several hundred press "releases," special articles for Commerce Reports, special circulars, trade reports, analyses of competition in the Far East by countries and commodities, trade notes, and trade reviews dealing with the Orient, all of which were distributed through the bureau's various channels to American business men.

CONCRETE COMMODITY SERVICE FOR AMERICAN INDUSTRIES

The National Association of Farm Equipment Manufacturers and its member firms have continued to rely very largely on the bureau's agricultural implements division for data with respect to the foreign field. Many concerns that had not previously engaged in export trade turned their attention to markets overseas, and in most cases the division was called upon to outline plans of campaign.

A survey of foreign markets for spraying and dusting machines was completed and the resulting information disseminated through 69 circulars; 29 trade opportunities for such equipment were made available to American makers. A study of foreign markets for threshers was also carried out, and the data were embodied in 48 circulars. The survey of markets for internal-combustion engines, begun in 1924–25, was also completed.

The division continued its monthly bulletin on exports, supplementing this with interpretative articles in Commerce Reports, discussing the monthly export figures. The series of "Implement and tractor notes" was continued. A trade information bulletin on Markets for Agricultural Implements and Farm Machinery in Argentina and Uruguay was published, as well as one on Modern Farm Equipment in India.

On the whole, the division expanded its services materially, and this fact may be regarded as having contributed to the increase of nearly $10,000,000 (over the preceding year) in the exports of the commodities to which it devotes its attention.

The work of the bureau in connection with automotive products showed a very substantial growth during the past year—the total

number of services in this field (at both Washington and the district offices) registering an increase from 181,606 to 228,727. There was a gain of 42 per cent in the number of foreign trade opportunities brought to the attention of American manufacturers. A total of 1,192 pages were issued for the Automotive Foreign Trade Manual, which was improved in character and given a wider usefulness.

A series of three trade information bulletins on the development of world motor-bus transportation were issued. The monthly and annual statistical presentations of American automotive exports were continued, as well as quarterly surveys of world automotive market conditions.

The Automotive Foreign Market News Bulletin has been sent each week to about 2,000 readers, many of whom clip it and file the clippings under geographic indexes.

A special trade press service was instituted, for a group of about 12 recognized national trade papers. Typical questionnaires sent out to the foreign offices during the year are those covering "Markets for motor cycles," "Incidental charges incurred abroad," "1925 world census of motor vehicles," "Outline for quarterly automotive market surveys," and "Regulations and taxes affecting motor vehicles."

There was continual cooperation with and guidance by the eight leading national automotive trade associations. Several groups, as well as individuals who were being sent abroad, spent periods in Washington ranging from one day to a week, making their headquarters in the division and following a program which it prepared. Hundreds of conferences with automotive exporters were held outside of the bureau, and several special conferences were called in the Washington office.

The chemical division was extremely active in the department's efforts with regard to foreign monoply control of essential raw materials. It concerned itself with four commodities—nitrate, potash, iodine, and camphor. The division brought out an important publication entitled "Potash: Significance of Foreign Control and Economic Need of Domestic Development."

There has been a noteworthy development in the division's statistical service. The bureau has brought to completion a system by which it shows every month (within a few days after the close of that period), in minute detail, the American imports of all commodities that come within the scope of activity of the chemical division. The division also maintains a file of statistics covering in detail the world trade in chemicals and related products, showing, by countries of origin or destination, every chemical mentioned in the official trade returns of the various countries for the years 1922 to 1924, inclusive. In this work about 11,000 reference cards, each carrying many notations, have been prepared.

The division has had in effect a weekly service whereby the markets for certain commodities in foreign countries have been reviewed; these studies have appeared under the titles "World trade in Toilet Preparations" and, similarly, "Naval stores" and "Prepared medicines."

In response to requests from the trade, questionnaires on markets for paints and pyroxylin plastics were sent to the foreign service,

and as replies are received these will be issued weekly as studies covering the various countries. The compressed-gas industry in foreign countries is being treated in a similar manner.

The number of chemical firms listed on the Exporters' Index has been increased during the past four years from 500 to the present figure of approximately 6,000—all active "contacts."

The division has participated, with exhibits, during the Chemical Exposition in New York and the Chemical Equipment Manufacturers' Exposition at Cleveland. It cooperated with the domestic commerce division in surveys of the fertilizer and naval-stores industries in the Southern States and with the division of simplified practice in the endeavor to bring about simplification and standardization in the paint and varnish, fertilizer, linseed-oil, and medicinal trades.

The division has endeavored to set up periodic services from abroad either by cable or correspondence—these including two monthly cable services covering the status of the French naval-stores industry and the Chilean nitrate situation.

A world survey of the market for electrical household appliances was carried out during the year, and the resulting data were made available through 29 special circulars, as well as Commerce Reports.

The electrical equipment division continued the collection and tabulation of data on electric power stations throughout the world, with technical details as to their equipment and current characteristics. A bulletin was issued giving information on central light and power stations in Africa, and similar publications on other areas are in course of preparation.

Electrical-equipment specifications have been handled for the State Electricity Commission of Victoria, Australia, the Uruguayan Government-owned plants, the South African Government telephone and telegraph system, and various other enterprises.

The bureau has under way the obtaining of data with regard to regulations governing the installation and control of industrial motors. Information is also being gathered on equipment used throughout the world for protection against lightning.

Special statistical studies of sales possibilities were made, including one on the markets for radio apparatus and primary batteries, with the object of helping radio manufacturers to "flatten their production curve."

The division aided in the preparation of circulars giving the import duties into selected areas on the items shown in the Glossary of Electrical Terms and Instructions to Exporters.

For the year just closing there was an increase of about 70 per cent in the outgoing correspondence of the foodstuffs division, and similar increases in other activities, such as material published, foreign trade reports received, etc. The work of the bureau's four foodstuffs specialists in Europe has been satisfactorily developed. A survey was undertaken to determine the reasons for and against the consumption of canned food products. A special effort has been made to obtain a list of all those engaged in export trade in foodstuffs and to establish contact with them. At the present time the meat-packing, fresh-fruit, and poultry trades have been almost completely listed.

A new group of trade information bulletins, giving technical information on foodstuffs commodities, has been started, the first being on prunes. Publications of the past year have included: International Trade in Meats and Animal Fats; International Trade in Butter and Cheese; International Trade in Coffee; Meat Marketing in Great Britain; Foodstuffs Export Trade of the United States; Butter and Cheese Markets in the West Indies; Mexican Market for United States Foodstuffs.

The bureau's intensive work in foreign markets in connection with hides and leather resulted in a 40 per cent increase in trade opportunities brought to the attention of American business men. The hide and leather division inaugurated in the industry an interchange of agency information and a program for the fullest possible utilization of the best agency connections throughout the world.

The division has been working on an exporters' manual covering markets for six types of leather throughout the world. Two questionnaires were sent to the bureau's foreign offices—one on markets for American leather and the other on world supply of raw hides and skins.

In order to give the industry the benefit of quick service, two weekly bulletins—one on leather markets and the other on raw materials—have been issued, containing a condensation of the important developments during the current week throughout the world. A monthly cable service on leather production in the important tanning countries has proved very effective. Statistical service has been so expanded as to make statistical inquiries practically unnecessary; detailed monthly export and import figures are now published and distributed directly by the division.

Contact with the reindeer industry in Alaska has been maintained and basic work amplified looking to the time when reindeer skins can be put upon the market in commercial quantities.

The hide and leather division, with the support of the industry, obtained the appointment by the Secretary of Agriculture and the Secretary of Commerce of an interdepartmental committee to conduct a national campaign for conservation and elimination of waste in domestic raw stock.

The bureau's industrial machinery division has put forth vigorous efforts to promote American machinery sales abroad, by directing the attention of manufacturers to promising fields, by helping them secure competent representation, by aiding them to overcome foreign competition, and in many other ways.

The division cooperated with a number of foreigners visiting the United States who were likely to promote American commercial interests; these included the large group of Pan American journalists and a number of Egyptian engineers.

As in past years, construction projects in foreign countries have been closely followed, with a view to facilitating American contracts and furthering sales.

An extensive collection of folios was prepared containing detailed reports on the principal machinery dealers in all the important countries; in addition to other action, copies have been distributed to the bureau's district and cooperative offices.

Many special studies were made of foreign machinery markets, trade practices in vogue, obstacles to overcome, etc., the results being distributed in the form of pamphlets, bulletins, and special circulars. A world-wide questionnaire on irrigation was handled.

The record of the services rendered by the bureau and its district offices in respect to all of the commodities handled by the iron-steel-hardware division shows that inquiries in the past fiscal year again doubled in comparison with the preceding year: they rose from 52,288 in the fiscal year 1924 to 112,559 in the 1925 period and to approximately 222,000 for the year ended June 30, 1926. The division prepared 186 special circulars, against 116 for the preceding fiscal year.

The work of the division has been greatly extended to include many new articles grouped about the principal commodities dealt with by the hardware section, whose work covers all lines of hardware, cutlery, tools, stoves, boilers, radiators, furnaces, abrasives, plumbing fixtures, lamps and illuminating devices other than electric, household utensils, chains, scales, tin cans, etc. The work of the hardware section has developed consistently throughout the fiscal year.

A study of the Pacific market area for iron and steel products was completed. A survey of the foreign trade of the United States in these lines has been made for each year as far back as 1901. Considerable effort was put into obtaining information on world markets for a number of commodities, prominent among which were welded tubing, wire rope accessories, standardized structural steel buildings, radio and transmission towers, and artificial abrasives.

Trade information bulletins pertaining to those commodities that come within the division's field have included: French Iron and Steel Industry; Iron and Alloy Metals in Siberia; Iron and Steel Trade of the Pacific Area; Philippine Market for Hardware and Allied Lines; and World Markets for Cutlery.

The bureau's lumber trade commissioner who was appointed October 1, 1925, to cover conditions in northwestern Europe, with headquarters in London, devoted himself to an intensive study of the lumber trade in the British Isles, resulting in basic reports and good sales connections for American exporters. A lumber trade commissioner to the Far East was appointed in June, 1926, and will spend the next year in a detailed study of the Japanese market, which is of great importance for our Pacific coast softwoods and also from the standpoint of hardwood competition.

In December, 1925, the chief of the lumber division was given leave of absence and was transferred by the Secretary of Commerce to the position of Director of the National Committee on Wood Utilization, organized at the direction of the President. In connection with grade marking, use of short lengths, and other wood-utilization problems, this committee has continued work that had been started in the lumber division of the bureau.

Continued special attention has been given to connecting American exporters with foreign agents.

In cooperation with the division of foreign tariffs, a series of Lumber Tariff Manuals was started, and the first number, covering the United Kingdom and western Europe, has been issued.

Special attention has been given to such matters as the Japanese and Australian-New Zealand trade, the pitch-pine contract proposed by the Spanish trade, agency conditions in Belgium and Germany, and Egyptian purchases of ties. The bureau's lumber trade lists have been extensively revised.

Four trade information bulletins issued under the auspices of the division discussed lumber conditions in the Philippines, Belgium, Siberia, and Latvia. Of the pamphlet entitled "Grade marks on lumber are the customer's guaranty," 160,000 copies have been printed thus far for purchase and distribution by interested organizations.

Contact with the industry has been continued through the Lumber Export Advisory Committee of 47 members, largely appointed by the various lumber associations which cooperate.

Attention to domestic trade has included advice to other Government departments as to lumber buying, cooperation with the Tariff Commission, assistance in marketing little-used species, etc. The division also has cooperated in the program of lumber standardization and the preparation of box-construction manuals.

Effective January 1, 1926, the personnel of the bureau's coal division, together with three specialists of the minerals division, were transferred to the Bureau of Mines. Foreign trade promotion work in petroleum, mineral-metals, and coal was retained by this bureau. Petroleum and its allied products, nonferrous metals and minerals, and coal and coke constitute the three general groups of commodities which concern the bureau's present minerals division in its efforts to promote and develop foreign trade.

"Foreign trade notes," a circular constituting an improved method of distributing foreign-trade information of interest to petroleum and mineral-metal industries, issued on alternate weeks, and "Overseas coal trade," released monthly, continued to serve the American demand for foreign-trade data and reduced very materially the amount of routine correspondence.

"Foreign markets for American copper products," a series of four circulars, exemplifies the type of nine special circulars released by the section to the mineral-metal trades. Two trade information bulletins covering the "World lead industry" were also published. A detailed report on "British petroleum trade in 1925" was prepared as a trade information bulletin, in addition to 55 special circulars released for the information of the American petroleum industry. Sixty special circulars relating to conditions abroad in the coal industry have been distributed since the taking over of this work by the minerals division on January 1, 1926.

Concerns manufacturing paper specialties of various kinds have been aided in finding foreign markets for their products and have been kept fully informed as to changes in industrial and sales conditions. Inquiries concerning markets for paper-working machinery registered a notable increase. Manufacturers of kraft paper in the South instituted an active investigation of markets abroad for their product, and plans were laid for the formation of a selling organization under the provisions of the Webb law; the bureau and the Consular Service have actively aided this project.

The investigation of markets for American printing machinery, accessories, and printing inks was practically completed and the results made public. The survey of pulp and paper resources, production and trade of each of the world's producing countries was continued and will soon be finished.

Investigations have already been begun on the box-board, paper-box, and carton industries and markets abroad. Plans have been made for surveys of foreign markets for American wall board, plaster board, wall paper, and building felts, and also for wrapping paper, paper bags, and fiber board. Material is being prepared for a bulletin on the markets for American paper products in the countries of northern South America.

The energies of the rubber division were largely devoted during the past year to crude-rubber work—completing the bureau's comprehensive study of that subject, and also in connection with the congressional investigation of foreign-controlled raw materials. Much service was rendered with respect to this last-named matter.

The series of crude-rubber reports was continued with the publication of monographs on Possibilities for Para Rubber Production in the Philippine Islands, Rubber Production in the Amazon Valley, and Rubber Production in Africa. A report on Possibilities for Para Rubber Production in Northern Tropical America is now in press. Another report finally reviewed for printing was Production of Gutta Percha, Balata, and Allied Gums. Work was done on the revision of the trade information bulletin on Marketing of Plantation Rubber.

Special crude-rubber services performed by the division included: (1) A survey of rubber consumption in the United States during the first seven months, to aid manufacturers in estimating the extent of their demands for the remainder of the year; (2) semiannual surveys of dealers' stocks of automobile tires, to aid manufacturers in establishing production schedules; (3) a survey of the reclaimed-rubber industry of the United States; and (4) the inauguration of a news-letter service pertaining to crude-rubber production and trade developments throughout the world. The number of crude-rubber inquiries answered by the division during the year was 1,646, as compared with 841 for the preceding year.

The division issued the Exporters' Manual on Rubber Footwear and Clothing, containing about 300 pages of basic information regarding the trade in these products in 100 foreign markets. A survey of International Trade in Machinery Belting was one of the publications brought out. The compilation of material for export manuals on the trade in mechanical rubber goods and in rubber sundries and specialties has been steadily carried on, and it is expected that these will be issued before the end of the current calendar year.

Exporters were assisted in foreign-market analyses through new classifications of rubber-export statistics containing several new items; through improved statistical information regarding exports from other manufacturing countries (made possible through the purchase of export statistics from a fund established by the Rubber Association of America); through the tariff manual, Import Duties Levied on Rubber Products Throughout the World, which is kept

up to date by means of monthly revisions; and through special circulars and correspondence.

An outstanding feature of the work of the shoe and leather manufactures division was the increase of 80 per cent in its outgoing correspondence—indicating a very substantially augmented service.

A world survey of shoe-polish markets was undertaken at the request of the National Association of Shoe Polish Manufacturers, and the resulting information was assembled and disseminated to the trade in mimeographed bulletins. A world survey of markets for horse collars and pads is now under way. A questionnaire on the methods of manufacture of leather footwear in important shoe-manufacturing countries has been forwarded to the bureau's foreign representatives.

Several important manufacturers sent representatives to Washington to spend some days in consultation and to review the available material. Upon request, sales compaigns in foreign countries have been outlined—resulting, in numerous instances, in satisfactory business abroad. Visitors from all parts of the United States have called to discuss foreign trade possibilities.

The division has been called upon by the National Boot and Shoe Manufacturers Association, the New England Shoe and Leather Association, and the National Association of Leather Glove and Mitten Manufacturers for extensive research work. The War Department has been advised as to dates for placing contracts for Army shoes; this service has been the means of a large saving to the Government, and the placing of these contracts at certain periods benefited the industry.

The specialties division handles a large number of unrelated commodities—including such classes as business equipment, furniture, ceramics, musical merchandise, jewelry, sporting goods, motion pictures, photographic goods, toys, professional and scientific instruments, printed and lithographic matter, etc.

The demands made on this division have taxed its capacity to the limit. As a direct result of the division's efforts, very satisfactory business connections have been established and substantial orders placed for American specialties during the past year—individual orders attributable to this service ranging as high as $17,000. Such initial orders, even though they may not be large in themselves, are a step toward future substantial business.

Also, by keeping specialties exporters fully posted on conditions abroad, outlining definite sales campaigns, and warning against various pitfalls, the division caused "invisible" savings and paved the way toward a more intelligent future development of some very profitable markets.

The division has conducted various surveys of foreign markets for specialties, studied foreign competition, and kept in as close contact as possible with the several trades.

Two trade information bulletins were issued on furniture, covering Europe and the Far East. Many brief surveys of a similar nature were issued in special circular form. More than 1,000 opportunities for the sale of American specialties abroad were published during the year in Commerce Reports.

Bureau activities with respect to advertising have been centered in the specialties division, which maintains special files, answers inquiries, and goes over all material for bureau publications having to do with that subject. The division cooperates with an advisory committee representing the advertisers and the agencies. To increase the efficiency of this advertising service, world-wide surveys will be made in order to obtain needed data.

The specialties division endeavors to keep in touch with the activities of the export merchants, commission houses, and allied enterprises, with a view to affording service to this important element in our export trade.

The motion-picture section materially strengthened its contacts with the industry. It cooperated actively in efforts to ward off discriminatory legislation by foreign governments against American films. Congress has appropriated $15,000 (available July 1, 1926), which will give this section official status and will enable it to enlarge the scope of its activities both abroad and at home.

As in previous years, the division has maintained close contacts with trade organizations representing the various industries within its field.

The textile division has continued its efforts to effect economies in Government purchases of textiles and to eliminate waste in the textile trades. The chairmanship of the textile committee of the Federal Specifications Board is now held by the chief of this division. His intimate contact with the trade has proved advantageous in furthering the work of establishing Government specifications for textiles which by conforming more nearly to commercial standards serve at once the interests of the Government and satisfy the trade, in that they enable more manufacturers to bid on Government contracts for supplies.

Converters, aided by the Bureau of Standards and the textile division, have been attempting for some time to produce a fast-color khaki that would meet the military specifications of the United States Government. Their efforts have been successful, and during the past fiscal year the Marine Corps placed orders for 450,000 yards of khaki in two lots with American manufacturers. In the past this goods has usually been bought in England.

Similarly, silk cloth for parachutes has been imported from Japan. American silk manufacturers, cooperating with the Bureau of Standards and the textile division, have been developing a type of parachute cloth which will form the basis for future specifications of this material.

Work was done in connection with the devising of cartons to reduce the cost of shipping blankets.

The textile division, with the assistance of field officers of the bureau, helped cotton exporters to arrange for settlement of accounts on which for various reasons difficulties in securing payment had been experienced in Spain, Czechoslovakia, and Poland.

An American silk company was unable to get its customary supplies of waste silk from China on account of the shipping strike in Canton last fall and faced the possibility of having to close its mills and throw hundreds of people out of work. Through the intervention of the textile division and the bureau's trade commissioner

at Canton, two shipments of waste silk were started to the United States and others were obtained later.

The textile division issued daily press releases, 9 regular bulletins (3 of which are weekly and the others monthly), and about 70 special bulletins.

SPECIALIZED TECHNICAL SERVICES TO COMMERCE

The activity of foreign countries in the revision of their customs tariffs and trade regulations has continued throughout this past year without abatement, and the resulting task involved in keeping abreast of all the changes in the commercial tariff and treaty relations in foreign countries, and their effect upon the competitive status of American goods, has taxed to the fullest degree the staff of the division of foreign tariffs.

Through the prompt "broadcasting" in the United States of the official details of changes in foreign tariffs and trade regulations, the division continues to perform valuable service. Its services have been directed to two objects—the promotion of trade and the elimination of waste. In the first of these functions it indicates openings for profitable trade made possible by a moderation of duty or related condition abroad; in the second it warns of the danger of waste and loss if new restrictions or requirements of foreign governments are not heeded.

An increasing number of firms is consulting the division before undertaking any new projects in which there may be tariff or trade-regulation angles. Thus a large automotive manufacturer, before sending a number of new representatives abroad, had them come to Washington for conferences. Again, an exhaustive study of the basis of tobacco import duties in Latin American countries was made for an exporter desirous of determining whether shipment in hogsheads or otherwise would be most economical.

Commerce Reports published a number of special articles taking up in detail tariff developments in foreign countries of particular importance to the United States; most of these articles consisted of analyses of the new trade régime following the more important tariff revisions of the year, such as the German, Greek, Bulgarian, Japanese, and Canadian.

The demand for copies of the trade information bulletin on sending samples and advertising matter to European countries having completely exhausted the supply, a revised edition was published. A handbook brought out on Taking Your Car to Europe has been warmly received and widely noticed throughout the country. Progress is steadily being made on the memoranda dealing with the consular and documentary requirements on shipments to Latin America.

In cooperation with the electrical division, the preparation of comprehensive tariff studies on the admission of electrical goods into the principal foreign markets has been advanced, manuals for Mexico and the Union of South Africa having been added to those for Australia and India previously issued. Progress is also being made in the preparation of tariff compilations on other commodities; a compilation of the import duties on confectionery in Latin American countries has been completed, and a study of import duties on office appliances in the world's principal markets is well under way. This

is in addition to the various intensive tariff studies of individual lines for special occasions or particular concerns or organizations; such smaller studies form part of the division's regular daily work.

Another phase of service that results in considerable savings to American merchants and manufacturers is to be found in the bureau's activities in extricating them from difficulties they have already run into. These services are actually carried out in cooperation with the Government's foreign representatives, although in some cases an inquirer's problem is fully analyzed in the division at Washington and the alternative courses of action are pointed out, with their advantages and disadvantages.

The advice of the Department of Commerce has continued to be sought by the Department of State in connection with the negotiation of commercial agreements.

As the extent of the services rendered by the division of commercial laws has become better known to American exporters and their counsel, the problems presented to the division have grown more complex and the inquiries increasingly technical.

A numerical increase of 12½ per cent in services rendered during the past year (in one section the increase was 60 per cent), and 400 per cent since the first year of its existence, indicates only slightly the increase in volume and value of the services rendered. During the past year, in addition to the legal, insurance, patent, trade-mark, and unfair-competition work of the division, special stress has been placed on the arbitration of commercial disputes, and the taxation of American business in foreign countries. In April, 1926, a special section devoting its entire time to the study of this last problem was established.

In various sections of the world, active piracy of trade-marks, infringement on copyrighted material, and copying of patent machines have resulted in repeated requests for assistance, and in a very large number of cases the division has been of service in notifying the interested manufacturers of such practices and endeavoring to bring about remedial measures.

Special services were rendered in preventing piracy of the new word "rayon" in many foreign countries. Outstanding services also were rendered the automotive and radio industries with regard to conditions in Germany and Japan. The prevention of unauthorized reproduction of American motion pictures abroad has been the subject of special study and attention.

The division has aided materially in the elimination of waste through the activity of its section of trade adjustments, actually rendering services that resulted in the savings of thousands of dollars and materially promoting the good will of foreign buyers toward American exporters by removing misunderstandings. Approximately 500 disputes, ranging from $10 to $325,000, have been handled by this section.

The division continually refuses to handle collections but has, by practical advice, aided in many problems of this nature. As a result of services rendered by the division, goods have been salvaged from bankrupt estates and, with the cooperation of the bureau's foreign offices, merchandise refused by consignees has been handled with a minimum loss to American exporters.

By making information available, by informing exporters and their counsel of the methods of transacting business abroad and the

various restrictions imposed by foreign law, and by giving publicity to the laws of foreign countries which are apt to impose undue burdens on American business, the division has saved American exporters much expense and delay, the dollar amount of which is incalculable.

The continued expansion of American financial interests abroad has resulted in an increased demand for the services of the finance and investment division and a marked extension in the variety and scope of its activities.

During the past year investment bankers consulted the finance division more freely than ever before regarding various phases of foreign loans under consideration and drew much more heavily upon the division's sources of information. The services of the division have been more freely utilized also by the commercial banks of the country, particularly in connection with developments in the banking, currency, and exchange movements in foreign countries.

To keep its clientele more fully informed as to current financial developments abroad, the division enlarged the scope of its mimeographed circulars and issued them at more frequent intervals. In special cases needed information has been sent by telephone or telegraph to the district and cooperative offices of the bureau for more prompt dissemination among the persons most interested.

Detailed and comprehensive analyses of the public finances of foreign countries are of prime importance for the bankers and investors of a country that is lending a billion dollars or more abroad each year. Complete and up-to-date studies of this character are not readily available to the public in any country. Several years ago the finance division began the preparation of a series of reports on the public finances of Latin American countries and has published such reports for Chile, Bolivia, Peru, and Colombia. Investment bankers and others state that they have found these studies to be of great practical value.

A similar series for the Far East was instituted during the past year with the publication of a comprehensive monograph on Currency, Banking, and Finance in China, which was prepared by an expert on far eastern finance attached to the division.

These studies on public finances are supplemented by annual reports on Latin American and far eastern budgets, by items in Commerce Reports, and by the circulars which the division issues at frequent intervals.

The total foreign investments of the United States now exceed $11,000,000,000. This total does not, of course, include inter-ally debts. No other nation, with the exception of Great Britain, has ever placed such a huge sum abroad and none has ever invested abroad at the rate maintained by this country since 1914. Nearly one-half of our foreign investments are direct in character—that is, made by American capitalists on their own account and in most cases without resort to the securities market. The time has come to compile detailed and comprehensive data on the character, extent, and location of these "direct" investments. Accordingly, this division proposes to take up this study in a comprehensive manner during the new fiscal year. A start has already been made in bringing down to date a monograph on Investments in Latin America which the bureau issued in 1918. During the past year the division published trade information bulletins covering the Argentine, Uru-

guayan, Paraguayan, and Chilean sections of this monograph and plans to complete the revision in this form during the present year.

Further refinements and additions were made in the study, Balance of International Payments of the United States, which the division prepares annually. Because of the increasing interest in this study, the report for the year 1925 was distributed free of cost to about 15,000 persons.

In addition to its regular activities, the division has rendered, through the Secretary of Commerce and otherwise, special services to the World War Debt Funding Commission in connection with negotiations for the settlement of foreign government indebtedness to our Government.

The commercial intelligence division functions as a clearing house of information respecting merchandise buyers located in foreign countries.

To the files of this division there are added, daily, data most valuable to American exporters in the maintenance and development of their oversea trade, and these data have been used more extensively during the fiscal year just ended than in any other similar period of the bureau's existence.

The most notable constructive work of the division has been the development of its directory of foreign buyers, which at this date contains detailed reports on approximately 225,000 foreign firms—more than 25,000 reports having been added during the past fiscal year. Practically every report that has been added to these files was in response to specific requests of bureau clients.

By a reciprocal arrangement with American banks, trade organizations, and others it has been possible to supplement very extensively the reports already on hand, keeping them of vital interest to the users of the service.

Bureau clients, during the fiscal year 1926, were supplied—in response to their requests—with 49,802 World Trade Directory reports (so called). In comparison with the preceding year this was an increase of 60 per cent, which is significant of a rapidly growing interest in foreign trade on the part of our exporters. This branch of the bureau's service is particularly useful, because the World Trade Directory report gives, in much detail, information as to the character of the foreign dealer's sales organization and points to all available sources of credit information to enable the American seller to rate the buyer as a credit risk if occasion requires.

During the past fiscal year, 1,096 commodity lists have been added to the bureau's very extensive listing of foreign importers and dealers in specific commodities, so that at the present time the names of more than 365,000 foreign importers, wholesale and retail dealers, sales agents, commission merchants, etc., are available in mimeographed list form or special typed lists covering practically every exportable commodity, for nearly every foreign country. These lists are not automatically distributed to a mailing list, but are kept on file at the bureau in Washington and its district and cooperative offices and are furnished to bureau clients upon request. New issues of these trade lists and revisions of old lists are being announced weekly in Commerce Reports. During the fiscal year 1926, 578,000 copies of commodity trade lists were supplied upon request.

Much effort has been concentrated, this past year, in the development of accurate information respecting foreign sales agents qualified to act for American exporters, and this has necessitated considerable correspondence with the field representatives, as well as with "contacts" in this country. As a result, it has been possible for the commercial intelligence division, in cooperation with the various commodity divisions of the bureau and its foreign field force, to be of very practical assistance to many bureau clients in the selection of sales agents in foreign markets. There is ample evidence that this service is much appreciated by the users.

Reports to an extensive list of American banks relative to foreign firms that have failed or gone into bankruptcy or liquidation, as well as reports respecting foreign firms or individuals resorting to unethical trade practices, have been regularly maintained and have, it is felt, been a valuable contribution of the bureau in making foreign trade safer for the American exporter.

The work of the division of statistical research consists of research in the fields of economics, statistics, and geography as related to industry and commerce. It compiles the Commerce Yearbook and the Statistical Abstracts of the United States, and prepares bulletins and articles analyzing trade and other statistics.

Since the initiation of the Commerce Yearbook in 1922 it has gradually become standardized in form, and comments of the press, of business men, and others show that it now meets very satisfactorily the demands of the public. The 1925 issue is being delivered early in July, 1926—about equaling the record time of the 1924 issue. A considerable amount of additional material was included, particularly in the sections relating to foreign countries and foreign trade of the United States.

As a result of greater standardization, much time and expense have been saved in the preparation and printing of the Statistical Abstract of the United States.

Bulletins were prepared during the year analyzing the foreign trade of the United States by calendar and by fiscal years, and summarizing the trade statistics of the principal countries of the world. A number of extended articles on these same subjects were published in Commerce Reports.

This division cooperated with the division of statistics in a revision of the classification of exports and imports with a view to securing consistent and logical grouping throughout.

The division has continued to supply data regarding the United States for standard statistical annuals and other publications.

The work of the translation section has expanded to a marked degree. Ordinarily only foreign-language material of a difficult and technical character is submitted to this division, simpler material being translated in other divisions. The translations during the year covered 14 languages, and many of them required advanced knowledge of the subjects concerned. This section also selects and digests on its own initiative foreign published material useful in the work of the bureau.

The geographic section has assisted in the preparation and revision of many maps and of numerous publications of the bureau dealing with the geographic aspects of industry and commerce.

The division of statistics compiles and prepares for publication statements of imports and exports of merchandise, gold, and silver;

of vessels entered and cleared; and other statistics of the trade of the United States with foreign countries and noncontiguous territories. The division issues regulations and instructions to collectors of customs regarding the statistical reports. The correspondence and inquiries relating to United States foreign-trade statistics are handled in the division. The division prepares the statistical tables published in the annual report on Foreign Commerce and Navigation and in the Monthly Summary of Foreign Commerce.

In order to expedite the issuance of the principal import and export data, it is planned to issue Foreign Commerce and Navigation in two volumes, beginning with the report for the calendar year 1925.

The second annual report showing quantities and values of the principal articles exported from each State was issued for the calendar year 1925.

Weekly reports are now published showing the exports of principal grains and flour; exports of pork products from principal ports; imports of raw wool into Boston, New York, and Philadelphia; and imports of wheat from Canada. A special report on imports of cotton cloth into five principal ports by specified trade designations is issued monthly for the information of cotton manufacturers. A similar report is compiled for imports of wool cloths and dress goods.

About 15 monthly statements, showing the exports and imports of principal articles and groups of articles, are prepared from data compiled for the Monthly Summary and are published before the Summary is sent to the printer. Special statements to the number of 253 are issued each month showing exports and imports of principal selected commodities in complete detail by countries and customs districts; these are distributed in mimeographed form to a mailing list of more than 30,000 addresses.

The outstanding work of the domestic commerce division at the present time is the compilation of a series of market analyses for the various homogeneous sections of the United States. These are predicated on the purpose of eliminating waste in marketing through providing more complete information and a better understanding of these regions from both the commercial and industrial standpoints. Extensive field work and statistical analysis are utilized in order to obtain the information from the most direct sources available. During the past year the first of these studies was issued under the title Commercial Survey of the Philadelphia Marketing Area. There are many evidences that this has been of practical assistance to business men in laying their plans for sales and advertising campaigns. A second study—more ambitious in that it covers a wider territory—is practically complete for the southeastern area of this country, embracing the States of North and South Carolina, Georgia, Florida, Alabama, and eastern Tennessee. It is proposed to carry out three additional market surveys during the present fiscal year. Work has already started in the New England area and in the California and Pacific southwest territory.

To keep these market surveys up to date, the division plans to establish investigators in central commercial points. During the past year two men have been appointed for this service, and others will be chosen soon.

Another project of major importance executed in this division during the past year is the Atlas of Wholesale Grocery Territories,

which will appear in the near future. Based upon a study of actual practice in wholesale grocery trade of overlapping zones of competition, rail and water transportation, good roads and trucking facilities, and transportation charges, there have been outlined 183 primary wholesale points and 196 secondary wholesale points from which groceries can be distributed most efficiently. For each primary and secondary center there has been delineated the normal trade area to which groceries and allied products naturally flow from those cities. Complete statistical data on population and retail outlets have been added.

On request of the paint and varnish industry, a study was made and published of the domestic markets for those products. A statistical analysis of productive trade territories in their varying degrees of importance has brought out clearly the possibilities of eliminating waste sales effort or excessive advertising expenditure for these lines.

The retail world has been assisted by two contributions of original research. Pamphlets on Department Leasing in Retail Stores and on Vehicular Traffic Congestion and Retail Business have been prepared through intensive studies of these problems.

A list of all agencies and their products in the field of market research is to be issued shortly as Market Research Agencies.

Another important project has been the revision during the past year of the Directory of Commercial and Industrial Organizations, the only source for accurate knowledge regarding trade and commercial associations.

As an outgrowth of this work, it was decided to revise also the department's study, Trade Association Activities, and this work will be ready shortly.

Not the least of the division's activities has been the answering of inquiries from American business men. During the past year 3,305 such special inquiries, each requiring extensive research, were received and answered—representing an increase of about 60 per cent over the work for the preceding fiscal year. Functioning thus as a clearing house of commercial information, the domestic commerce division has been helpful, in a great variety of ways, to many organizations.

An economic survey of the project for a deeper waterway from the Great Lakes to the Atlantic was completed during the past year by the transportation division.

The standardization of terms and conditions in the warehouse industry was the subject of several conferences at Washington, and at a meeting on April 30, 1926, of representatives of various industries, shippers, members of trade associations, bankers, railway men, and officials of the American Warehousemen's Association, the adoption of standard terms and conditions was considered and certain conclusions formulated. In accordance with the unanimous action at this meeting, the department has sent out circulars to the interested parties, with the understanding that when a sufficient number of acceptances are received the adoption of these standard terms and conditions will be recommended by the Department of Commerce.

The division has continued its study of container construction in cooperation with the domestic packing advisory board. The sale of the publication Paper Wrapped Packages has already exceeded 69,000

copies. Five other bulletins (prepared in the transportation division) on various types of container construction have been approved, and several are ready for the press.

Following the publication of the trade information bulletin on The Through Export Bill of Lading, several meetings were held with a view to furthering the use of this form of bill of lading.

The division has established and maintained close contacts with the newly formed regional advisory boards of the American Railway Association. Through the Florida Regional Advisory Board and the Florida State Chamber of Commerce, the division inaugurated during the year a transportation field survey for that State; this survey is now proceeding, and its results will be published.

The shipping section has continued its reviews of the facilities for transoceanic transport of cargo and passengers. During the coming fiscal year the bureau will issue a study outlining the growth of this control by comparisons of the situation before the war and in 1925. A trade information bulletin, Ocean Freight Rates in United States Foreign Trade, was completed.

The highways section assisted materially in the preparation of data for the Pan American Highways Conference at Buenos Aires and performed similar work in anticipation of the part to be taken by the United States in the Fifth International Roads Congress to be held at Milan in September, 1926. Surveys of motor roads in Australasia, India, and South Africa were begun.

The transportation division continued to handle matters pertaining to the transportation aspect of aeronautics; these consisted largely of inquiries about the extended operation of air lines abroad, comparisons with commercial flying in the United States, nature of commodities carried by air, etc. Items of interest from abroad were published in Commerce Reports or otherwise made available. In March, 1926, the division began the publication of Foreign Aeronautical News. This is issued biweekly and as the news justifies. The list of those requesting the bulletin is rapidly growing, and the publication is being enlarged. The division contributed substantially to the report on Civil Aviation prepared by the Joint Committee on Civil Aviation of the Department of Commerce and the American Engineering Council and published in June, 1926.

Publications compiled by the division during the year included three in the series covering Latin American railways, a study of motor roads in Latin America, and others already referred to.

STANDARDIZATION WORK

The section on Pan American standards, with the cooperation of the Bureau of Standards and aid from private sources, has completed tentative plans and agenda for the Second Pan American Conference on Uniformity of Specifications. This conference is to be convened in the United States during 1927.

In preparation for the Pan American Highway Congress held in Buenos Aires, Argentina, in October, 1925, a bilingual glossary (Spanish-English) of automotive terms was compiled and, as well, one covering road terms and highway equipment. Twenty standard specifications for iron and steel products were translated into Spanish during the year and issued as revisions of editions in the bureau's

Industrial Standards Series, while translations into Portuguese of 15 similar standards have been practically completed and prepared for printing.

An increasing number of inquiries from the United States and abroad on engineering subjects and relating to standards for merchandise entering into foreign trade have been directed or referred to the standardization section.

This bureau continued to lend its aid to the Bureau of Standards in the development of companion volumes to the National Directory of Commodity Specifications—namely, Specifications for Household Commodities, Encyclopedia of Specifications, and Treatise on Specifications. The Directory, which was published in September, 1925, contains reference to about 27,000 specifications for more than 6,000 commodities and is now in its third printing.

COMPARATIVE STATEMENT OF SERVICES RENDERED

In the following table are figures presenting a concise picture of the development, during the past five fiscal years, in the more important phases of the bureau's activity:

Items	Fiscal year ended June 30—				
	1922	1923	1924	1925	1926
Commercial services rendered:					
Total services rendered	[1] 505,661	[1] 881,521	[1] 1,168,972	[1] 2,041,250	[1] 2,032,825
Commodity—					
Agricultural implements	6,210	14,014	28,353	47,841	29,753
Automotive	17,674	56,232	105,459	181,606	228,727
Chemical	----------	36,984	66,601	105,477	119,613
Coal	[2] 10,877	5,356	6,711	8,744	4,199
Electrical	7,822	32,636	64,355	112,245	133,462
Foodstuffs	28,565	103,373	143,579	142,306	155,301
Iron and steel	7,456	27,918	52,288	112,559	221,252
Leather	2,923	12,881	23,471	29,108	16,858
Lumber	10,844	26,177	37,826	70,483	91,393
Machinery	11,178	46,399	71,999	99,038	117,200
Minerals	(3)	[4] 18,566	[4] 21,371	45,049	23,973
Paper	2,829	13,668	16,923	17,518	11,785
Rubber	4,114	14,407	19,894	21,208	14,260
Shoes	3,803	10,211	11,892	10,388	7,148
Specialties	15,948	75,023	97,860	230,223	185,667
Textiles	18,503	64,429	80,669	106,195	106,590
Technical—					
Commercial law	3,998	10,376	14,727	14,543	16,318
Finance and investment	----------	7,660	13,726	15,546	20,578
Statistics (foreign trade)	10,996	23,530	28,711	29,871	50,749
Transportation	5,244	15,193	20,940	28,620	25,806
Tariffs (foreign)	16,300	19,764	25,730	27,062	30,031
Domestic commerce	----------	----------	19,148	51,370	65,559
Miscellaneous	320,377	246,724	215,887	585,620	422,162
Regional and reclassification of above—					
Latin America	20,619	132,486	232,200	329,737	288,649
Near East	5,905	29,287	49,917	52,464	42,718
Far East	15,399	93,224	173,763	253,875	246,990
Eastern Europe	4,837	29,812	55,617	53,295	40,390
Western Europe	32,378	269,244	339,679	745,318	831,043
Foreign trade opportunities:					
Number of individual opportunities published	2,960	4,290	3,846	4,909	5,389
Number of cases in which reserved information was furnished	127,385	332,127	345,784	446,865	437,059
Trade lists (lists of foreign merchants) ..... number of copies	71,900	181,049	417,195	687,159	578,524
Special informational circulars (mimeographed) ..... number of copies	350,000	1,000,000	3,100,000	3,713,800	3,327,120

[1] Does not include services rendered by the foreign service of the bureau and by the cooperative offices maintained by the bureau in chambers of commerce and boards of trade in the United States.
[2] Coal and petroleum.
[3] Shown under "Coal."
[4] Petroleum only.

Greater systemization and efficiency in numerous phases of the work account for certain apparent decreases in the table above. In many cases data are now being sent to bureau clients automatically (for example, through a regular, routine circular service), so that the firms no longer need to send in so many of the individual inquiries that go to make up the tabulated total of services.

COOPERATION WITH OTHER DEPARTMENTS

The bureau's liaison office has continued to make steady progress in effecting closer relations between the bureau and other Government departments.

Visiting consuls have been shown how their reports are utilized, and the aims and scope of the bureau's work as a whole have been fully explained to them. Special care has been taken to familiarize them with the work of the commercial intelligence division. In May of this year the graduating class of the Department of State Foreign Service School visited the bureau in a body.

Through the efforts of the members of the liaison committee, meeting informally at frequent intervals, much has been accomplished in reducing to a minimum the duplication of work between the field officers of the various departments. The relations between the field officers have grown increasingly cordial in all parts of the world, and it is believed that this is due in no small measure to the efforts of the liaison officers to guard against the issuance of conflicting instructions by their respective departments.

The system of sending consular officers questionnaires carefully reviewed by the questionnaire committee has continued to function with highly satisfactory results. Much time and effort on the part of the consular officers have been saved through the questionnaire committee's avoidance of unimportant investigations. During the year, 1,250 questionnaires were sent to the consulates. The practice of sending weekly to the liaison officers of other Government departments a list of reports received from the bureau representatives has been maintained, and the reports requested have been made available to them.

Careful records have been kept by the liaison office of the action taken by the bureau on consular reports. These records are of great assistance to the State Department in grading the work of its consular officers. That department has also expressed its appreciation of clippings from the press and from trade journals relating to the activities of consular officers and copies of special circulars issued by the bureau giving the text of consular reports as published, which the liaison office has supplied regularly.

RECOMMENDATIONS

1. *Foreign service bill.*—It is felt that possibly the most urgent need of the bureau at the present time is the enactment of the legislation that was considered by the last session of Congress as the Jones bill—providing for the establishment of the Foreign Commerce Service on a permanent basis. It is vitally essential that the service should be given a firm foundation in law, a definite organization, and clearly indicated salaries, functions, and prerogatives, with

requisite legal authority vested in the persons charged with its direction. Under such circumstances the service would provide a genuine career and would prove more attractive for men of high caliber whom the bureau is desirous of retaining or procuring for its offices abroad. It is the earnest hope not only of the bureau administration but—it may confidently be said—of the business community in general that this needful legislation will soon be placed on the statute books.

2. *Additional field offices.*—More field offices of the bureau are needed, both in the United States and abroad. In the fiscal year 1926–27 there will be 17 district offices in this country, but it is believed that various others would prove eminently useful and profitable. What such offices are capable of accomplishing has been shown on pages 116 to 121 of this report. Among the cities where similarly effective service might be rendered are Los Angeles, Kansas City, Cleveland, Indianapolis, Mobile, Denver, Omaha, Norfolk, Jacksonville, and Wilmington (Del.).

In the foreign field also, expert commercial service is needed at places that can not be covered adequately from the bureau's existing posts. Berne (Switzerland), Budapest (Hungary), Oslo(Norway), Dublin (Ireland), and Caracas (Venezuela) may be suggested as prospective posts where commercial attachés of this department could undoubtedly accomplish much. In the Far East, Auckland (New Zealand) and Singapore (Straits Settlements) offer opportunities for an active service of trade promotion and information. Trade commissioners are needed to cover the Near East, West and East Africa, and Algiers. At La Paz, in Bolivia, conditions seem to warrant the establishment of a bureau office.

3. *Specialists for existing foreign offices.*—It is highly desirable that the bureau should be enabled, through additional appropriations, to employ a greater number of specialists for its existing foreign offices. Naturally, a commercial attaché or trade commissioner in charge of a foreign office can not be equally well versed in the details of all the innumerable American industries and interests that he is endeavoring to serve. Unless he has the necessary specialists under his direction, it is difficult to provide the full amount of information that a given industry in this country has a right to expect. A degree of specialization is already in force in some of the larger offices, but the system should be considerably extended. The making or the losing of a sale abroad is often dependent on some relatively minor technical detail. If the American manufacturer does not know what is needed with respect to this point, his efforts may be frustrated. And he can be kept adequately informed on such matters only through the watchful, unremitting service of men in foreign countries who are capable of specialization and who, moreover, can give their entire time and attention to trade questions of this kind. In connection with this aspect of the foreign service, it should be stated that it is considered very desirable to appoint a special lumber trade commissioner for work in Argentina and another special trade commissioner to devote himself wholly to a study of the developments in the Brazilian coffee situation.

Very truly yours,

JULIUS KLEIN, *Director.*

BUREAU OF STANDARDS

DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS,
Washington, July 1, 1926.

Hon. HERBERT HOOVER,
Secretary of Commerce.

DEAR MR. SECRETARY: I submit herewith the following brief report upon the work of the Bureau of Standards during the fiscal year ended June 30, 1926. The various outstanding accomplishments are grouped according to the subjects for which Congress had made specific appropriations. This is by no means a complete report of all work accomplished, but the examples cited have been chosen to give a reasonably accurate idea of the field covered in each case.

GENERAL ACTIVITIES

Organization.—For the first time in many years the bureau now has a complete administrative and scientific roster. Some important changes in the divisional organization were carried out and will make for greater efficiency through a more logical grouping of the work. The sections devoted to rubber, textiles, paper, and leather have been formed into the division of organic and fibrous materials, while the new ceramics division includes work on clay products, glass, enamels, cement, lime, gypsum, and stone, including the sections to be transferred from the Bureau of Mines on July 1.

Contacts with industry.—Contacts with industry are maintained on the one hand by means of advisory committees and on the other hand by research associates. There are approximately 80 of these advisory committees composed of technical representatives from the various industries interested in the bureau's work. The research associates are stationed at the bureau by industry, usually through trade associations, and during the past year there were 62 of these associates representing 36 industries, working on fundamental problems of immediate industrial concern. The results of this cooperative work are published by the bureau and thus made available to all. This arrangement continues to work very satisfactorily and has the advantage of making possible more prompt solution of these problems than would otherwise be the case under the limitations of the bureau's own staff. The bureau's equipment has also been used more effectively than would otherwise be the case. It is estimated that this work represents an outlay at the bureau of some $500,000.

The bureau's staff is also represented on many technical committees of the engineering societies. This is very advantageous in keeping the bureau in close touch with programs of research, and

much of the bureau's work is planned with the advice of such national committees.

Visiting committee.—This committee, established by law "to visit the bureau at least once a year, and report to the Secretary of Commerce upon the efficiency of its scientific work and the condition of its equipment," met at the bureau twice during the past year and has given particular attention to the financial needs of the bureau to meet the ever-increasing demands from the public and Government for testing and research, as embraced in two reports to the Secretary of Commerce. The present personnel of the committee is: Ambrose Swasey, Dr. S. W. Stratton, Gano Dunn, Dr. William F. Durand, Dr. W. R. Whitney.

International relations.—The bureau has taken part in three important international conferences held in this country, the first dealing with the international standardization of screw threads, preceded by an Anglo-American conference; the second on electrotechnical standardization; and the third looking to the formulation of an international body concerned with standardization projects in general. In all three fields definite advances were made.

A first Pan American standardization conference was held in Lima, Peru, and a second will be held in this country in 1927. Progress in all these fields will undoubtedly be slow, but we may expect eventually great industrial and commercial benefits to accrue as it becomes possible to facilitate and systematize the nomenclature and specifications for the commodities that enter into international trade.

Informal conferences have also been held with foreign standardizing laboratories on questions relating to length, sugar, thermometric, photometric, electrical, and X-ray standards.

A sum of 15,000 francs was awarded to the Bureau of Standards by the Institut International du Froid in recognition of the work of the laboratory in the determination of the thermal properties of ammonia. This sum is being administered by the National Research Council and is being utilized for the preparation of tables of the thermal properties of methane, based on experimental results which were obtained by the Bureau of Standards in 1917 and 1918.

Weights and measures conference.—The Nineteenth National Conference on Weights and Measures was held in May and was unusually successful, there being 27 States represented. Important progress was made in preparing model legislation on weights and measures subjects for the use of the several States and municipalities.

State utility commisison engineers conference.—The third technical conference of State utility commission engineers was attended by representatives of 14 State utility commissions and 2 Provinces of Canada. Many technical problems relating to the work of these commissions were discussed.

New ceramics committee.—There was formed a new advisory committee on ceramics, which met several times at the bureau to help lay out the program of work for the newly organized division of ceramics, into which is being correlated the work of the Columbus station transferred from the Bureau of Mines as of July 1, 1926.

American engineering standards committee.—The bureau has continued actively its cooperation with the American engineering stand-

ards committee, is sponsor for 13 standardization projects, and is represented on 69 committees having for their object the formulation of "American standards."

Federal specifications board.—This board, under the general supervision of the Chief Coordinator, has continued to function actively during the year and has issued in that period 114 specifications, making the total number of master specifications now in force 414, which are mandatory on all Government establishments. These purchase specifications of the Federal Government are being used more and more by local governmental and institutional bodies and by industry. There is a great deal of experimental research work being done for the Federal Specifications Board, most of which is carried out at the Bureau of Standards.

National screw thread commission.—The life of this commission has been extended indefinitely by act of Congress approved by the President April 16, 1926, which action puts the commission in a position to plan its work on a constructive, long-time basis. This is of particular advantage on account of the complexity of many of its problems, some of which take several years to mature.

During the year the commission was particularly active on matters of interest to the oil industry, the tap and die industry, electrical industry, specifications and tolerances for Acme threads, and for wrench-tight studs, bolts, and nuts; and threads for cutting and welding torches.

The commission has also cooperated with manufacturers and users of die heads and chasers used in connection with the production of threaded products and with the division of simplified practice. This cooperative effort has resulted in the elimination of many threads of special diameters and pitches and in the adoption and use of the screw-thread standards approved by the commission.

Relations to Government departments.—The bureau is authorized to receive funds for specific research projects from other departments, and in pursuance of this policy in the past year the bureau has received $173,250 for the support of 40 projects, representing work for 15 Government establishments. In addition, the bureau does a great deal of consulting and specification work for the other departments.

Publicity.—In addition to its regular scientific and technologic publications describing the work of the bureau there is issued a monthly Technical News Bulletin, giving brief references to progress in current work, and in addition there are published many papers by the staff in outside technical journals. There are also released to the press numerous short accounts of interesting achievements, together with many photographs illustrating the bureau's work. These have been well received all over the country.

Tests completed.—The tests completed during the year numbered 179,849, involving 659,858 determinations and having a fee value of $675,046.18. An itemized statement of tests completed is given in the table following.

Number of test items, determinations, and fee value for tests completed during the fiscal year ended June 30, 1926

Kind of instrument or material, class of test, or nature of service rendered	For public			For Government departments and State institutions (not Bureau of Standards)		
	Number of test items	Number of determinations	Fee value	Number of test items	Number of determinations	Fee value
Electrical standards, instruments, and materials	816	921	$6,059.10	687	850	$5,510.90
Electric batteries				1,546	2,601	7,675.00
Electric lamps and lighting equipment [1]	173	197	518.00	2,894	2,919	13,184.00
Length measuring devices	192	701	721.65	148	1,242	1,223.75
Gauges and gauge steels	876	3,900	929.50	101	338	88.00
Miscellaneous dimensional determinations	2,928	12,632	2,377.60	303	1,325	524.90
Weights and balances	4,259	7,954	1,807.40	1,451	2,767	578.10
Scales	1	10	25.00	1,256	37,341	55,899.50
Timepieces	208	4,415	491.50	107	1,294	403.00
Volumetric apparatus	8,267	15,810	5,375.85	1,994	3,437	1,044.10
Hydrometers	958	2,874	1,430.25	500	1,500	551.00
Density determinations, etc	14	27	27.00	31	31	31.00
Laboratory thermometers	2,199	12,750	4,257.55	595	2,367	790.10
Clinical thermometers	34,382	137,528	2,775.84	26,235	104,940	1,706.84
Pyrometers	185	3,112	1,429.70	46	786	456.10
Insulating materials	29	66	250.00			
Fire-resisting materials				102	363	6,115.00
Fuels and lubricants	15	53	444.00	1,689	7,426	12,060.50
Viscometers, calorimeters, etc	140	575	459.15	43	113	633.00
Optical instruments and materials	293	542	2,671.30	888	981	645.00
Carbohydrates	7	91	70.50	1,943	2,939	3,069.50
Radioactive materials	1,046	1,097	6,645.50	16	16	70.00
Engineering instruments and appliances	78	78	714.00	1,027	1,078	7,338.00
Aeronautic instruments	10	14	29.00	408	1,038	1,858.50
Aerodynamic tests of models	1	1	15.00	51	144	875.00
Physical properties of engineering materials	33	57	207.50	2,666	5,926	10,254.35
Sound producing and measuring instruments	7	7	14.00	63	64	845.00
Acoustic properties of structures				6	6	300.00
Making of special castings				640	640	1,056.50
Fusible boiler plugs				332	332	830.00
Metallographic examinations				560	837	2,912.50
Miscellaneous metallurgical tests				279	1,887	2,315.00
Pottery and chinaware	8	11	8.00	361	1,475	5,415.00
Glass				9	11	55.00
Refractories and heavy clay products	2	3	5.00	38	134	546.00
Cement, concreting materials, lime, etc	30	56	257.50	6,783	11,519	45,729.00
Stone and sand-lime brick				21	31	156.00
Miscellaneous ceramic materials				608	916	4,846.70
Rubber	7	35	102.00	1,445	11,860	22,717.00
Textiles				5,758	15,883	27,036.00
Paper	107	190	350.50	1,630	4,547	6,833.00
Leather	10	30	39.00	252	1,246	1,876.00
Paint, varnish, and bituminous materials				1,385	12,006	26,140.50
Chemical analysis of metals	8	40	120.00	568	2,564	8,718.00
Chemical tests of miscellaneous materials	10	12	150.00	909	3,951	9,947.00
Distribution of standard samples	5,259		11,255.00	556		974.25
Total [2]	62,648	205,789	52,032.89	68,930	253,671	361,833.59

[1] In addition, the bureau inspected 1,459,201 incandescent lamps at various factories for other branches of the Government, the fee value for which would amount to $3,792.42.

[2] In addition, in connection with its own work of research and standardization, the bureau tested 36,406 items, involving 166,866 determinations, the fee value for which would amount to $254,988.09, making a grand total for testing work of 179,849 items, 659,858 determinations, and a fee value of $575,046.18.

Number of test items, determinations, and fee value for tests completed during the fiscal year ended June 30, 1926—Continued

Kind of instrument or material, class of test, or nature of service rendered	For Bureau of Standards			Total		
	Number of test items	Number of determinations	Fee value	Number of test items	Number of determinations	Fee value
Electrical standards, instruments, and materials	273	275	$901.35	1,776	2,046	$12,471.35
Electric batteries				1,546	2,601	7,675.00
Electric lamps and lighting equipment [1]	950	950	2,924.50	4,017	4,066	16,626.50
Length measuring devices	2	33	12.70	342	1,976	1,958.10
Gauges and gauge steels	2,596	6,853	1,441.25	3,573	11,091	2,458.75
Miscellaneous dimensional determinations	287	1,987	2,048.30	3,518	15,944	4,950.80
Weights and balances	552	1,287	454.00	6,262	12,008	2,839.50
Scales	6	74	73.00	1,263	37,425	55,997.50
Timepieces	21	401	61.00	426	6,110	955.50
Volumetric apparatus	465	748	603.30	10,726	19,995	7,023.25
Hydrometers	13	39	19.50	1,471	4,413	2,000.75
Density determinations, etc	783	783	783.00	828	841	841.00
Laboratory thermometers	266	1,132	293.10	3,060	16,249	5,340.75
Clinical thermometers				60,617	242,468	4,482.68
Pyrometers	108	908	625.61	339	4,806	2,511.41
Insulating materials				29	66	250.00
Fire-resisting materials	10	36	165.00	112	399	6,280.00
Fuels and lubricants	149	452	1,206.00	1,853	7,931	13,710.50
Viscometers, calorimeters, etc	136	213	583.00	319	901	1,675.15
Optical instruments and materials	643	1,736	4,626.00	1,824	3,259	7,942.30
Carbohydrates	20	147	584.00	1,970	3,177	3,724.00
Radioactive materials				1,062	1,113	6,715.50
Engineering instruments and appliances	93	94	291.00	1,198	1,250	8,343.00
Aeronautic instruments	16	79	225.50	434	1,131	2,113.00
Aerodynamic tests of models				52	145	890.00
Physical properties of engineering materials	95	281	1,090.75	2,794	6,264	11,552.60
Sound producing and measuring instruments	16	16	84.00	86	87	943.00
Acoustic properties of structures				6	6	300.00
Making of special castings	540	540	1,991.00	1,180	1,180	3,047.50
Fusible boiler plugs				332	332	830.00
Metallographic examinations	39	55	266.00	599	892	3,178.50
Miscellaneous metallurgical tests	442	1,191	4,382.00	721	3,078	6,697.00
Pottery and chinaware	17	21	167.50	386	1,507	5,590.50
Glass	41	59	205.00	50	70	260.00
Refractories and heavy clay products	134	1,119	2,407.00	174	1,256	2,958.00
Cement, concreting materials, lime, etc	902	1,866	4,718.75	7,715	13,441	50,705.25
Stone and sand-lime brick	17	23	320.00	38	54	476.00
Miscellaneous ceramic materials	251	390	1,095.50	859	1,306	5,942.20
Rubber	548	3,154	12,380.50	2,000	15,049	35,199.50
Textiles	316	1,255	5,768.00	6,074	17,138	32,804.00
Paper	25	75	125.00	1,762	4,812	7,308.50
Leather	10	56	127.00	272	1,332	2,042.00
Paint, varnish and bituminous materials	118	976	1,839.00	1,503	12,982	27,979.50
Chemical analysis of metals	613	2,737	7,830.50	1,189	5,341	16,668.50
Chemical tests of miscellaneous materials	352	1,491	3,473.00	1,271	5,454	13,570.00
Distribution of standard samples				5,815		12,229.25
Total [2]	11,865	33,532	66,191.61	143,443	492,992	420,058.09

[1] In addition, the bureau inspected 1,459,201 incandescent lamps at various factories for other branches of the Government, the fee value for which would amount to $3,792.42.

[2] In addition, in connection with its own work of research and standardization, the bureau tested 36,406 items, involving 166,866 determinations, the fee value for which would amount to $254,988.09, making a grand total for testing work of 179,849 items, 659,858 determinations, and a fee value of $675,046.18.

SALARIES ($516,760)

This fund provides for personal services of administration and operation; the establishment, upkeep, and comparison of standards; the development of methods of test, as well as most of the testing; and for the determination of fundamental constants of importance in physics, chemistry, engineering, and technology not otherwise provided for.

Constant of gravitation.—The Newtonian constant of gravitation is one of the fundamentally important constants of nature like the speed of light and Planck's constant of action. It occurs in the formula giving the gravitative attraction of any two bodies for each other and is independent of the nature of the attracting bodies. On this later point Einstein based his theory of gravitation.

The accepted value of this constant is 6.66 by 10^{-8} cm. ^{3}/ gm. sec.^{2} and is based upon the independent work of Boys and of Braun some 30 years ago. It is felt that laboratory technique has advanced sufficiently in this time to make it worth while to attempt the redetermination of this constant with the end in view of obtaining one more significant figure. This work has been in progress for the past 3 years and is now within sight of completion. A tentative figure of 6.653 by 10^{-8} has been obtained, subject to possible slight modification as additional results are computed.

Basic electrical standards and units.—During the past year definite progress has been made toward checking the bureau's electrical working standards by reference to the original basic standards, and also toward the establishment of units more precisely in accord with the fundamental definitions. Such work has to be reliable to at least 1 part in 100,000, and requires the choice and special training of a staff suitable for the work. During the year a new set of standard cells has been made the standard for voltage measurement; comparisons of such cells have been made with Great Britain, Canada, Japan, and Russia; details of methods for the accurate determination of the true values for the units of resistance and inductance have been worked out, and comparisons of standards of candlepower of different kinds have been made with the laboratories of Great Britain, France, and Germany.

Magnetic testing methods.—Work on magnetic testing methods has included the revision of Circular 17 on methods of making magnetic measurements; a critical analysis of current methods of testing sheet steel for electrical uses (leading to revision of the standard specifications for such tests); continuation of work on relation between magnetic and mechanical properties of materials, with several publications; besides important contributions to the general principles of magnetism, particularly the relation between magnetization curves and the degree of homogeneity of the material.

Commercial applications of measurements.—Other electrical projects have included measurements and collection of data on commercial aluminum as an electrical conductor, leading to the establishment of a tentative international standard value of conductivity for this material; periodic checks on the efficiency ratings assigned to their product by the larger lamp factories; and improvements in labor-saving methods of testing lamps described in a publication now ready for the press.

Elastic hysteresis research.—Elastic hysteresis may be defined in its restricted sense as the residual deformation of a spring, diaphragm, or any other pressure element at the end of a cycle of loading during which the load is increased to a given value and then decreased to the original value. Knowledge of the hysteresis characteristics of the various spring and diaphragm metals in relation to their other elastic constants is of importance in the design of instruments of

improved performance. Owing to the difficulty of measurement, little trustworthy information is available. It seems established that the elastic hysteresis can not be entirely eliminated due to the presence of purely statical hysteresis, but research may indicate better materials and ways of using them. Attention has been given during the past year to the development of a satisfactory method of evaluating statical hysteresis, as measured statically, if the hereditary hysteresis is negligible. Accordingly, it now seems possible to determine the statical hysteresis of the various metals under various conditions of loading by constructing tuning forks and measuring the damping. Simple bars are also under investigation.

Study of spectra of the chemical elements.—In cooperation with the National Education Board, the bureau has continued its investigations on arc, spark, and higher order spectral systems, and six publications describing the results have been issued. The quantum theory of spectroscopy—which considers the atoms of the elements as planetary systems, with each electron planet confined to certain selected orbits and radiating according to a simple frequency law as it drops from a higher energy orbit to a lower—has been a powerful aid in coordinating the numerous individual spectral lines of the chemical elements into consistent systems. These systems in turn are used for determining the theoretical constitution of the different atoms and their chemical relationships.

Improvements in aerial mapping.—Surveying by aerial photography is a war-time activity of supreme importance. Peace-time surveying by the same method, for the purpose of mapping areas and contours of watershed, woodland, etc., has become an important commercial activity. One of the greatest difficulties to overcome is the distortion which the very best photographic lenses introduce, especially the lenses used for enlarging the original protograph. The bureau has succeeded in practically eliminating this distortion without introducing other harmful aberrations, by inserting at the proper place in the camera a plate of glass of proper thickness. This device reduces flying time to about one-half that necessary before.

Eye protective blue glass.—The use of goggles or glasses for protecting the eyes of workmen engaged in electric or acetylene torch welding and cutting, reduction furnace work and the like, is mandatory. The need for protection against excessive radiant heat and the intense visible radiation has long been recognized, but in more recent years the invisible ultra-violet has been revealed as the most harmful of all. The glass used for protecting against the latter is usually brown, which does not afford metallurgical furnace workers satisfactory contrast between the melt and the furnace walls, hence they are likely to remove the glasses at critical times. The bureau has developed a blue glass which affords the proper contrast and at the same time cuts out the ultra-violet radiation.

Properties of ammonia.—Analysis of the results obtained on properties of ammonia showed that values of properties not directly determined but derivable from the results are in excellent agreement with the best direct determinations made elsewhere.

Low temperature plant.—The carbon dioxide refrigerating plant and the liquid-air plant furnished special low-temperature facilities to the other laboratories of the bureau.

Liquid hydrogen and other facilities, including assistance by the staff, were furnished to Prof. C. C. Bidwell, of Cornell University, for a research on thermal conductivities and specific heats of lithium, sodium, and lead at low temperatures.

Viscometry.—During the year the necessary equipment has been provided to furnish standard viscosity samples for calibrating viscometers, and to make the tests for determining viscosity and jelly strength of glue, as adopted by the National Association of Glue Manufacturers.

Tests of the "apparent viscosity" of airplane motor oils at 32° F. have been made in connection with a research on airplane engine lubrication undertaken for the United States Navy.

Testing of thermometers.—The number of clinical thermometers tested (60,617) greatly exceeds that for any previous year. A special appropriation made this possible. A revision of the test methods will reduce the time required to complete tests. Unfortunately it has not been possible to keep up to date in the testing of other thermometers, since the staff and facilities available are inadequate to meet the demands of manufacturers. The delay in certifying thermometers has caused severe financial loss to some makers.

Testing of pyrometers.—The testing of pyrometers has been kept practically up to date, but only by taking time which should be placed upon the maintenance of the bureau's high-temperature standards and the improvement of test methods.

Radio apparatus.—The bureau is constantly asked to test radio apparatus for manufacturers and users. Its staff and funds available do not permit it to carry out general testing in this field. As a matter of fact, for several years it has been necessary to refuse all tests except those of fundamental reference standards of manufacturers.

Development of improved methods of chemical analysis.—The properties of numerous materials such as paints, varnishes, bituminous and other kinds of protective coatings, detergents, rubber, refractory materials, wrought iron, and aluminum alloys have been studied with the object of developing improved methods of testing and particularly to assist in the preparation of specifications. Better analytical methods have been developed for aluminum, silicon, columbium, tantalum, uranium, and various other elements, and a special method was perfected for the detection of small amounts of aluminum in nonferrous alloys, the results of which work will save thousands of dollars annually to manufacturers. Purification and analysis of the platinum metals and their alloys have likewise been carried out. A method has been perfected for the preparation of pure rhodium wire, and improvements have been made in methods for accurate assaying of gold-filled metal for the analysis of dental gold alloys. An examination has been made of reagent chemicals and a critical study carried out in cooperation with the American Chemical Society on methods of testing and in the preparation of specifications for these materials. Determinations have been made of the chemical constituents of petroleum products, and automatic apparatus has been designed for analyzing respired air in connection with medical research and diagnosis.

Metallurgical tests for the Government.—Many duralumin specimens from the *Shenandoah* and *Los Angeles* have been tested for the

Navy in regard to embrittlement by corrossion. Fusible plugs for the Steamboat Inspection Service, invar tapes for the Coast and Geodetic Survey, bearing metals for the Fleet Corporation, and a variety of materials for other departments have been tested.

The experimental foundry has made iron, brass, aluminum, and special alloy castings for the bureau's shops and the Coast and Geodetic Survey. Melting and working platinum for the bureau's use has been continued.

Weights and measures.—The usual activities in connection with research, testing, and maintenance of equipment used in length, mass, time, capacity, and density measurements and in testing gas-measuring instruments have been continued. This work is of fundamental importance in carrying the national standards of weights and measures into science, industry, commerce, and everyday life. This is done through the testing of various types of length measuring devices, weights, balances, watches, chronometers, glass volumetric apparatus, hydrometers, gas meters, and meter-testing equipment, together with the necessary researches related thereto.

Construction of apparatus for laboratory and other purposes.—The construction division, consisting of the combined instrument and machine shops, woodworking, pattern, and glass-blowing shops, took care of all requirements for instruments and apparatus needed by scientific and technical divisions of the bureau, preparing all metals and other samples submitted for tests, also the standard steel and alloy samples for the chemical division, besides furnishing mechanical service to the laboratories wherever needed.

In the past a number of the mechanics have been assigned to some of the divisions to attend to their special requirements for mechanical service. This arrangement was discontinued on January 1, 1926. All mechanics are now members of the construction force, and better service has been obtained through this change.

A heavy demand was made upon the shops in the construction of apparatus and models for the Sesquicentennial Exposition.

Some of the instruments and apparatus constructed during the year may be mentioned:

Optical set-up for double galvanometer system, magnetic testing apparatus, 4 photometric sector disks of high precision, lens mounting for galvanometer mirror projection system, gauge for barrel measurements, calorimeter, 1 A. C. shunt 0.0005 ohm 1,000 amperes, 6 strain gauges, paint and varnish testing apparatus, 10 deflection measuring instruments, 24 laboratory telescopes, one 5-point rotary mercury switch, densitometer for measuring the density of photographic films, 6 optical aberration models, model of tire-endurance testing machine, model of tire dynamometer, electroplating demonstrating apparatus, pencil testing machine, and 11 fixed air con-
e rs.

Besides the usual construction work for the plant and repair and upkeep of buildings and office equipment, the wood shop constructed a number of wooden models and cases for exhibition purposes, also all the woodwork required in setting up the absolute electrometer, a humidity chamber for the paper and textile sections, woodwork for the new X-ray chamber, cabinets for dry-cell tests, and exposure racks for balloon fabrics. A number of pieces of glass apparatus

were made in the glass-blowing shop. On account of the high grade of work performed by this shop frequent requests have been received from other Government departments for difficult pieces of glass work which could not be obtained elsewhere. A number of aircraft instruments, designed by the aeronautic-instruments section, have been built in the instrument shop.

General administrative and office work.—During the year 158 new publications were issued, making 1,290 publications as the total published work. A complete descriptive catalog (271 pages) was issued comprising all published matter from the establishment of the bureau (1901) to June 30, 1925. A complete subject index permits instant reference to all published research. An annual supplement keeps the list and index current. A popular illustrated description of the bureau was issued as Circular 1 and placed on sale to meet a continuing demand.

More than 400,000 communications were handled in the mail room, routed, filed, and where necessary carefully recorded.

EQUIPMENT ($70,000)

General equipment for laboratories.—The usual purchases of apparatus and supplies have been made, in order to keep the bureau's laboratories in up-to-date and efficient condition. Among the special apparatus purchased may be mentioned a large electromagnet, X-ray tube and transformer, air-conditioning equipment, and some small refrigerating equipment.

Longitudinal comparator.—A longitudinal comparator has been ordered. This is fundamental equipment which has long been needed for high precision comparisons of length standards, such as yard and meter bars. The equipment ordered will be at least the equal of any that has ever been built, and will make possible a distinct advance in this field of the bureau's work.

Circular dividing engine.—A new precision circular dividing engine was purchased and is now installed in the length section. This machine has long been needed and will permit the bureau to rule special scale and other measuring instruments for its own use and for other Government laboratories, as well as to check commercial instruments.

Refrigerating plant for watch testing.—New refrigerating equipment of small size for the watch-testing cabinets has been installed. The new apparatus has eliminated the use of ice and makes possible a much more convenient and accurate temperature control.

GENERAL EXPENSES ($43,500)

Upkeep of mechanical plant.—Necessary repairs have been made to all steam, electrical, and mechanical equipment during the past year. A new water-service pump, a new vacuum pump, and a motor-driven centrifugal pump for brine service have been installed. The installation of these units was made necessary because of increased demands for such services and to replace worn-out units. A central refrigerating plant for the industrial building is being installed and will eliminate the necessity for the purchase of any additional refrig-

erating units for this building and will replace smaller units now installed which will be available for use in buildings where central refrigeration is not practicable at this time.

Electrical construction and repair work.—Necessary electrical repairs have been made to motors, generators, switchboards, transformers, electrical furnaces, and other miscellaneous laboratory equipment. Wiring of new installations of equipment has included a thermocouple system for the panel furnace, X-ray machine, high-frequency furnace, sugar-laboratory motors, gas-plant motors, and new trunk lines for the colorimetry laboratory.

Plumbing and steamfitting.—The necessary maintenance work on fixtures and piping for supplying water, gas, air, vacuum, steam, and refrigeration has been performed and numerous pieces of small equipment have been installed. The larger installations included piping for the gas plant and the sugar laboratory.

Miscellaneous repairs and alterations.—Numerous foundations were constructed and necessary alterations made for the installation of laboratory equipment. The settings of two of the boilers in the north building and one in the kiln building were relined and the brickwork of all boilers has been repaired.

Travel.—Necessary travel for the purpose of consulting with experts at meetings of scientific and technical societies, travel of members of the bureau's visiting committee, and travel in foreign countries in connection with cooperative work of the bureau and other national standardizing institutions is provided for by this fund.

Library books.—During 1926 there were purchased and obtained by exchange for the bureau's technical library 686 volumes of new periodicals and serials, 362 old periodicals and serials, 251 new books and continuations, and 224 old books, a total of 1,523 accessions. Practically all books and old periodicals were purchased, while of the new periodicals about one-half were obtained on an exchange basis.

Contingent expenses.—Part of the contingent expenses of the bureau and of the Department of Commerce as a whole have been provided for under this fund.

IMPROVEMENT AND CARE OF GROUNDS ($11,000)

New roads, grading, etc.—The new entrance road has been completed and the east section of the bureau's site has been improved through grading, seeding, and the planting of trees and shrubbery. The work incident to the care of lawns, shrubs, flowers, and drain systems has also been performed.

TESTING STRUCTURAL MATERIALS ($230,000)

Building codes.—The building code committee, which consists of nationally known professional experts, completed and published its report on Recommended Practice for Arrangement of Building Codes. A report on Recommended Building Code Requirements for Unit Working Stresses in Building Materials was also completed. At least six States have used substantial portions of the plumbing code recommendations in their laws. An incomplete survey shows

that some 50 municipalities distributed throughout the country have used recommendations of the committee in their newly revised building codes.

City planning and zoning.—In the field of city planning and zoning a report was published on zoning progress, containing an authoritative discussion of the constitutionality of zoning by Edward M. Bassett, one of the members of the advisory committee, together with a list of the 436 municipalities that have adopted zoning ordinances and references to State enabling acts authorizing cities to zone.

A preliminary edition of A City Planning Primer dealing with the usefulness of city planning in facilitating traffic, encouraging more careful utilization of expenditures for street and public works, and developing home sites at low cost, was published in mimeographed form. References to State acts permitting cities to create planning commissions and control the layout of new streets were obtained and made public.

A permissive standard State city planning enabling act to provide for city and regional planning, the creation, organization, and powers of planning commissions, regulation of subdivision of land, and the acquisition of the right to keep planned streets free from buildings was drafted.

Standard State Mechanics' Lien Act Committee.—The voluntary committee referred to in last year's report, the Standard State Mechanics' Lien Act Committee, completed its preliminary tentative draft which will be sent out for comments and criticisms shortly after the close of the fiscal year.

Better homes.—Substantial aid was given to Better Homes in America (Inc.), an organization which works closely with other Government departments and numerous national bodies in the preparation of pamphlets, in obtaining cooperation from various agencies, and in other ways.

Statistical work.—Statistical work included obtaining monthly prices for 24 building-material items as paid by contractors in about 50 cities. These prices were issued regularly and republished by a number of trade papers. The figures so obtained are used in compiling index numbers of the price of materials for small frame and brick houses. Current statistics on building activity; building costs; and production, consumption, and stocks on hand of the principal building materials were printed monthly in the Survey of Current Business and in Commerce Reports.

Seasonal operation in the construction industries.—The work of the bureau, in cooperation with the committee representing national organizations and with local groups, has borne very definite results. The winter months of the years 1924–25 show a distinctly greater volume of construction, as indicated by employment of labor and purchase of materials by representative contractors, with a corresponding leveling off of the peak that usually occurred during the late summer. Publication of such findings in chart form created wide and favorable comment.

Vitreous china plumbing fixtures.—Cooperation between the bureau and the manufacturers of vitreous china plumbing fixtures has resulted in the standardization of their product or procedure as

regards types, sizes, nomenclature, and grading rules. The recommendations will be submitted for the regular procedure of the division of simplified practice.

Properties of soldered joints.—Work on the properties of soldered joints under prolonged stress and on the effect of phosphorus in wrought iron was completed and published.

Holding power of wood screws.—The results of tests of the holding power of over 10,000 wood screws inserted in the side and end grain of seven different kinds of wood ranging in density from yellow poplar to white oak were summarized in a technologic paper published during the year.

Proportioning and grading of concrete aggregates.—The proportioning and grading of aggregates for concrete were extensively studied during the year, and the work is not yet completed. The variables considered were three different cements, the gradation of the coarse aggregate, and the ratio of the fine to the coarse aggregate when the latter was deficient in certain sizes. In addition to these variables, aggregates from three different sources were used: Gravel, crushed stone, and crushed slag. It appears safe to follow in concrete design the criterion that the sand should be at least one-third of the total aggregate and that the gradation of the coarse aggregate should be such that the percentage passing any one sieve and retained on the next smaller should be not less than one-third that retained on the former and passing the next larger.

Impact strength of reinforced concrete.—In cooperation with the Bureau of Mines a chamber has been designed and is in course of construction by means of which it is proposed to determine impact strength of reinforced concrete. This information is needed in the design of concrete stoppings for mines.

Stevenson Creek experimental dam.—Another extended investigation of concrete originating during the year is in connection with the testing of the Stevenson Creek Dam in California. This is a dam of the arch type, designed entirely for testing purposes. The testing of the dam has been placed in charge of the bureau. So far only a minor amount of testing has been done, the time having been spent in the construction and in the placing of instruments.

Inspection of cement.—The inspection work in connection with cement and concrete for Government purposes and use has been in about the same amout as in previous years. Approximately 800,000 barrels of cement have been shipped under bureau supervision for Government purposes. The close of the fiscal year, however, showed a marked increase in requests for service from different departments, due apparently to an increased building campaign in those departments which the bureau serves. In connection with the routine testing of cement further steps have been taken to obtain better correlation of methods and results obtained in the different laboratories of the bureau, and in the future monthly samples will be exchanged between the laboratories. The routine testing of sieves for the general public and the distribution of cement of standard fineness increased slightly during the year. One hundred and ten No. 200 sieves were tested and 404 standard samples of cement were distributed.

Hardening of cement.—The hardening of cement has been followed both by an examination of the solutions resulting when water, chlorides, and sulphates act on cement and also by means of an adiabatic calorimeter. It has been found that the aluminate reacts with the chlorides and sulphates to form definite compounds, and that the aluminate present in Portland cement reacts with water to form one and possibly two compounds. The study of the reaction of the silicates is more complex, and definite information is not available. The calorimeter has not proven as satisfactory as anticipated in the study of the heat of reaction of the compounds, or cement with water or solutions, due to the fact that the reaction extends over several days, but it has been found that it will distinguish between different cements and the effect of SO_3 in retarding the rate of setting of different cements.

Durability of glass tank block.—A thorough study of commercial glass tank blocks was made in small tanks constructed at the bureau in which about 400 pounds of glass were melted per day for 30 days. It was found that the physical structure of the block is the dominating factor controlling its life in service irrespective of chemical composition. The block should be homogeneous, the pores small, and, if possible, either closed or nonconnected. Corundum and mullite resist solution better than the other possible solid phases, and hence if block of these could be obtained of the proper structure, a most satisfactory product would be obtained.

Waterproofed gypsum products.—There is much demand for waterproofed gypsum products for exterior use, consequently this problem has been attacked from three angles, first, waterproofing the set product; second, precipitating on the surface a soluble compound; third, by the addition of an integral waterproofing compound. A very large number of each of these methods has been tried. Up to date the one which seems to promise the most success is the use of a small amount of blood albumin glue added to the mixing water. Some specimens which have been treated with a solution of barium hydroxide also give some promise, but to a lesser degree.

Sand for gypsum plaster.—Considerable time was spent in determining what should be the characteristics of sand that would give the best results in gypsum plasters, so very much used for interior plastering. As was expected the finer sands proved to have greater tensile and compressive strengths and gave the most workable mixes. As 25 per cent of calcined gypsum for use in mortars may be replaced by other products, use of lime, asbestos, talc, and clays was studied. In general, these all improved the workability of the plaster mixes, but on the other hand decreased their strength and required more water to bring the mixes to the desired consistency.

Miscellaneous lime and gypsum problems.—Other problems studied during the year were the use of hydrated lime in Portland cement mortars, limes for the chemical industry, strength of bond between mortar and sand-lime brick, the acoustics of wall plasters, electrical calcination of gypsum, rate of drying of wall plasters, and the effect of impurities in limestones and in gypsum on the properties of the lime and calcined gypsum produced from them.

Physical properties of limestones.—The physical properties of the characteristic limestones of the country have been determined. It

was found that the compressive strengths varied from 2,000 to 24,000 pounds per square inch, modulus of rupture from 500 to 2,500 pounds, and shearing strength from 800 to 4,400 pounds, and the modulus of elasticity ranges from 2,000,000 to 11,000,000 pounds. The weathering of these stones has also been followed by freezing tests and by the crystallization of salts in the pores. The data, however, are not yet completed. Waterproofing tests have also been carried out, and it was found that one of the most satisfactory of these was one both readily available and very cheap, namely, the application of a solution of paraffin in light solvents from mineral oils.

Molding sands.—Improved apparatus has been developed for determining the compressibility, permeability, and refractoriness of molding sands. Cooperative work has been conducted with the American Foundrymen's Association and the Washington Navy Yard on sand testing and sand control.

Specifications.—The following specifications have been prepared during the year in cooperation with representatives of other Government departments: Seamless brass pipe, seamless brass tubing, cast-iron soil pipe, lapwelded charcoal iron boiler tubes, malleable iron or steel unions, padlocks, plumbing fixtures. These specifications have been submitted to the Federal Specifications Board for promulgation as mandatory Government standards.

Branch laboratories.—To take care of the many requests from governmental agencies for the testing of structural materials the Bureau of Standards maintains three branch laboratories which are located at Northampton, Pa., Denver, Colo., and San Francisco, Calif.

The work of the Northampton laboratory is exclusively cement testing and as it is situated in the Lehigh Valley cement-producing district, it supervises the major portion of Government orders for Bureau of Standards tested cement. The Denver laboratory cares for the cement testing of the territory west of the Mississippi River and east of the Rocky Mountains. Besides its cement-testing work many studies are made of the suitability of local aggregates for use in concrete structures for the Reclamation Service. The San Francisco laboratory cares for the cement testing on the west coast which includes many shipments to the Hawaiian Islands and also cares for many tests of miscellaneous materials used in construction work.

At the present time with the large amount of work undertaken by the Government in various parts of the country, these branch laboratories are caring for a volume of work which prohibits further demands unless the personnel and equipment can be increased. With the demand of purchasing agents that materials meet the requirements of the specifications of the Federal Specification Board this commodity testing work will continue to increase.

A careful survey of the needs of the several districts should be made and provision by added personnel and equipment made in order adequately to care for this important part of the bureau's work.

TESTING MACHINES ($38,000)

Strength of brickwork.—Special attention is being given at present to the measurement of the strength of brickwork under com-

pression. Test walls are built and aged, and then subjected to a slowly increasing load in the testing machine until they fail. The machine used in this work has a capacity of 10,000,000 pounds in compression, and is the largest testing machine in the world. The walls under test are 6 feet long by 9 feet high, corresponding approximately in height to the distance from one floor to the next and in length to the distance between adjacent windows. The program is being carried out in cooperation with the Common Brick Manufacturers Association and includes four grades of brick, three mortars, and two grades of workmanship, as well as several novel methods of constructing walls, such as the Ideal brick wall. It is probable that about 200 walls will be built, aged, and tested before the investigation is completed. The results of these tests are greatly needed by engineers, architects, and city officials who are responsible for safe construction.

Welded rails.—Another investigation of importance relates to the strength of welded rails for street railways. In this work the American Bureau of Welding, the American Electric Railway Association, and a large number of traction companies in different parts of this country have cooperated whole-heartedly.

Tensile tests of welded joints have been made in the large Emery testing machine (capacity 1,150,000 pounds in tension, 2,300,000 pounds in compression). A large number of joints have also been subjected to repeated impact until they failed, using a machine designed for the purpose which simulated service conditions. The metallurgical and electrical divisions of the bureau have cooperated extensively in portions of the work which lay in their fields.

Calibration of testing machines.—There is a very great need for accurate and inexpensive methods of measuring the load applied to test specimens by testing machines.

A portable proving ring has been developed at the bureau for testing Brinell machines, the maximum load being 3,000 kilograms. These rings are simple and accurate and are now being supplied commercially by a reliable manufacturer. Each ring is calibrated by the bureau under dead weights and a certificate furnished the purchaser.

Proving rings for higher loads are being developed and it is expected that apparatus for calibrating testing machines having a capacity of 1,000,000 pounds will soon be available. This work can not be completed until dead-weight machines for loads of, say, 200,000 pounds are available in our laboratories.

Investigation of strength of steel columns.—The results of tests of 69 steel columns, having H-shaped sections and of 5 different types of construction, have been prepared for publication. This work was conducted in cooperation with the American Bridge Co. and the Bethlehem Steel Co. These firms supplied more than 130 tons of steel for this purpose. The finished columns were tested to destruction in the 10,000,000-pound testing machine. Over 1,000 test specimens were cut from the columns and subjected to chemical analyses and physical tests to determine as accurately as possible the properties of the steel from which the columns were made.

This work indicates that differences in the physical properties of the material entering into the columns produce greater variations in strength than all the differences in type of construction.

Lines of stress in fabricated columns.—A poster illustrating and describing the method used by the bureau to render visible the lines of stress in steel columns under compression has been issued. The method was first used in the investigation of special fabricated steel columns for the Delaware River Bridge.

INVESTIGATION OF FIRE-RESISTING PROPERTIES ($28,100)

Fire tests of materials.—The program of fire tests of brick walls was completed, and 40 fire or fire and water tests of hollow-tile walls were made.

Over 300 fire tests of roofing materials were conducted. In this work, 126 decks were tested with brands, 77 for flame resistance, and 114 for spread of flame over the surface. Tests of gypsum-block partitions conducted elsewhere were summarized. Two fire tests of plaster partitions were made.

Theater curtains.—Strength tests of asbestos theater-curtain cloth were made at high temperatures and inspections made of installations in the city of Washington.

Building safety codes.—The bureau has cooperated with the National Fire Protection Association and the American Engineering Standards Committee on building safety codes and with the latter in adoption of specifications for the conduct of standard fire tests of building constructions and materials.

Strength of materials at high temperatures.—Fifty strength tests of structural steel and cast iron were made at temperatures up to 910° C.

Insulated safes.—Six fire and impact tests and three fire-endurance tests of insulated safes were conducted for Government departments.

Fire intensity and duration.—A new structure 30 by 60 feet in area has been built for fire intensity and duration tests and filled for burning out with a record room occupancy. Two sheet-metal garages were burned out to determine the hazard to adjacent structures.

Ignition points and spontaneous ignition.—During the past year tests for ignition points or spontaneous ignition have been made on three insulating felts, one type of timing-pad holder, and four classes of rayon.

INVESTIGATION OF PUBLIC UTILITY STANDARDS ($100,000)

Measurement of high voltages, large currents, and electric power in large blocks.—Accomplishments during 1926 include the development of improved methods of using standardized transformers so as to get reliable measurements up to 100,000 volts, design and construction of shunts for measuring alternating current up to 1,200 amperes, approximate completion of parts for an absolute electrometer to operate up to 300,000 volts, preliminary tests on the corona voltmeter to determine conditions which affect its use at these high voltages, and mathematical work which indicates that a new and more exact method for measuring power at high voltages is practicable.

Electrolysis and soil corrosion.—An extensive technologic paper on methods of electrolysis testing has been prepared, and a circular explaining the use of the earth-current meter has also been prac-

tically completed. These papers summarize the results of several years' experience in testing for electrolysis conditions; another paper summarizing the results obtained by different methods of remedying those conditions is well under way. The second installment of pipe samples in the soil-corrosion research has been dug up and returned to the bureau for examination, together with samples of the soils in which they are buried. There are some 7,000 samples in 46 locations involved in this investigation.

National Electrical Safety Code.—Two volumes of the new edition of the National Electrical Safety Code have been published, and two more are ready. The additional part which covers rules for the installation and maintenance of overhead and underground electrical supply and communication lines has also been completed. A considerable part of the year has been spent in rearranging the form of the code to comply with the wishes of the industrial interests involved and to facilitate adoption of the rules as a whole by State authorities.

Surveys of Government telephone service and defense of patent suits.—Practically the full time of the bureau's telephone group has been given to surveys of Government telephone service and defense of patent suits in accordance with requests from the Chief Coordinator. This continuing survey work returns several fold what it costs, while the patent suits involve an aggregate which may run into millions of dollars of possible savings to the Government.

General cooperation with State utility commissions and utility companies.—General cooperation with State utility commissions and utility companies has been maintained. The regular annual conference of State Commission Engineers, May 13 and 14, 1926, was attended by 26 engineers representing 14 States and 2 Canadian Provinces. The work on standards for electric service and street-lighting service has been continued, the code for electricity meters has been revised in cooperation with the National Electric Light Association and the Association of Edison Illuminating Companies. Many standardization projects in the electric utility field have been dealt with through the machinery of the American Engineering Standards Committee, the American Institute of Electrical Engineers, and the International Electrotechnical Commission. Several members of the bureau staff took an active part in the plenary session of the latter organization which was held in New York City, April 13 to 22.

Investigation of gas service and appliances.—The relation between the conditions of manufacture, distribution, and use of fuel gases and economical and satisfactory public service, including the effect of changing heating-value standards, has been studied and methods have been developed for determining the safety and efficiency of gas appliances. Several successful methods for such determinations have been perfected and a large number of domestic appliances have been tested. The results of this work have been used by the American Gas Association in the preparation of appliance specifications. The corrosive effect of gas flames on the appliances have likewise been investigated. The national gas safety code, sponsored by the bureau and the American Gas Association, has been adopted as an American standard by the American Engineering Standards Committee.

TESTING MISCELLANEOUS MATERIALS ($44,090)

Routine chemical tests.—Many chemical and physical tests have been conducted on a great variety of materials such as paints, varnishes, roofing and waterproofing materials, boiler waters and compounds, metals, alloys, graphite, fire-extinguishing compounds, asbestos products, boiler scale, cements, antifreeze solutions, technical and photographic chemicals, soaps, polishes, rubber, packings, typewriter ribbons, carbon paper, adhesives, lubricants, textiles, rope, twine, and dyes. Most of the above materials were tested for the Government departments, the total number of samples being about 4,700. These tests serve to control the quality of Government purchases of these materials.

RADIO RESEARCH ($44,800)

Reduction of interference.—On the general problem of reduction of radio interference the bureau's work during the year has been of importance. This work was directed largely to the holding of broadcasting and other transmitting stations exactly on their assigned frequencies. Marked progress in the actual operation of the country's radio stations in this respect has been made possible primarily through increasing the accuracy of the bureau's frequency standards and certain procedures adopted for their dissemination and application. These have included the transmission of special signals of standard frequency and the setting up of a system of standard frequency stations. The accuracy of frequency measurements generally has been raised to a higher level of precision through development by the bureau of specific applications of the piezo oscillator, a remarkable new device serving as a constant frequency standard. A form of this instrument as well as other necessary measuring instruments were designed for the use of the radio inspectors of the Department of Commerce. The results of a statistical study of the distance range and interference conditions of broadcast reception were issued.

Propagation of radio waves.—Several contributions were made to the knowledge of the vagaries of radio wave propagation. A study on a nation-wide scale of the effects of high power broadcasting was directed by the bureau. This definitely established that certain deleterious effects that had been anticipated through the use of many kilowatts of power did not exist, and also that high power does not bring with it a cure for radio fading. The fading or fluctuation of received signal intensity remains as the principal obstacle to radio development, and the bureau, with the cooperation of 20 laboratories in universities and other places, made a concerted attack on this problem. The year's work resulted in the establishment of a number of conclusions as to the nature and characteristics of fading. This study led to a better understanding of the way in which radio waves are transmitted in the space between the transmitter and receiver. In connection with this, studies of the peculiar behavior of very high frequencies or short waves was also made.

Radio-direction finder.—A number of advances were made in the technique and applications of the radio-direction finder, one of the main reliances of the future for both marine and air navigation.

Special developments extended the frequency range in which it is possible to do accurate direction finding. Direction finders of special design for several types of service were developed for the Coast Guard, the Navy, and the Signal Corps. A number of improvements of detail were made on a laboratory scale in the directive beacon system provisionally designed for use in air navigation.

COLOR STANDARDIZATION ($9,000)

Consistent system of color standards.—The eye is capable of distinguishing about 1,000,000 different colors, no 2 of which match. To match in white light, two given colors must be alike in three attributes: Brightness, hue (dominant spectral color), and saturation (percentage of white). To match under all lights, the spectral distribution of the transmitted light, or reflected, as the case may be, must be identical in the two cases. There has been established as yet no system of color standards sufficiently precise and consistent for the demands of trade in which considerable financial loss often hinges on barely perceptible color differeces, while the comparison standards used vary by a much greater amount. For several years the bureau has been working on the widely used Lovibond system of about 400 colored glasses with the object of selecting out of these as adjusted color standards the ones which are consistent with each other as regards the three attributes mentioned. During the past year the spectrophotometric measurements on these glasses have been completed and are now ready for publication. The colorimetric analysis of the same glasses, which involves a revision of the three elementary excitations of the normal eye, is to be pushed to rapid conclusion. With this second part completed the bureau will have the first existing set of color standards of a precision adequate to the demands of trade. In this standardization program the bureau has been greatly assisted by the cooperation of the Munsell Research Laboratory.

INVESTIGATION OF CLAY PRODUCTS ($27,000)

Use of feldspars in whiteware.—In the investigation of the use of feldspars in whiteware, the following properties have been determined: Softening point, chemical composition, specific gravity, fineness, deformation range, mineral constituents as determined by the microscope, rate of vitrification, resistance of glazed ware containing the spars to impact, and resistance of glazed ware containing the spars to thermal shock. It has not been possible to find any general law connecting the spars with their properties. Further work will therefore be done considering such features as thermal expansion, rate of solution of the clays, flints, and spars, etc.

Consistency of enamel suspensions.—An apparatus has been developed by means of which it has been possible to determine the consistency and follow the changes in consistency of enamel suspensions. The apparatus has been simplified for use under plant conditions so that it will be possible for an inexperienced operator to use the equipment and foretell whether a slip will act as desired in the dipping process, also what changes in the slip will be needed to bring it to the right condition when it is not in that state.

Clay for saggers.—In the study of the determination of those properties which make a clay of value in the making of saggers the thermal dilation of a large number of clays and sagger mixtures was determined. It was definitely noted that certain clays are characterized by rapid expansion between 100° and 200° C. and there seems to be relation between this phenomenon and the durability of saggers made from such clays. It is also noted that repeated use of saggers brought about an increased expansion between these temperatures.

Drying of clay bodies.—A satisfactory method has been devised for measuring the velocity of water flow, percentage of water evaporated, percentage of shrinkage grading, and percentage of water concentration in the drying of a clay body. It was found that successful drying requires a high humidity and a temperature not over 45° C. for the first one-fourth to one-third of the total drying period; that successful drying also depends on preserving a low shrinkage grading within the dry clay body. It is also not possible to predict the behavior of a full-sized specimen in drying from the drying of smaller sections.

Workability of clays.—The apparatus designed for measuring the workability of clays under conditions that prevail in plants, and to measure the efficiency of various designs of augers, dies, and spacers, has been given a thorough trial and found to meet all requirements needed for the proper determination of the fundamentals on which an auger machine should be designed. It is surprising to note that a decrease of about 2 per cent of moisture content below that of optimum plasticity caused a decrease of more than 50 per cent in workability. This illustrates the close control that will be needed in preparing the material for use in the machine.

Data on burned-clay products.—Two publications have been issued covering the obtaining of data for engineers in the use of burned-clay products. One of these covers the tests of hollow tile and concrete slabs reinforced in one direction, and the other the compressive and transverse strength of hollow-tile walls. There has also been completed a second series of tests of slabs of hollow tile and concrete, and there has been partially completed a series of tests of common brick walls. These tests all cover the use of built-up specimens of a size comparable with that used in construction, the walls being approximately 6 feet long by 10 feet high and of the several thicknesses used commercially.

German and American fire brick.—Among other investigations which have been conducted are those relating to the comparison of German and American fire brick, examination of refractories after service in boiler installations, resistance of glazes to abrasion, properties of vitrified chinaware, study of white ground coats for enameling, effect of typical enamels on colors obtained with various stains, and the blistering of enamels. The American Face Brick Association and the National Terra Cotta Society have maintained fellows studying problems in relation to their industries.

Ceramics Advisory Committee.—There was formed an advisory committee, representing the various members of the ceramic industry, to assist the bureau in formulating its investigations in this field, including the work of the Columbus, Ohio, station to be taken over July 1 from the Bureau of Mines.

STANDARDIZING MECHANICAL APPLIANCES ($27,800)

Testing mechanical appliances.—The amount of testing carried out for other bureaus of the Government in the field of mechanical appliances and engineering instruments is constantly increasing. Current meters have been calibrated for the Reclamation Service, the Geological Survey, the Coast and Geodetic Survey, and other agencies. These meters are used in gauging the stream flow of rivers and canals, and are standardized by towing them at various known speeds through still water in a testing tank about 450 feet long. Numerous tests have been made of various types of fire extinguishers to determine their suitability as fire-fighting equipment on vessels under the jurisdiction of the Steamboat Inspection Service. For the Supervising Architect's Office tests have been made of radiator return line valves. Many aeronautic instruments, anemometers, pressure gauges, and paper testers have been calibrated for other branches of the service, and new instruments developed.

Elevator safety interlocks.—About three-fourths of the accidents to passengers on elevators can be prevented by reliable elevator interlocking safety devices. Previous work in developing methods of testing the reliability of such devices has been extended to determine the reliability of additional existing commercial devices. The results of these tests are made available to and are used as a basis of approval by several of the Government departments, the government of the District of Columbia, several municipal and State governments, and one of the largest groups of casualty and insurance companies.

Radiator air valves.—The successful operation of certain types of heating systems in common use is largely dependent upon the manner in which an air valve placed on each radiator performs its functions. At the request of the Supervising Architect of the Treasury Department an investigation was made of commercial samples which resulted in the formulation of a standard of performance for these radiator air valves and in the development of methods of testing them, which will permit their purchase on the basis of a previously determined compliance with definitely stated performance requirements.

Altitude chamber for testing instruments.—Progress has been made on the fittings and equipment of a steel chamber which will be used to reproduce in the laboratory the low temperatures and pressures experienced in airplane flight. The size and arrangements are such that the observer may be inside of the chamber during its operation, thus permitting both the test and adjustment of many instruments under conditions encountered in flight. The chamber is designed to obtain low pressures corresponding to an altitude of 40,000 feet and temperatures as low as −20° C.

Aeronautic instrument specifications.—In cooperation with the Army and Navy Air Services a general revision of the specifications for aircraft instruments has been completed. This work involved the revision and amplification of 23 specifications and included experimental work on a number of types of instruments for the purpose of establishing tolerances.

INVESTIGATION OF OPTICAL GLASS ($20,520)

Production of optical glass.—In the course of the study of the factors which affect the quality of optical glass during melting, molding, and annealing, 36 pots of approximately 1,000 pounds each were melted. It was found that the eliminating of the seeds in the borosilicate glass can be accomplished to a major degree by the use of about 2 per cent zinc oxide in the batch. Just why the zinc acts in this manner is not known. This suggests the possibility of finding a material which will act similarly in the barium crown glasses which even at the best contain more bubbles than are allowed in other glasses. The glass produced was turned over in a certain amount to the optical shop of the Navy. Approximately 9,300 blanks were molded and annealed for this purpose.

Viscosity of glass.—Viscosity of glass is of great interest to manufacturers, because it is believed that the most advantageous temperature for melting, fining, and working of the glasses depends upon the viscosity at that temperature. A viscometer of the rotary type has been developed and calibrated with a mineral oil of naphthene base between 200 and 25,000 poises. Following calibration the instrument has been used in the determination of the viscosity of some commercial and some optical glasses in which the viscosity in poises varies from 140 to slightly over 25,000, depending upon the temperatures at which the determination was made and the composition of the glass. The study will ultimately, of course, show the effect on viscosity at different temperatures of various constituents in glasses.

Reduction of strain in glass.—Strain is a result of the temperature of glass while being molded or pressed and too rapid cooling after this process. This strain can be removed by annealing, which consists in heating glass to a certain temperature and then cooling at a definite rate. The annealing range has been determined for a number of glasses and has been found to vary, especially with the composition of the glass. The rate at which the glass may be cooled depends also upon its thickness. Glass 1 centimeter thick can be cooled at about 100° C. per hour initially, while glass 4 centimeters thick should not be cooled faster than 4° C. per hour.

Large glass disk.—During the past two years considerable work has been done on the production of a large glass disk for a reflecting telescope. It is to be made of borosilicate crown glass and when finished will be 61 inches in diameter by 11 inches thick and will weigh about 3,000 pounds. The cast pots in which the glass is melted were made at this bureau. They weigh about 2,500 pounds and will hold 5,000 pounds of glass. Results have not been satisfactory because the glass cracked during cooling, either on account of too rapid cooling or too large temperature differences in the furnace. Plans are now being perfected to pour the molten glass into a cast-iron mold which will be placed in an electrically heated furnace. This will insure better control of the cooling rate and a greater uniformity of temperature throughout the furnace, which are thought to be the chief requirements in obtaining a large disk of satisfactory quality after the glass is properly melted.

INVESTIGATION OF TEXTILES ($26,560)

Effect of laundering upon thermal insulating value of cotton blankets.—A study has been made of the changes in thermal insulating value of cotton blankets resulting from repeated laundering. The sample materials used in the experiments were representative of most common blanket types, and the laundering process corresponded to a good commercial practice. Washing was found to cause small losses in thermal resistance (0 to 10 per cent), which were almost completely restored by the application of a suitable process for raising the nap of the laundered fabric. This result emphasizes the importance of such a restoration of the nap. Shrinkage was also observed to produce a counteracting gain in thermal resistance.

Physical tests of yarns of different twist.—A comprehensive study of the physical properties of cotton yarn is being made in order to furnish adequate data to cotton mills. The lack of fundamental knowledge on this subject is frequently a serious handicap in cotton manufacturing. Twist, for instance, is a primary factor in production costs, so it is economically desirable that a knowledge of the effect of different twist factors be available.

In the bureau's experimental cotton mill, quantities of the following cotton yarns were made: Seven sizes of yarns, each with seven twist factors, on single and double roving mill organizations for both carded and combed types. The following physical tests were made: Size, twist, angle of twist, diameter, and breaking strength, using single strand and skein methods. The data have been obtained and are being evaluated.

Improvement of wearing quality of paper currency.—Research on improving the wearing quality of United States paper currency was carried on actively in cooperation with the Bureau of Efficiency, the Treasury Department, and the manufacturers of the paper. Study of the paper-making processes in the bureau's semi-commercial mill led to commercial production of currency paper having double the former strength, with no increase in cost of production. A glue-formaldehyde surface sizing treatment for the printed bills was evolved. This appears to be of much value for making the bills resistant to surface disintegration and to soiling. It seems assured that these developments will materially increase the service life of the bills and make it possible for the Treasury Department more adequately to meet the demand for paper currency at reduced cost.

Water absorption of paper.—A publication was prepared containing the results of a critical examination, including experimental comparison, of 38 different methods proposed by various investigators for measuring the rate at which paper absorbs aqueous liquids. The need of inexpensive and simple means of testing paper under controlled humidity led to development of an air-conditioned testing cabinet which so far has given very promising results.

Use of glue in paper.—As a part of the cooperative work with the National Association of Glue Manufacturers a demonstration was given of the results obtained in the study of the use of glue

for mineral coating paper. Representatives of both the glue and the paper industries observed the technic on a semicommercial practice. Additional results in using glue for beater sizing tend to confirm in general the view that the rosin-sizing quality and the folding endurance of paper can be improved by such application.

Aging of soft rubber compounds.—An investigation of the aging properties of soft rubber compounds, which was started in January, 1925, has been continued during the past year. The work to date covers the aging of a series of rubber compounds under all conditions of storage and exposure. It was found that certain types of compounds resist the deteriorating effects of age much more than others, and the results showing striking differences in aging properties are being compiled for publication. The importance of this investigation lies in the fact that rubber goods purchased in quantity often deteriorate in storage to such an extent that they are unfit for use.

Guayule rubber.—In cooperation with the Continental Mexican Rubber Co., a study is being made of the properties of guayule rubber. By improved processes in the extraction of this material from the shrub, an attempt is being made to obtain a better quality of product than has been produced from this source. The use of guayule in place of Hevea rubber would prove of great economic value to the United States, as the shrub from which it is secured can be successfully grown in southwestern United States, California, and in Mexico.

SUGAR STANDARDIZATION ($63,160)

Production of crystalline levulose.—The first plant for the production of crystalline levulose has been assembled at the bureau. It is made up of borrowed and purchased pieces of equipment, the capacities of which do not match, but nevertheless it has been found possible to produce the new sugar with this plant. The important fundamental problem in this development is the determination of an economically sound method of extraction of the levulose from the raw material. Experiments on the diffusion method of extraction used in the beet-sugar industry have been carried to a point where it has been definitely determined that the results are complete and economically sound. A scientific paper on the preparation of levulose was issued during the year.

New sugars discovered.—A method for transforming certain sugars into new ones has been discovered, which represents a distinct advance in the creation of new carbohydrates. The method employs the action of aluminum chloride upon the acetates of the reducing sugars; and by it the well-known sugars, lactose and cellobiose, have been changed to new sugars of the type known as disaccharides. The names neolactose and celtrobiose have been given to these new sugars. The change of structure resulting from applying this reaction is of a novel type, and the method gives promise of wide applicability in the production of new sugars from old ones and of rare sugars from the more common ones.

Discovery of gentiobiose in dextrose (corn sugar) molasses.—Two important contributions have been made to the bureau's newly created dextrose (corn sugar) industry, one economic in character,

and one of considerable scientific importance. The hydrol, or molasses, from the dextrose industry is a very complex product of unknown composition. Knowledge of similar products has long been sought. In cooperation with the Corn Products Refining Co., the bureau has cracked this hydrol for the first time and taken therefrom a rare sugar, gentiobiose, present in considerable quantities. The work led also to the discovery by the bureau that Prof. Emil Fischer's classical isomaltose, a compound of great importance in organic developments, is none other than gentiobiose. This discovery promises to reopen the whole subject of the synthesis of the sugars.

Imported sugar and molasses.—Approximately $140,000,000 per year in revenue is derived by the Government from the customs duty on imported sugar and molasses. The supervision of the testing methods at the customs' laboratories is one of the important functions of the bureau. The tariff act of 1922 provided for the collection of duty on imported molasses on the basis of total sugars. This required the bureau to develop precise methods for testing molasses. These were worked out, and during the past year have proved to be very satisfactory.

GAUGE STANDARDIZATION ($38,320)

Testing of gauges for manufacturers.—Practically all quantity production of machines and machine parts is dependent upon the use of limit gauges, and the degree of interchangeability obtained in the product is a measure of the adequacy of the gauging system employed.

An idea of the importance of limit gauges in interchangeable manufacture can best be gained from a few representative examples. The production and inspection of the Springfield Army rifle requires the use of 1,263 gauges; a machine gun about 2,200 gauges; and one make of automobile about 15,000 gauges. The Ordnance Department of the War Department has under its charge in the various arsenals more than 500,000 gauges, the replacement value of which is about $30,000,000.

Obviously the Bureau of Standards or any other single organization could not hope to test all or even a large proportion of the limit gauges in use in the manufacturing industries of the country. Fortunately this is not necessary, since each manufacturer can, through the use of certified standards, be largely responsible for the accuracy of his own gauges and product. It is desirable, however, for all manufacturers and users of gauges to have access to the same ultimate standards. This means is provided by the gauge section of the Bureau of Standards.

In addition to the ordinary testing and research carried on under this fund, two projects deserve special mention—work on gauges for use in the petroleum oil industry and researches on screw threads carried on in cooperation with the National Screw Thread Commission.

New equipment purchased for gauge standardization.—A Zeiss interference comparator designed primarily for use in the measurement of length, planeness, and parallelism of gauge blocks was purchased during the year. This instrument is similar to the Fabry and Perot

interferometer and is useful in checking measurements made by the interference method ordinarily employed at the bureau. It is especially useful in the comparison of relatively long blocks, blocks of poor reflecting surfaces, and blocks differing in length from the standard by more than five bands.

A second interference comparator of the modified Michelson type has also been ordered. This instrument will be used primarily for checking the bureau's master precision gauge blocks. By its use both the absolute length of blocks and the difference in length of blocks of different nominal sizes can be determined.

Cooperation with Federal Specifications Board.—A member of the bureau's staff has served as chairman of the gauge committee of the Federal Specifications Board. Preliminary surveys have been made of existing specifications, and in cooperation with the National Screw Thread Commission it is believed that uniformity will soon be brought about.

INVESTIGATION OF MINE SCALES AND CARS ($14,540)

Mine-scale tests.—Bureau mine-scale testing equipment operating in Pennsylvania, Maryland, and West Virginia, tested 233 scales used for fixing the amount of wages due miners.

Of this number 117, or 50.2 per cent, were found to be correct within the tolerance adopted by the bureau for scales in service of that character.

The figure of 50.2 indicating the percentage of correct scales is somewhat lower than the corresponding figure for the preceding year, when 56.5 per cent of the scales passed the prescribed tolerance. This circumstance, however, does not represent a general retrogression in weighing conditions in the coal fields, since the districts covered in the two successive years are different. It is the bureau's policy to investigate different coal-mining districts in succeeding years in order that all may have the benefit of the inspectional service and in order that information as to progress may be had for all important coal-producing sections of the country.

In general, it is evident that progress is being made toward securing a greater degree of accuracy in weighing throughout the various coal-mining fields. For example, of 54 scales tested in West Virginia fields during 1919, 15 scales, or 27.8 per cent, were found to be within the bureau's tolerance.

METALLURGICAL RESEARCH ($43,140)

Properties of steel.—A thorough investigation has been made of the cutting properties of high-speed tools and a publication was issued on the effect of various alloying elements. A comprehensive report on the machineability of carbon and alloy steels is nearly ready for publication.

Dimensional changes with time and the wear resistance of gauge steels have been studied, special apparatus having been constructed for the last-named work. Two publications have been made on this project, which is carried on in cooperation with the Gauge Steel Committee.

The presence of aluminum has been found to be concomitant with the "abnormality" of carburizing steel, and the effect of dissolved gases in the quenching media in favoring the formation of soft spots has been noted. The Bureau of Mines has cooperated with the bureau on this project and many manufacturers and users have likewise assisted.

Corrosion of metals.—Cooperative work with the Bureau of Mines on tarnish resistant silver alloys and with the American Society for Testing Materials on screen-wire cloth has been practically completed and the latter has been reported on. Very extensive work on methods of nonferrous corrosion testing for the American Society for Testing Materials has been completed and reported. Work for the same society on accelerated corrosion testing of zinc-coated materials has been begun. The electrolytic method of testing is also being studied.

Much work has been done for the Navy, the Army, and the National Advisory Committee for Aeronautics upon the problem of the embrittlement of duralumin by corrosion. Accelerated methods for testing have been developed and various coatings have been studied, some of which appear so satisfactory as to greatly strengthen confidence in duralumin as a material of construction in aircraft.

Resistance to wear of car bearings and soundness of railway rails.—In cooperation with a guest worker from a manufacturing company the resistance to wear of bronze railway bearings has been studied. Metallographic work has been done on welded rails for the Welded Rail Committee, and plans laid for work on the relation between ingot soundness, rail failures, and transverse fissures.

Methods of testing metals and studies of their properties.—Projects were completed and information published on methods of testing the flow in steel at high temperatures, on quenching media, and on determination of hardness by the scratch method. Progress was made in the study of precision methods for crystal analysis by the X-ray spectrometer and of methods for wear testing.

The study of the properties of pure zinc was completed and published, and those on pure nickel, pure iron, and pure thorium are in progress. Work on the recrystallization temperatures of electrolytic iron and open-hearth steel strips was completed and prepared for publication. Work on the density of carbon and alloy steels is still in progress.

Meetings of metallurgical advisory committees.—The annual meetings of the advisory committees to the Bureau of Standards on ferrous and nonferrous metallurgy were held at the bureau on May 5 and 6. The total attendance numbered 76 at the first meeting and 66 at the second. The committees agreed that the major projects in hand at the bureau should be continued and that new projects should be taken up only as the present ones are completed, except in cases where the necessary support can be furnished through the establishment of research associateships.

Information on metallurgy.—A dozen papers on projects previously finished experimentally were completed and published. Five letter circulars were issued. Current metallurgical literature was reviewed and indexed for use in replying to the many inquiries received from the public; revision of the circular on aluminum is under way.

HIGH-TEMPERATURE INVESTIGATIONS ($9,740)

Standardization of pyrometric cones.—The thermal characteristics of the pyrometric cones most widely used in this country were determined and standard tests for refractories developed. A committee of representative ceramists cooperated with the bureau in this work. The results will improve the facility of control of ceramic kilns, thus decreasing the losses of badly fired ware.

Optical pyrometry.—The methods and computations in optical pyrometry have been thoroughly revised, which will simplify all high-temperature measurements in the pyrometry laboratory of the bureau and improve the measurements in industrial laboratories which depend upon the Bureau of Standards.

SOUND INVESTIGATION ($5,580)

Acoustic properties of building materials.—Investigations of the acoustic properties of building materials have been continued with the cooperation of the Gypsum Industries (Inc.) and the National Lime Association. Sound transmission measurements were made on some 30 panels representing types of partition-wall construction in general use. Measurements of sound absorption were also made on certain of these panels and on a dozen or more substances commonly occuring in construction. These values of sound absorption are of importance in predetermining the acoustic qualities of a proposed auditorium.

Scientific Paper No. 526 on transmission and absorption of sound by some building materials was issued during the year.

Phonetics.—The sound laboratory has cooperated with a member of the staff of Purdue University in researches in phonetics. Photographs of different vowel sounds have been made and analyzed for their harmonic components. Similar assistance has been extended to a member of the National Research Council in work in the education of deaf-mutes.

Substitution of tuning fork for chronometer.—Investigations have been made at the request of the Coast and Geodetic Survey with the purpose of finding, if possible, some means of substituting a tuning fork for a chronometer in gravity determinations.

INDUSTRIAL RESEARCH ($174,120)

Battery investigations.—During the year work has been continued on the effects of impurities in electrolytes, and wide publicity given the results in order to protect the public from loss through use of fraudulent battery dopes. This work is also providing information which is needed by manufacturers on the degree of purity required in both electrolyte and other storage-battery materials. Desirable physical properties and dimensions of battery plates for special uses have been determined. Studies of performance of different forms of caustic soda primary cells have provided a basis for specifications of such cells for railway and similar purposes, in which their use is growing rapidly.

Electrical insulating materials.—The work on electrical insulating materials has developed during the year along three lines: (1) The

specific conditions to be met in order to find a practicable substitute for gutta-percha in submarine cables; (2) electrical properties of rubber and rubberlike materials in general, and the conditions which cause deterioration and breakdown of insulators in service; (3) cooperation with committees of the American Society for Testing Materials in the development of testing methods and specifications for insulating materials, including thermal, mechanical, and chemical tests, as well as electrical.

Electrical recording strain gauges.—The carbon pile instruments devised at the bureau for showing and recording strains and other small displacements have found many important applications. In 1926 they have been installed in the experimental arch dam at Stevenson's Creek, Calif., have been used for measuring pressures in rolling mills, and the distortion of welded street-car rails in service, and are being considered for a number of other applications for which no other instruments are available.

Thermal conductivity of insulating materials at high temperatures.—The apparatus for determining the thermal conductivity of insulating materials at high temperatures was completed during the early part of the year.

Thermal conductivity of commercial insulating materials.—Thermal conductivities and densities of a large number of commercial insulating materials have been measured.

A standard of thermal conductivity is being developed to aid in intercomparing results of different laboratories.

Heat transfer through building walls.—Data were obtained on heat transfer through building walls, but it was thought advisable to defer publication of this until a few more walls were included, permitting the calculation of a large number of others without actual tests.

Critical review and recalculation of the data in the literature brought to light certain discrepancies which may be cleared up by additional tests. A new constant temperature room has been built and equipped.

Properties of refrigerating brines.—A complete report has been prepared on the properties of refrigerating brines.

Thermal properties of steam.—An investigation of the thermal properties of steam forms part of an extensive program sponsored by the American Society of Mechanical Engineers, which has maintained two research associates at the bureau throughout the year. The work has been brought to the stage of assembling the completed experimental equipment.

Measurement of fuel volatility.—Considerable progress has been made in the development of a method of measuring fuel volatility, which consists essentially of an equilibrium distillation in the presence of air. Preliminary tests indicate that the method can be handled without appreciable difficulty and will give directly the information desired. This method supplements the present form of distillation, the results of which can not be readily translated into expected performance in the engine and do not permit of direct, quantitative comparisons of fuels.

Antifreezing solutions for automobile radiators.—The bureau has shared in the activity regarding new antifreeze solutions by de-

termining the freezing points of many of these solutions, by investigating their corrosive properties, and by incorporating essential information concerning these solutions in a letter circular dealing with the subject.

Bearing wear.—An investigation has been made of the effect of viscosity on bearing wear when an abrasive is in the oil, and a report of this work has been completed.

Automobile tires for Government use.—The purchase of tires by the Government constitutes an item of expense which during the past year amounted to approximately $1,000,000. The bureau's equipment has been of immense value in testing representative tires offered for delivery, thus insuring that the tires purchased meet the specification requirements. Tests have also been made for several States and municipalities, as well as for tire manufacturers who were not equipped to make the tests. In addition to the obvious value of these as a check on the quality of tires purchased, the bureau's work has been of material assistance to manufacturers, and in a number of instances the design of tires has been improved as a result of some weakness developed under the bureau's test.

Motor-car brake-lining performance.—The performance of brake linings on a car has been studied with respect to the influence upon the coefficient of friction of the temperature of the brake lining, the presence of water, and the presence of oil. The standard test for brake linings developed by the bureau is now being used by about 20 manufacturers, including several makers of automobiles.

Behavior of synthetic tanning materials.—The investigation of synthetic tanning materials was completed during the year. Publications were issued dealing with studies of various coal-tar crudes with respect to their suitability for producing materials with tanning properties. A report also was issued showing the behavior of these materials toward hide substances with respect to solvent action and rate and amount of combination. Two additional reports are about to be published which relate to the action of sodium sulphate in certain syntans, and methods of analysis. The information will be useful to users and producers of these new materials which are being slowly developed for the tanning industry.

Sulphite cellulose extracts for tanning.—Researches during the year show that a treated and concentrated extract made from the waste liquors discarded in the manufacture of paper pulp can be satisfactorily used for tanning hides, particularly when blended with the ordinary vegetable tanning materials. These extracts were found to contain usable amounts of material which would firmly combine with hide to form leather, to give satisfactory color, and to be suitable for blending with vegetable extracts on an equal tanning basis. The leather made had satisfactory chemical, physical, and aging properties. The use of these extracts, which are low in cost would benefit the tanner to the extent that they could be substituted for more costly materials and be of direct benefit to the paper pulp producer through the utilization of a waste product. The increased use of these materials in the actual tanning processes may be predicted in view of the fact that the source of chestnut-wood extract, the cheapest and most widely used domestic material, is at present being destroyed by blight.

Orifice gas meters.—The work on the standardization of orifice meters has been continued. Meters of this type are used in the measurement of natural gas obtained from Government reservations, involving revenues amounting to millions of dollars annually. In order to obtain the required accuracy it is necessary to standardize orifice meters by measuring the gas flow through them by some independent method. From such a comparison a coefficient is obtained which is applicable to other orifice meters of the same kind used under similar conditions.

Comparisons of this kind have been undertaken by the bureau, the work falling under three heads: (*a*) Cooperation with the American Gas Association in experiments with manufactured gas at Chicago; (*b*) experiments by the bureau at Edgewood Arsenal using compressed air; (*c*) cooperation with the Natural Gas Association of America in experiments with natural gas at Cleveland. (*a*) The experiments at Chicago were performed in 1924, but it has not yet been possible to attack the task of preparing the results for publication. (*b*) The experiments at Edgewood Arsenal were concluded in 1925 and it is expected that the results will be ready for publication within a year. (*c*) Some preliminary work was done at Cleveland in 1925.

Melting points of metals and alloys.—The melting points of iron and a series of typical iron alloys were determined in response to urgent demand from the industries. Preliminary work on the melting point of platinum has consisted in the development of refractory materials in which this metal can be melted and kept pure.

Expansivity measurements.—Research in thermal expansivity of solids, precision screw cutting and ruling, and a preliminary investigation of dental materials have been conducted.

Accurate knowledge of materials of low thermal expansivity is becoming of increasing importance in industry, and much work has been done in this field. Special study has been given to fused silica, graphite, tungsten, and nickel steel alloys.

A linear dividing engine suitable for ruling gratings and linear scales, which has been under construction at the bureau for several years, is nearing completion.

Specifications for dental materials.—The work on dental materials has made possible the writing of definite specifications for dental amalgams, and has also been of material assistance to the Veterans' Bureau and other Government departments in securing of high-grade gold alloys for dental purposes.

The bureau's work on dental materials has already been productive of such results that the American Dental Association has promised cooperation and financial support.

Industrial metallurgical problems.—Heat-resisting alloys have been studied with improved and considerably augmented equipment, and a paper on flow in a low-carbon steel published. This work is carried on in cooperation with the American Society of Mechanical Engineers and the American Society for Testing Materials.

Quenching media were examined, papers published on the origin of quenching cracks, and on initial temperatures and mass effects in quenching, and apparatus was assembled for the study of temperature distribution.

Gases in metals were studied chiefly from the analytical viewpoint, and projects on hydrogen in steel, on vacuum-fusion methods for oxygen and hydrogen, and on the oxygen content of cast iron were completed and published, while work on vacuum fusion and other methods for nitrogen, and on the fusible alloy metal for oxygen was brought well toward completion.

Technique was developed for the collection of gases in "blistered" metals and for the analysis of minute amounts of gas. A research fellow from the Swedish Engineers' Academy and a guest worker from an American manufacturing company were in attendance part of the year for work on gases in metals. Additions were made to the specialized equipment for this project.

Metal spray work was continued, especially on the preparation of surfaces for the reception of adherent deposits. Cooperation was given to the Navy in connection with metal spray.

Industrial chemistry.—Investigations have been conducted on methods of electroplating with nickel, copper, silver, gold, chromium, and platinum. Pure dyes have been prepared and their transmissivity for light determined. Methods for analyzing dyes have been studied, and an investigation, in cooperation with the American Society of Textile Chemists and Colorists, is now under way to determine the strength and purity of dyes and their fastness when used to dye textiles. Proposed methods of labeling commercial fabrics to indicate the fastness of color under various conditions have been considered, as well as the relation between the chemical constituents and the color of dyes. A method for the separation of gases by fractional distillation has been developed with the object of providing an analytical method for the natural gas and petroleum industries. A fundamental study has been made of the chemistry and physics of gas flames, and a helium recorder has been developed for the War Department.

Spectrochemical analysis.—During recent years the early expectations, for a long time unfulfilled, that the spectroscope would eventually become a powerful aid in quantitative chemical analysis, have been realized in a most important way. For instance, the spectroscope has been used to determine small percentages present as impurities in alloys, thereby permitting the correlation of these impurities with anomalous behavior on the part of the alloy. During the year over 200 such investigative analyses have been made, one result of which was the correlation of the anomalous behavior of steel with minute quantities of impurities present, especially aluminum. Three publications were issued.

Atomic structure and X rays.—The bureau has conducted, in cooperation with the National Research Council, investigations in which quantum dynamics and the radiations of atoms have been applied to determine both their ionization potentials and their structure. Ten publications have been issued in this connection.

An X-ray outfit has been installed in a special lead-lined X-ray chamber. An investigation of barium sulphate plaster as a protective screen against X rays was made and a paper published giving the results.

Determination of salinity of sea water.—In cooperation with the Bureau of Fisheries an investigation of the accuracy, reliability, and convenience with which the refractometer can be used for test-

ing the salinity of sea water, has been made. It was found that, after eliminating common errors, the accuracy obtainable is much greater than that of present standard tables, and this taken with the extreme convenience of the method demands a revision of the tables which assume to give the indicative figures.

Improved photographic emulsions.—Progress in the science of photography is possible through either the lens which forms the image or through the emulsion which records it. The science of lens design has received a great amount of attention which is almost classical in character. The preparation of photographic emulsions, on the other hand, is largely a secret and empirical art known to relatively few. There is probably room for ten times more improvement in making emulsions than in making lenses. During the past year the bureau has made over 400 batches of emulsion and tested them. As results of this work a method was developed for enhancing the color sensitivity of panchromatic emulsions without loss in their keeping qualities and progress was made toward replacing customary "ripening" of emulsions by processes susceptible of more exact control.

A scientific paper was issued, describing a new nonintermittent sensitometer (time-scale exposure machine) for testing photographic plates.

Precise measurements of pressures.—Special precision dead-weight pressure gauges designed and built at the bureau for use in other researches have shown an absolute accuracy of better than 1 part in 10,000 from 1.5 to 100 atmospheres.

Wind pressures on structures.—A scientific paper (No. 523) on the subject of the effect of wind pressures on structures was issued during the year. The report contains a general discussion of the many variables on which the pressure of the wind depends and gives general recommendations as to wind-pressure coefficients for structures of various shapes. In addition, values of the pressures on a model of a tall building are given for a large number of points on the walls and roof, as obtained by measurements in the 10-foot wind tunnel of the bureau at speeds up to 70 miles per hour.

Measurements have been made on cylinders of the general proportions of the tall chimneys used on power plants. The work begun last year on a cylinder 8 inches in diameter and 5 feet high was completed and a detailed study was made of the distribution of pressure for a larger cylinder, 12 inches in diameter and 5 feet high. It was found that results which were directly applicable to full-scale chimneys could not be obtained even with the 12-inch cylinder, owing to the persistence of scale effects. However, the data offer a basis for reasonable estimates of the total loads and give information as to the character of the distribution of load over the surface.

At present, measurements are in progress on prisms of various lengths in order to find the effect of height on the loads of a tall building. It is planned to study next models of the mill-building type with monitor and sawtooth roofs.

Cooperation with industry.—One of the most effective ways in which the bureau cooperates with American industries is through its system of research associates, briefly referred to in the first part of this report.

During the past year there were stationed at the bureau 62 of these associates, representing 36 industries. The research associate plan has proved most successful in making available to our industries the unusual research facilities of the bureau. Since the results are all published for the benefit of everyone interested, the work has influence, the amount of which is hard to estimate.

The large building-materials industries have availed themselves of the advantages of the research associate plan to the fullest possible extent. For instance, the Portland Cement Association maintains a corps of seven physicists and chemists, under the direction of a recognized expert, at the bureau to work on fundamental problems in the cement industry. The Hollow Building Tile Association supports two associates who are working on problems connected with the fire-resistance of hollow tile. Several important papers dealing with this work have already been published. The National Terra Cotta Society also maintains two experts at the bureau who are working on special problems affecting this widely used material.

The National Association of Dyers and Cleaners has three associates at the bureau, and has obtained some very valuable results on cleaning of silk, particularly the effect of acids and cleaning solvents on weighted silk. A paper on this subject will be published within a few months.

The Society of Automotive Engineers is represented by four experts who are carrying out fundamental research on fuels for internal-combustion engines, a matter that is becoming of greater importance each year.

These are only a few examples selected at random. Many more of equal importance might be cited.

A circular (No. 296) fully describing the research associate plan was issued during the year and has been in great demand.

TESTING RAILROAD-TRACK AND OTHER SCALES ($39,000)

Railroad-track scales.—During the last fiscal year tests were made of 980 railroad-track scales located in 39 States and on 79 railroad systems. On 172 scales adjustments were made to reduce the error of weighing, a service feature which is included with tests whenever considered practicable. Of all the scales tested 65.4 per cent were found to be within the bureau's tolerance and the mean error of all scales was 0.29 per cent. These figures are virtually identical with those of last year. However, a notable improvement over results of previous years is observed in the southern district where 61.9 per cent of all scales tested passed the tolerance as compared with 47 per cent in 1925. Further evidence of betterment in that district is to be found in the mean error. Excluding 1 scale with an exceptionally excessive error, the mean error was only 0.30 per cent as compared with 0.42 per cent the preceding year. No appreciable improvement is discernible in other districts. The general conclusion drawn is that maintenance efficiency and replacement rate have reached, for the present, a peak level in the eastern and western districts, while in the southern district, where such factors have heretofore been deficient, the work done has drawn attention to their value with gratifying results.

Master-track scales.—The 15 master-track scales calibrated and, when necessary, adjusted during the year were found to be correct

within allowed limits. Five master scales in the southern and eastern districts remain untested in consequence of personnel shortage and necessity for repairs to testing equipment. These tests will be brought up to date in the very near future.

Railroad-track scales in grain-weighing service.—Included in the general track scale testing program were tests of 90 scales used for weighing grain. Of this number 37 were within the special tolerance adopted for this class of service and 15 more were adjusted to reduce the errors within the tolerance limits. Very few of the large grain terminal markets possess equipment adequate for properly testing these scales, and the services of the bureau's units for that purpose are in increasing demand. In view of intimations made to bureau representatives during the year, it is not unlikely that the bureau will shortly be requested to enter the field of testing automatic and hand-operated grain-hopper scales. This would be a logical field for bureau investigation and one in which very valuable work could be accomplished, but special equipment and additions to the staff would be required.

Test-car calibration.—Twenty-seven test cars operated by railroads and industrial plants at points remote from a regular master scale were standardized during the year. A commendable trend toward acquisition of approved types of test cars is apparent and is interpreted as being a direct result of bureau recommendations for improved testing practice and facilities.

Specifications.—Two section track scales of the knife-edge type have lately been placed on the market and their advent has aroused a considerable degree of interest and controversy as to their merits and adequacy. Issuance of specifications for the guidance of manufacturers, purchasers, and builders is contemplated and the necessary preliminary data have been compiled.

General.—As in past years, the field work suffered interruption and delay occasioned by lack of funds, resignation of inspectors, and repair of equipments. No. 1 unit was withdrawn from service in February for a necessary overhauling and was not thereafter operated. In spite of this and other unfavorable circumstances the aggregate number of field tests exceeded by 10 per cent the number for last year. Prosecution of essential phases of the work at the bureau was necessarily neglected. If the section is to pursue a consistent policy of improving the commercial weighing situation and is to develop related projects successfully, additional personnel must be acquired and salaries of field men brought up to a plane where the bureau's schedules will not be so frequently disrupted by resignations of inspectors who receive more attractive offers from other agencies.

STANDARDIZATION OF EQUIPMENT ($110,000)

Simplified practice recommendations accepted.—Up to the present time simplified practice recommendations have been accepted by manufacturers, distributers, and users of the following commodities:

No.	Item	Reduction in varieties		Per cent reduction
		From—	To—	
1	Vitrified paving brick (fourth revision conference)	66	4	94
2	Beds, springs, and mattresses	78	4	95
3	Metal lath	125	24	81
4	Asphalt (penetrations)	88	9	87
5	Hotel chinaware	700	160	77
6	Files and rasps	1,351	496	65
7	Rough and smooth face brick	75	2	97
	Common brick	44	1	98
8	Range boilers	130	13	90
9	Woven-wire fencing	552	69	87
	Woven-wire fence packages	2,072	138	93
10	Milk bottles and caps	78	10	87
11	Bed blankets (sizes)	78	12	85
12	Hollow building tile	36	19	48
13	Structural slates for plumbing and sanitary purposes			[1] 84
14	Roofing slates, descriptive term (thicknesses and sizes)	98	48	51
15	Blackboard slates, slab heights and sizes	251	25	90
16	Lumber (first revision) [2]			
17	Forged tools	665	351	47
18	Builders hardware:			
	Items			26
	Finishes			71
19	Asbestos paper (sizes, widths, weights of rolls)	14	8	43
	Asbestos millboard (sizes, thicknesses)	10	5	50
20	Steel barrels and drums	66	24	64
21	Brass lavatory and sink traps	1,114	72	94
22	Paper	[3]	[3]	[3]
23	Plow bolts	1,500	840	44
24	Hospital beds:			
	Length	33	1	97
	Width	34	[4]	91
	Height	44	1	97
25	Hot-water storage tanks	120	14	88
26	Steel reinforcing bars (cross-sectional areas)	40	11	73
27	Cotton duck (widths and weights)	460	94	80
28	Sheet steel (first revision)	1,819	263	85
29	Eaves trough and conductor pipe	21	16	24
30	Terne plate (weights)	9	7	22
31	Loaded shells (first revision)	4,076	1,758	57
32	Concrete building units (length, width, and height of blocks, tile, and brick)	115	24	80
33	Cafeteria and lunch-room chinaware	668	177	73
34	Warehouse forms	[3]	15	
35	Steel lockers	65	17	74
36	Milling cutters			[1] 35
37	Commercial purchase forms	[3]	3	
38	Sand-lime brick (length, width, and height)	14	3	79
40	Hospital chinaware	700	113	84
42	Paper grocers' bags	6,280	4,700	25
44	Box board thicknesses	244	60	75
45	Grinding wheels	715,200	255,800	64
47	Cut tacks and small cut nails:			
	Sizes	428	181	58
	Packing weights	423	121	71
49	Sidewalk lights:			
	Sizes	120	6	95
	Styles	80	5	94
	Shapes	10	2	80
51	Die-head chasers (for self-opening and adjustable die heads)			75

[1] Average reduction.
[2] Standard nomenclature grades and sizes for softwood lumber.
[3] Indeterminable.
[4] 1 standard, 2 specials.
[5] Thousands.

Recommendations in process of acceptance.—Simplified practice recommendations for the following items have been proposed and approved at a general conference of manufacturers, distributers, and users, and are now in process of acceptance by the various groups interested.

No.	Item	Reduction in varieties		Per cent reduction
		From—	To—	
39	Dining-car chinaware	700	113	84
41	Insecticides and fungicides (packages)	38	21	45
43	Paint and varnish brushes	480	138	71
46	Tissue paper:			
	Roll tissue	13	3	77
	Shoe tissue	21	6	72
48	Shovels, spades, and scoops	5,136	2,178	57
50	Checks, notes, etc	(1)	(2)	(3)
53	Steel-reinforcing spirals	7	3	58
54	Sterling-silver flatware	190	62	67
55	Tinware, galvanized and japanned ware	1,154	873	24
56	Carbon brushes and brush shunts	(3)	(3)	(3)
57	Wrought-iron and wrought-steel pipe, valves, and pipe fittings:			
	Sizes of valves and fittings	20,000	19,238	4
	Sizes of pipe	62	49	21

[1] Thousands. [2] One size for each instrument. [3] Indeterminable.

Field surveys in progress.—Surveys of existing varieties are in process for the following industries:

Seeds, hospital linen, trap-screw ferrules, radiators, registers, horseshoes, casket hardware, hollow-metal doors and trim, steel sash, wire-bound boxes, office furniture, hardwood lumber, millwork, tires, knitted underwear boxes, waxed paper, explosives, pyroxylin plastics, metallic cartridges, refractories, vitreous china plumbing fixtures, sterling-silver flatware, porcelain-enamel table tops, brake lining, piston rings, ball bearings, taper-roller bearings, spark plugs.

American Marine Standards Committee.—This organization is controlled by the marine industry but administered as a unit of the division of simplified practice. Its membership is now composed of 312 member bodies and is increasing. The technical activities are carried on by special committees, technical committees, and subject committees, the aggregate number of which is at present 45 and most of which are active. Its work has perceptibly advanced during the year and the prospects for progress are good. Twenty-eight standards have been promulgated and there are numerous others nearing completion. Encouraging interest is being manifested in the organization's program and activities.

General.—Eighteen general conferences of manufacturers, distributers, and users, and 58 preliminary conferences with manufacturers were held during the year. Also 11 revision conferences were held during year, revealing the fact that there is an average adherence to simplified practice recommendations of about 82 per cent. Thirty-eight new fields requested the cooperation of the division in connection with a simplification program. Thirty-four projects (commodities) have developed to the point where there is reasonable expectation of their completion into simplified practice recommendations. Forty-five articles were prepared by members of the staff for printing in outside publications.

A total of 3,461 acceptances of simplified practice recommendations have been received to date from associations, manufacturers, distributers, and consumers. Approximately 250,000 copies of simplified practice recommendations have been sold through the Government Printing Office up to July 1.

The outstanding event of the year has been the appointment of simplified practice committees by a number of the State manufacturers associations, to cooperate with the division of simplified practice, in circularizing their membership for recommendations as to items in greatest need of simplification. This has resulted in a large number of requests for information, and many items were suggested as being fertile fields for the application of simplified practice.

Considerable attention is being given abroad to the subject of simplification, as it is being introduced and practiced among American manufacturers. Many foreign publications are carrying editorials and articles on the "waste elimination program" as being promulgated by the Department of Commerce in cooperation with American industry.

National Directory of Commodity Specifications.—In September, 1925, copies of the National Directory of Commodity Specifications were received from the Public Printer. This book contains references to about 27,000 specifications for more than 6,000 commodities, there being listed therein the current specifications of the Federal Specifications Board, the separate departments of the Federal Government, the State and city purchasing agents, public utilities, technical societies, and trade associations. The book is now in its third printing, the first and second supply having been exhausted within a month after coming from the press.

Specification manuals in progress.—Considerable progress has been made in the preparation of manuscript for three books that can be looked upon as companion volumes to the directory, namely, Specifications for Household Commodities, Encyclopedia of Specifications, in which will appear actual copies of certain nationally recognized specifications for the more important commodities, and Treatise on Specifications, dealing with the selection, use, and limitations of commodity specifications and testing methods.

Certification plan.—With the object in view of facilitating the use of United States Government master specifications by purchasers who are not equipped to test deliveries under these specifications, compilations are being made of lists of manufacturers desiring to supply material in accordance with specifications of the Federal Specifications Board and willing to certify to purchasers upon request that the material thus supplied complies with requirements and tests of the specifications.

List of testing laboratories.—In recognition of the desirability under present conditions of independent commercial testing service and in anticipation of a marked increase in the demand for such service in both domestic and export trade, there is being compiled a classified list of all of the laboratories throughout the country that are prepared to test various kinds of commodities to determine whether or not they comply with purchase specifications. In this list will be included the laboratories of universities and colleges that are equipped for doing commodity acceptance testing on either a purely commercial basis or for the purchasing officers of the States, municipalities, public institutions, or the schools themselves.

Heretofore purchasers not individually equipped to make their own acceptance tests have been reluctant to adopt the specification

method of buying commodities because of the fixed belief that many manufacturers work off "seconds" on such customers. The knowledge that they can at any time, when they so desire, call upon testing laboratories to check the deliveries made to them on contracts, based on specifications with which certificates have been issued by the manufacturers, will induce a large number of such purchasers to take full advantage of the so-called certification plan.

Radio standardization.—Considerable work has been done on specifications and standards for radio apparatus suitable for both Government and public use. Definite standardization in this field is difficult on account of its rapid development, but the general principles are being established through cooperation with the manufacturers' organizations, the Institute of Radio Engineers, and the American Institute of Electrical Engineers. Definite standards for a Government standard receiving tube have been established and considerable progress has been made on specifications for power tubes.

Automobile headlight standards.—During the past year the bureau has furnished consulting service for various States in the establishment of their requirements and procedure for approval of types of automobile headlight devices. It has made tests of many devices for some of the States, particularly Oregon and the District of Columbia. Circular 276, Motor-Vehicle Headlighting, has been widely distributed and the headlight adjusting chart issued with it has been used by thousands in various places where an improvement in the headlight situation has been actively sought.

Safety standards.—The bureau's engineering and consulting service in the preparation of safety codes includes cooperation with representative committees dealing with the construction and operation of industrial equipment of many kinds. This work also includes regular examination of Underwriters' Laboratories reports on electrical devices and advice to State industrial commissions and local authorities regarding safety requirements. During the year the first edition of the Aeronautic Safety Code has been issued, the elevator inspector's handbook has been nearly completed, a code of colors for traffic signals has been published, and a study of desirable colors for tail lights has been begun.

Battery standardization.—During the year extensive tests of the product of all important manufacturers of dry cells have been made with a view to the establishment of Government qualification lists and the revision of specifications. A new and much enlarged automatic battery-testing equipment has been designed and its installation nearly completed.

Handbook on optical design.—The first (100 pp.) of three parts of a handbook on optical design has been prepared for publication. This handbook is intended to lead to standardized methods in the design of optical parts and thus save a great amount of time and labor in this field.

STANDARD MATERIALS ($10,000)

Distribution of standard samples.—Sixty-four different kinds of standard samples were distributed, 4 new samples prepared, and 8 samples renewed. Approximately 5,500 samples were sold to private

establishments for which $11,000 was received for deposit in the United States Treasury. In addition, 500 samples with a value of $1,000 were issued free of charge to Government and State laboratories and State universities. The total return to the Government was, therefore, $12,000 or $2,000 more than the present appropriation. Standard samples comprise ores, metallurgical products, and pure chemicals. They are used to check methods of analysis that control the manufacture and sale of metallurgical and agricultural products, to calibrate instruments, and to further research. A direct result of their use is a saving of thousands of dollars a year through improved manufacturing operations and the avoidance of litigation based on faulty analysis.

INVESTIGATION OF RADIOACTIVE SUBSTANCES ($10,680)

Beta-ray spectroscopy.—With the cooperation of the National Research Council apparatus was designed and constructed for investigations in Beta-ray spectroscopy. Two minor publications have been issued.

Tests of radium preparations.—Over $800,000 worth of radium preparations were tested, the sale price being determined by these tests, eliminating controversy between buyer and seller. The fees received in this service amounted to $6,715.50.

INVESTIGATION OF AUTOMOTIVE ENGINES ($25,000)

Supercharging of aircraft engines.—This project has as its purpose the determination of the maximum improvement in engine performance to be expected as a result of supercharging. By means of the altitude laboratory equipment it has been possible to test both a Liberty 12 and Curtiss D–12 engine over conditions of temperature and pressure corresponding to altitudes up to 25,000 feet. The performance which these engines would give if equipped with an "ideal" supercharger has been determined and the foundation thus laid for tests of actual superchargers to determine the extent to which they meet this ideal.

Economic volatility of motor fuels.—The bureau for several years has cooperated with the American Petroleum Institute, National Automobile Chamber of Commerce, and Society of Automotive Engineers in an investigation of the economic volatility of motor fuels. A marked increase in the use of closed cars and a nation-wide program of road development have increased greatly the winter operation of automobiles. Starting cars in cold weather is one of the outstanding difficulties of winter operation. The bureau has studied this problem both from the standpoint of improvements in fuel and improvements in engine design which would help the situation. Three reports covering the findings to date have been presented to the cooperating societies and at their request the work is being continued.

Fuels for high-compression engines.—The development of cracking processes by oil refiners during the past year has resulted in a considerable increase in the amount of antiknock fuels available. As the bureau has done a great deal of work in the past, particularly as regards the use of high-compression ratios with antiknock fuels in aviation engines, it has been called upon not only to test these fuels

but to furnish information as to the proper field for their use. Considerable work has been done, therefore, in showing the application of the results obtained in previous years to motor-car problems. This work has emphasized the fact, frequently overlooked, that an increase in compression ratio makes it possible to use a smaller engine and thereby improve fuel economy considerably more than would be anticipated from the effect of the compression ratio upon thermal efficiency. It is evident that development along these lines will be even more rapid during the coming year and the bureau expects to render even greater service along these lines.

Lubrication of aviation engines.—In cooperation with the Bureau of Aeronautics, the bureau has studied the lubrication of aviation engines under the low temperatures which prevail when starting such engines in the winter time. Many engine failures are attributable to faulty lubrication under such conditions. The flow of oil in the various elements of the system has been investigated separately and the flow in an actual engine mounted in a cold chamber has been measured. Various oils have been compared in the same engine. The work has emphasized the seriousness of the problem by showing how extremely small the flow of oil is at low temperatures and at the same time has indicated how engine design may be modified to improve conditions, and what characteristics an oil should possess to be most satisfactory under these critical conditions.

Oxidation.—The oxidation test for lubricating oils which the bureau developed has continued to prove very satisfactory as a measure of the stability of such an oil in service. An obstacle to the adoption of this test, however, was the fact that several experimenters had reported explosions as a result of it. The explosion hazard in connection with this test has therefore been investigated and found to be due to a lack of proper precautions in drying the flasks used in the test before use. The accidents therefore were not due to difficulty in drying the flasks, but to a lack of appreciation of its importance. It is believed, therefore, that the way is now clear for the widespread adoption of this method of test.

TRANSFERRED FUNDS ($173,250)

Oil pollution.—A member of the bureau's staff has served as technical adviser to the Interdepartmental Committee on Oil Pollution. Several voyages have been made on oil-burning vessels so as to study the behavior of oil and water separators under service conditions. The bureau presented a comprehensive report to the international conference showing that several types of separators now in use can be made to save practically all the oil now thrown overboard.

Radio-direction finder for Coast Guard.—At the request of the United States Coast Guard, the bureau designed a special direction finder for use in connection with the radio receiving sets installed on small motor-driven patrol boats. Only one movement of a handwheel is necessary to determine the position of a vessel sending radio signals, as a sharp minimum signal is obtained for all positions of the direction-finder coil by means of a special balancing condenser operated automatically.

Helium recorders.—At the request of the Navy Department, the bureau has designed several sets of apparatus to be used in helium-

recovery plants to control the manufacturing process, for analyzing the gas in the gas bags of airships, and for determining the amount of leakage from the gas bags.

Chromium plating.—A process for plating steel printing plates with chromium has been developed for the Bureau of Engraving and Printing. Chromium is the hardest metal known, and a thin coating of this material greatly increases the life of the steel plate. The quality of the resulting impression is likewise improved. A great saving will result in the cost for replacement of plates, and the better impression will render counterfeiting more difficult.

Corrosion, fatigue, and embrittlement of duralumin.—In cooperation with the Army, Navy, and National Advisory Committee for Aeronautics a thorough investigation is being made of all possible causes of deterioration of duralumin used in aircraft construction. The factor of safety employed in building aircraft is necessarily much smaller than would be the case in other work, so absolutely accurate information on the strength of materials is essential.

Electrically charged dust.—At the request of the Bureau of Entomology of the Department of Agriculture, experiments have been made of spraying electrically charged dust from airplanes in order to destroy insect pests. However, it was found that the method was not a practicable one and the work was discontinued.

Optical glass.—Thirty-six pots of optical glass, each containing approximately 1,000 pounds, were melted during the year. All glass of satisfactory quality is turned over to the optical shop of the Navy Department to be used in making periscopes, range finders, officers' binoculars, and other optical instruments.

Miscellaneous.—Other work which has been performed for the Government on transferred funds includes: Study of performance of machine guns, investigation of bomb ballistics, general radio problems, and causes of embrittlement of duralumin for the War Department; investigation of stresses in aircraft structures, corrosion of duralumin, development of substitutes for parachute silk and goldbeater's skin, investigation of storage batteries for submarines, study of internal combustion engine fuels and lubricants; development of aircraft instruments and improved photographic emulsions, investigation of stresses in riveted ship-plate joints, and stresses in rope and cordage for the Navy Department; miscellaneous chemical and metallurgical tests for the Shipping Board; and development of airplane instruments, wind-tunnel tests of models, investigation of aircraft engine performance, study of velocity of flame in explosive gaseous mixtures, development of substitute for parachute silk, and study of fatigue and corrosion of duralumin for the National Advisory Committee for Aeronautics.

GENERAL RECOMMENDATIONS

Needed increase of funds.—The visiting committee has in the past three years strongly recommended increased funds for the bureau to enable it more adequately to fulfill its functions as a standardizing and national research laboratory, in order that it may keep pace with the industrial development of the country and the demands from other Government departments. The upkeep of standards is seriously in arrears and it is also impossible for the

bureau to meet many of the legitimate requests for testing service which can not be met elsewhere. In many lines of work there are urgent demands for the determination of physical and chemical constants which are not now known with the accuracy that industry and engineering require and which can only be determined satisfactorily in a national laboratory.

In view of the increased governmental requirements for testing of commodities for the Government departments, largely as a result of the establishment of unified specifications promulgated by the Federal Specifications Board, provision should be made for the bureau more adequately to meet the constantly increasing demand for this service. The situation is particularly serious in the branch laboratories, in view of the fact that the comptroller is very properly insisting that materials purchased by the Government establishments be tested in a Government laboratory. Provision for an adequate testing service for all purchases has many times been shown to be economical in the end. I therefore recommend that most serious consideration be given to increasing the bureau's appropriations for the establishment, maintenance, and upkeep of standards, testing work for industry and the Government, and the determination of fundamental constants and the properties of materials essential to progress in industry.

Coordination of Bureaus of Mines and Standards.—The entrance of the Bureau of Mines into the Department of Commerce has made possible the coordination of the work of the Bureaus of Mines and Standards. The oil testing heretofore done by the Bureau of Mines has been transferred to the Bureau of Standards, and provision will have to be made to care for this work on our funds. The ceramics work of the bureaus was also concentrated at the Bureau of Standards with reduced appropriations. The committee representing the ceramic industry is strongly recommending substantial increases in the ceramics work of the bureau and provision should be made to meet this situation.

Industrial utilization of waste farm products.—Looking ahead into the future the time will undoubtedly come when it will be necessary to utilize more effectively the enormous quantities of waste products of the farm, such as stalks and straw. I recommend that a survey be made of the possibilities in this field, and that if it seems warranted the Government take the initiative in this activity. There would appear to be great possibilities in the recovery of gums, sugars, and cellulose products from these materials now wasted, and it is possible from our present knowledge to work over these recovery products into derivatives of great economic value and importance. The end products include a great variety of chemicals, cattle feed, and also fuels, and a large variety of cellulose products.

Heating and power plant.—Congress at the last session authorized the erection of a power-plant building to cost $200,000, and I recommend that this appropriation be made as soon as possible, as our present heating and power plant is obsolescent, inefficient, and in some respects unsafe. Provision should also be made for installing operating equipment which will cost about $300,000. It is expected that when the new plant is in operation there will be a saving of $25,000 a year, with greatly enhanced service to the bureau. The

setting in operation of this plant is the most urgent need of the bureau.

Master-track scale.—Congress has authorized an appropriation of $50,000 for the installation of a master-track scale and heavy test weight depot on a site to be acquired by gift. It is important that this site be acquired and the authorized building erected and the equipment installed at the earliest possible date to meet the demands on this most important service.

Medical aid.—I again recommend that provision be made for the establishment at the bureau of a first-aid station in care of a competent physician, preferably detailed from the Public Health Service. Such a station is an imperative need at an institution of the type of the bureau where there are so many accident hazards. Also there are several lines of work, including radium and furnace operations, requiring medical oversight of the physical condition of the operating personnel.

Care of buildings.—As stated last year, the number of janitors, laborers, and watchmen necessary properly to care for the buildings and grounds is entirely inadequate. There is actual danger in this situation, and it should be remedied at once. The safety of the valuable buildings and equipment of the bureau is often dependent on this service, which is now very much below the standard set for ordinary office buildings belonging to the Government, in which no unusual risks are housed.

Congress has authorized the retransfer to the jurisdiction of the bureau the custody, maintenance, protection, and operation of the bureau's plant and buildings.

Care of grounds.—Under the present appropriation for care and upkeep of the bureau's grounds it has been impossible to put them in a satisfactory condition. Likewise, it has not been possible to install drains which are urgently needed, make necessary repairs and additions to roads, or make provision for a suitable entrance. It is therefore recommended that the appropriation for grounds be substantially increased.

Important legislative proposals affecting the bureau.—Among the bills before Congress affecting the bureau are the following: Clinical thermometer bill, metric bill and resolutions, misbranding bill, paints, oils, etc., truth-in-fabric bill, hampers and basket bill, wheat-mill products, etc., and bread bill.

At the first session of the Sixty-ninth Congress, Senator Copeland introduced two bills relating to the accuracy of clinical thermometers entering into interstate commerce or imported into the country. One bill provides for compulsory tests, while the other proposes to set up a system of licensing manufacturers.

The bureau has tested clinical thermometers upon request ever since its organization and the experience thus gained as well as testimony adduced from various sources has convinced us that there is a very real need for some legislation on this subject. The bill contemplating compulsory tests has been passed by the Senate (S. 2142).

Very truly yours,

GEORGE K. BURGESS,
Director, Bureau of Standards.

BUREAU OF FISHERIES

DEPARTMENT OF COMMERCE,
BUREAU OF FISHERIES,
Washington, July 1, 1926.

HON. HERBERT HOOVER,
Secretary of Commerce.

DEAR MR. SECRETARY: In response to your request I furnish the following condensed report upon the work of the bureau during the past year.

Unexcelled progress has been made during the past year to insure the maintenance of our important fishery resources. The provisions of the Alaska fisheries law of 1924 have been put into effect, and the wisdom of this legislation is indicated by improved runs of salmon. Every effort is being made to provide for the escapement of an adequate number of breeding fish to the spawning beds. With the aid of a highly efficient scientific staff, excellent progress is being made in the study of the Pacific halibut fisheries by the International Fisheries Commission, the United States, and Canada; and an effort is being made to determine what changes in the regulations, if any, are necessary to insure the maintenance of that fishery. The present closed season has had a stabilizing effect on the industry itself and is appreciated.

The convention between the United States and Mexico, ratified on March 18, 1926, contains a fisheries section for the conservation of the fisheries off the coasts of California and Lower California. The fisheries commission provided for thereunder has been formed, and the treaty provisions are being carried out as speedily as practicable.

The preliminary conference on oil pollution of navigable waters, held in Washington, D. C., from June 8 to 16, 1926, promises to yield results of practical value in lessening the menace of oil pollution to fish and shellfish. The bureau had an active part in the work of the committees formed for the study of the problem for the guidance of the American delegates, one of whom was the solicitor of the department.

The North American Committee on Fishery Investigations is accomplishing much in stimulating and coordinating programs of scientific research of the several Governments with respect to the fisheries of the western North Atlantic, and the International Pacific Salmon Investigation Federation is performing like service through the several agencies concerned. The chairmanship of the former and the position of director on the latter are held by bureau representatives.

Laws enacted at the last session of Congress included an amendment to the Alaska fisheries act of June 6, 1924, which makes it less difficult for the halibut fishermen to obtain herring for bait

without endangering the supply of herring. An act governing the interstate transportation of black bass makes it illegal to engage in the interstate transportation of black bass illegally taken.

The bureau is assembling boats and other equipment that will be needed in carrying out the provisions of the upper Mississippi River wild-life and fish-refuge act as soon as the Secretary of Agriculture secures suitable water areas for the purpose.

The fisheries industries are in a thriving condition. At the present time they afford employment to more than 191,000 persons and represent an investment of about $202,000,000. The catch amounts to 2,881,000,000 pounds, valued at nearly $97,000,000. Manufacturing greatly enhances this value, the output of canned products and by-products in 1925 being valued at $95,177,000. Domestic exports of fishery products were valued at $21,263,000 and imports for consumption amounted to $49,031,000.

The enlivened interest of State, municipal, and private authorities in conserving and building up our fish supply, as well as our harmonious international relations with respect to the fisheries, have augmented materially the demands upon the bureau for service and have added to the difficulties of meeting such demands with existing appropriations. A brief account of the work of the several divisions of the bureau follows:

ALASKA FISHERIES

Two seasons of work under the new fishery law for Alaska, approved June 6, 1924, have shown the wisdom of granting the broad powers conveyed therein to the Secretary of Commerce for the control of the fisheries of Alaska. Further restrictions upon fishing, deemed necessary to make possible an adequate escapement of salmon to the spawning grounds, have cut commercial catches in certain localities, but these immediate decreases undoubtedly will bring greater returns to the industry in the future through the restoration of runs of salmon to waters now more or less depleted. A good beginning along this line has been made.

In the highly important work of enforcing the laws and regulations 145 persons were required, exclusive of the crews on the 21 Government-owned and chartered vessels and several small boats engaged in this work during part of all of the year. This was an increase of 26 persons and 2 vessels over the previous year. The Commissioner of Fisheries spent the greater part of the active salmon-fishing season in Alaska and therefore was in position to recommend necessary modifications in the regulations from time to time as the season progressed. A number of changes were made to meet specific situations as they arose.

On December 5, 1925, new fisheries regulations were issued, to be effective January 1, 1926. The chief changes were the inclusion of additional restrictions on the operation of certain kinds of fishing apparatus and the closure of 23 localities in addition to 76 previously closed.

The catch of salmon in the central and western districts declined 45 and 31 per cent, respectively, due to the smaller run of humpbacks in the central district (which occurs in alternate years) and

a light run of red salmon in western Alaska, together with the shortening of the fishing season in Bristol Bay. The catch in southeastern Alaska increased 3.6 per cent, but for the whole of Alaska the decrease from 1924 was 19 per cent.

The number of persons employed in the fishery industries of Alaska in 1925 was 27,685, the active investment was $67,077,495, and the total value of products was $40,038,745. The output of canned salmon was 214,076,976 pounds, or 4,459,937 cases on the basis of forty-eight 1-pound cans each, valued at $31,989,531, a decrease of 15.8 per cent in quantity and 3 per cent in value as compared with the preceding year.

The salmon ascending streams to spawn were counted through weirs established at Anan Creek, in southeastern Alaska, and in Chignik River, Karluk River, and two streams tributary to Alitak Bay waters in central Alaska. Weirs will be erected in several other streams when opportunity and facilities permit, thus affording greater opportunity to collect data on the problem of the ratio between escapement and catch necessary to maintain the runs in perpetuity. In continuation of the study of salmon migration routes, 13,645 salmon of various species were tagged and released in southeastern Alaska and 2,000 red salmon at Port Moller. The subsequent recapture of about 4,722 of the fish tagged in southeastern Alaska and of 949 tagged at Port Moller gives valuable information with reference to the movements of the fish on their way to the spawning grounds. Studies of the clam fisheries of central Alaska were continued and an investigation of the herring industry was begun in 1925. The herring fishery showed marked expansion during the year.

The annual closed season of three months provided by the North Pacific halibut treaty of March 2, 1923, was in effect this year. While its value as a conservation measure has not yet been established, it has proved beneficial to the industry.

ALASKA FUR-SEAL SERVICE

The American fur-seal herd, which breeds on the Pribilof Islands, Alaska, was computed to contain 723,050 animals as of August 10, 1925. This was an increase of 25,892 seals over 1924. The total take of sealskins in the calendar year was 19,860.

In the season of 1925, 9,354 3-year-old male seals were marked and released for future breeding purposes. This reserve was augmented by the number of 3-year-old males that were not secured in the season's drives. The size of the herd requires a larger reserve of these animals than the minimum of 5,000 specified by law.

In the fiscal year 1926 there were sold 24,479 sealskins taken at the Pribilof Islands. The aggregate price was $787,385.13. The sales consisted of 19,617 skins dyed black, 910 dyed Chataigne d'Or (golden chestnut), 3,777 dyed Bois de Campêche (logwood brown), and 175 miscellaneous skins.

In the winter of 1924–25 681 blue and 28 white fox skins were taken at the Pribilof Islands. Of these, 341 blue and 28 white skins were sold at public auction on September 24, 1925. The gross proceeds of the sale were $17,619. The remaining skins will be disposed of later. In the winter of 1925–26 705 blue and 20 white fox pelts

were secured. Improvements in the method of feeding foxes in the winter season on St. George Island and the extension of winter feeding to St. Paul Island undoubtedly have improved the condition of the animals and led to an increase in the breeding stock.

PROPAGATION AND DISTRIBUTION OF FOOD FISHES

The extension of the cooperative fish-nursery plan represents the outstanding development of the year in the field of fish culture. Under this plan the bureau assists fish and game organizations in securing a stock of fish and advises as to their care and distribution. The private organization furnishes the hatching troughs, rearing ponds, fish food, and other incidental items. The fish are reared to the fingerling size, and when ready for distribution the organization uses one-half the output for stocking its streams and the bureau distributes the balance to applicants desirous of stocking waters in the surrounding region. In the case of trout, for example, the output of fry at the bureau's stations is much greater than its pond systems will carry to the fingerling stage. Furthermore, the number of fish that can be carried in each container during the spring distribution period is approximately ten times greater than if shipment be postponed until fall. Under artificial cultivation at the nursery it is possible to carry virtually the entire number to the fingerling stage, when their ability to care for themselves under natural conditions is assured and the bureau's distribution from the local point to applicants can be accomplished with a minimum of loss and expense. The cooperative fish nursery arouses the interest of the public in the production and protection of fish, brings financial support from those most vitally interested, reduces the bureau's distribution costs, insures the rearing of a larger number of fry to the fingerling sizes, and simplifies distribution. During the current season nine cooperative trout nurseries were opened, with a prospective output of 765,500 fingerling fish.

In keeping with the growing demand for fingerling fish, the bureau increased its output from 136,954,000 in 1925 to 299,040,000 in 1926. Results obtained in holding young salmon in rearing ponds have been successful and reveal the necessity for larger scale operations throughout the service. Ponds are being expanded as rapidly as practicable to make possible a much larger output of fingerling fish. In addition, a campaign of education in the best methods of planting the fish in the streams is being conducted.

The total output of the bureau's stations in 1926 was 5,237,990,000 eggs, fry, and fingerling fish, as compared with 5,301,860,000 in 1925. About 75 per cent of this total is the output of the marine stations, produced at but little more than 7 per cent of the total outlay for fish culture. The principal source of egg collections is the catch of the commercial fishermen. The cost of this marine work was less than $14 per million eggs and fry.

That the supply of shad is decreasing is indicated by the increasing difficulty of obtaining a take of eggs comparable with those of former years. At the Edenton (N. C.) station comparatively few eggs were taken, and at Bryans Point, Md., less than 10,000,000, as compared with 16,000,000 in 1925 and 35,000,000 in 1922.

To maintain this fishery it is suggested that the States give consideration to more restrictive measures to insure the escapement of a larger number of fish to the spawning grounds. This may be accomplished in various ways, as by weekly closed periods and the closure of natural spawning areas.

From the overflowed lands along the upper Mississippi River, and to a lesser degree in the lower reaches of the river in Louisiana, 149,815,000 fishes were salvaged and inoculated with 3,145,000,000 glochidia of fresh-water mussels before they were distributed. More than 98 per cent of the fish are returned to the river at the point of rescue, the balance being used to supply applicants for warm-water fishes in the Mississippi River region. Following is the output of fish and eggs of 12 of the more important commercial species:

Buffalo fish	116,573,600	Pike perch	213,732,200
Whitefish	208,344,000	Chum salmon	18,163,500
Cisco	95,080,000	Cod	983,967,000
Chinook salmon	62,921,900	Haddock	145,946,000
Sockeye salmon	80,247,800	Pollock	428,788,000
Lake trout	31,816,400	Winter flounder	2,388,057,000

BIOLOGICAL INVESTIGATIONS

With the continued decline in abundance of numerous important commercial species of fish on both our Atlantic and Pacific coasts and in the interior waters, it has become increasingly apparent that the great problem of the fisheries to-day is that of maintaining the supply so as to afford a maximum production for all time. The problems of conservation, therefore, are the most immediate and urgent problems of the fisheries and are those upon which the scientific investigations of the bureau are focused. But fishery science is so unorganized that the causes of fluctuating abundance of fish are little understood and require a study of fundamental and often elementary facts in aquatic biology. Feeding, migrations, spawning, growth and development, enemies, and mortality all have their influence in an understanding of the factors that control the abundance of a species. But the abundance of fish fluctuates from year to year, and these fluctuations are due to many causes, such as the changing abundance of food, the effect of physical environment, and to various natural or artificial influences such as competition with the same or with different species and the effect of man's exploitation. Because of this great diversity of causes, the principle of cooperative or group research which has been found so effective in other lines, has been applied to the major projects of the division's work. For example, the investigation of the cod fishery in the western North Atlantic is now being carried on not only by the three Governments most directly concerned in the prosperity of this fishery but is being approached from several angles by the various institutions conducting the investigations.

The present state of the cod fishery and the distribution of the fish (in point of abundance) on the various fishing banks and inshore areas is being determined by a statistical analysis of the records of yield. The factors affecting the abundance are being sought by studying the embryology and early life history of the fish, its period of spawning, rate of development, migration from bank to bank, localization of the distinct races of the species, and the physical fac-

tors, such as temperature, salinity, and gas content of the water, that affect the fish throughout its entire life. Its food habits also are being investigated, together with variations in the character and abundance of the microscopic organisms upon which it must depend for food in its early period of growth. Thus, statisticians, biologists, biochemists, planktonologists, and oceanographers are cooperating to a degree never attained heretofore, each conducting investigations that individually may be considered problems in pure science but which are so coordinated and centralized that complete understanding of the fishery and its problems is rapidly being attained.

This work, in addition to investigations of other commercially important fish in the western North Atlantic, is being fostered and to a large degree coordinated by the North American Committee on Fishery Investigations, composed of delegates from Canada, Newfoundland, France, and the United States.

While the principle of group research is being applied to the bureau's investigations as far as possible, the demands upon it for such investigations are so numerous, the interests so diverse, and the areas to be covered so great, that in many lines research is seriously handicapped. Through cooperative arrangements with the several State fish commissions, however, much more has been accomplished than would have been possible otherwise. Joint investigations by Federal and State Governments, including work in the States of Georgia, North Carolina, California, Oregon, Washington, Michigan, and Wisconsin, have been continued, and additional projects have been undertaken in South Carolina and Texas.

In surveying the year's accomplishments, gratifying progress can be noted. In the North Atlantic region, in addition to material increases in our knowledge of the oceanographic and general ecological factors affecting the lives of all fish of the region, real advances have been made in acquiring an understanding of the limitations upon the source of supply of cod in the Gulf of Maine and in the Nantucket-Long Island regions. Studies of the migration and spawning habits of the adults and the distribution of the young by ocean currents indicate that the stock in Massachusetts Bay is distinct from that farther north but is dependent upon stocks in other and as yet unknown regions.

Further investigations of the interdependence of various shore and offshore areas have been made possible by the acquisition from the Navy during the past year of an excellent seaworthy research vessel. In addition to oceanographic work, the vessel will be used in the cod, pollock, and haddock studies and in the mackerel investigations. The knowledge of these fisheries thus obtained gives promise of affording, for the first time, means of discovering depletion should it occur and means of devising regulations for the threatened areas—a scientific control essential to safe expansion of the fishing industry. The submission of an extensive report on the plankton, and the virtual completion of one on the oceanography of the Gulf of Maine, mark the culmination of many years' study and provide information as to this rich fishery region which is probably more complete than that of any other area on the Atlantic coast.

The mackerel investigation initiated last year has been continued and progress has been made in determining the age of fish compos-

ing the various runs. The study of migrations, by means of tagging experiments, has been continued; and analyses with the view to discovering the cause and also of foretelling the occurrence of fluctuations in abundance of this erratic but valuable species of fish have been attempted.

Our knowledge of the fishes of the Chesapeake Bay has been materially increased by an extensive report based on several years of field work just completed, which not only gives descriptions and authoritative account of the systematic relationships of all the fishes known to occur in the region, but includes a great amount of information on the natural history of the more important species. The fisheries for the more valuable fishes also are treated at some length.

In compliance with urgent requests and offers of cooperation, fishery investigations on an increased scale have been conducted at various points on the South Atlantic and Gulf coasts. The fisheries here are largely for shore species and are conducted near the coast or in inclosed lagoons or sounds. They are particularly subject to pollution and overfishing and many of them show unmistakable signs of depletion. The mullet fishery, which yields approximately 40,000,000 pounds annually, is the most important in the region. Because of signs of decline this fishery has received first attention, with encouraging results. The studies show that the coastal migrations of the mullet are much more restricted than formerly was supposed, and that the problems of conservation are of local significance only. Specific recommendations for application in the most seriously threatened areas are being prepared.

A thorough investigation of the destruction of immature fish by various fishing gear in North Carolina disclosed the fact that pound nets fished in the sounds are a very wasteful type of gear, and cause the destruction at certain times of year of more than 54 per cent, by number, of the gray trout or squeteague caught, and as high as 97 per cent of the harvest fish under marketable size. Haul seines were not found to be destructive of immature fish. Specific recommendations were made for the elimination of this waste in the pound-net fishery and for the protection of squeteague by closed seasons, which were adopted promptly by the State fisheries authorities.

The life histories and habits of the spotted trout or squeteague, redfish, and black drum, the most important food and game fishes of Texas, also are being investigated with State cooperation in order to determine the proper means of conserving the supply that is thought to be seriously reduced. A report on the preliminary survey has been prepared for publication which points out serious weaknesses in the administration and control of the fisheries and recommends necessary changes. The field work now under way shows promising possibilities.

One of the greatest tasks of the Bureau of Fisheries, and at the same time one of the greatest opportunities for public service, is the conservation of the salmon fisheries of the Pacific coast. These fisheries, which are among the most valuable in the world, producing annually manufactured products valued at from forty to fifty million dollars, have shown serious decline in many localities due to long-continued overfishing. In cooperation with the International

Pacific Salmon Investigation Federation the bureau has established a laboratory at Seattle, Wash., and the former chief of the division of scientific inquiry is in charge of a program of investigation of the salmon of the entire Pacific coast. The bureau's investigators are conducting intensive studies in Alaska and on the Columbia River in Washington and Oregon. Studies on the migration of fish and of the importance and productiveness of various spawning areas are being continued, and a report on tagging experiments in 1924 and 1925 is in press, which will aid materially in drafting effective and wise regulations. Experiments in several important salmon streams in Alaska, begun several years ago, are now being brought to completion, whereby it is hoped to be able to determine the probable volume of future runs based on the known numbers of spawning fish and the percentage of escapement of spawners necessary to maintain the stock. The marking experiments conducted on the Columbia River in cooperation with the Oregon Fish Commission have yielded valuable results, not only in making known the habits of the salmon of this region but in proving the importance of changes in fish-cultural methods involving the use of rearing ponds for holding the salmon fry until ready for liberation. In addition to studies on the chinook salmon, the life history of the blueback salmon in the Columbia River also has received attention.

The investigation of the Alaska herring, begun last year, has been continued. Material progress has been made on such fundamental problems as the composition of the fish stock, natural fluctuations in abundance, and the detection and prevention of overfishing.

A comprehensive report on the commercial fisheries of the Great Lakes was published last year; a report on detailed studies of the life history of the lake herring of Lake Huron has been submitted, and an equally comprehensive study of the systematic relationships and natural history of the whitefishes of the Great Lakes has been brought to virtual completion. Minor investigations in this region include a preliminary survey of the destructive action of seines and other gear in the vicinity of Sandusky, Ohio.

In response to the growth of public interest in the development of aquiculture, or water farming, the bureau is giving attention to the problems of developing the fishery yield in interior waters. Efforts are being made not only to improve practical fish-cultural practices in Federal and State hatcheries, but studies on the physiology and nutrition of fishes, the prevention and treatment of disease, and the development of a superior brood stock are being carried on at an experimental hatchery and at several of the stations. Extensive experiments in pond culture have been undertaken with a view to increasing the productiveness of ponds and more fully utilizing marshy lowlands as sources of food supply and recreation. Highly significant studies on the basic food supply in fresh-water lakes have been continued as a part of this program in cooperation with the University of Wisconsin, and a report that adds materially to our knowledge of the subject has been submitted.

Following the plans adopted when the oyster investigations were reorganized during the last fiscal year, preliminary surveys of oyster grounds on the Atlantic and Gulf coasts were continued in an effort

to determine the cause and discover the remedy for the serious decline in oyster production. At the close of successful experimental work in the Long Island Sound region and in Massachusetts, a thorough survey of Texas waters was undertaken, investigations in Georgia were continued, and a brief survey of South Carolina waters was made.

As a result of these surveys preliminary recommendations for immediate improvements in planting oysters and for the correction of various commercial practices were made, and form the basis for more intensive experimental and field work on these problems.

Studies were made of the scallop in North Carolina, the freshwater mussel in the Mississippi River Basin, clams on the coasts of Washington, Oregon, and Alaska, and diamond-back terrapin culture in North Carolina. During the year an extensive survey of the mussel resources of Arkansas was made to determine the best means of protecting them from overfishing. Recommendations were formulated and were adopted at once by the State authorities and put into immediate effect.

While the division of inquiry has maintained its leading position as a research unit in the development of knowledge essential to the proper care of the fisheries, it also has rendered notable service in distributing such information to the public. Not only are the finished results of researches published as technical papers, but advance information on timely subjects is made available as economic circulars, mimeographed and typewritten memoranda, and letters. During the past year memoranda and letters were written on a wide variety of subjects—on the care and rearing of fish in ponds and aquaria; the propagation of fish, frogs, terrapin, snapping turtles, and other aquatic animals; the treatment and control of fish diseases; the identification and distribution of little known species of fish; the source of supply and utilization of various species; the effects of pollution of certain rivers and harbors on fish and shellfish; and various other questions on the lives and habits of food and game fishes. This dissemination of information to the public is greatly facilitated by the free use of the bureau's files and records by newspapers and various syndicated information services.

FISHERY INDUSTRIES

Conditions in the fisheries during 1925 compare very favorably with those in the past few years. Vessel landings at the New England ports were above normal in quantity in consequence of unusually large mackerel and haddock landings. Although the average prices declined slightly the total value of products was substantially greater than in 1924. Seattle landings were below those of 1924 in quantity and value. The canning industry produced greater quantities of nearly all varieties of canned fishery products, the total value being considerably above that of recent years. By-products also were produced in larger quantities and were of greater value. Exports of edible fishery products showed an upward trend, while imports for consumption were slightly less.

While 1925 marked no spectacular changes, the fishery industries, by reason of large gains in canning and filleting, seem to be in a more prosperous and stable condition than in any year since the

postwar depression. Especially encouraging are the advances made in the preparation and marketing of fishery products, though conditions are yet far from ideal in these respects.

Through its division of fishery industries, the bureau has been of direct service to the fishery industries by the collection and publication of fishery statistics, technical research, and dissemination of practical information to the industry. Vessel landings of fish in 1925 at the ports of Boston and Gloucester, Mass., and Portland, Me., as shown by statistics collected and published monthly, totaled 216,869,000 pounds valued at $8,115,570, as compared with the preceding 5-year average of 169,382,000 pounds valued at $6,691,936. A noteworthy improvement in the dissemination of statistics of the cold-storage holdings of fish has been the issuing of a preliminary mimeographed statement, which makes these statistics available to the trade within 15 days of their collection. The trade's appreciation of this service has been particularly gratifying. Statistics of canned fishery products showed a production valued at $80,577,000, as compared with $72,165,000 in 1924, and by-products valued at $14,600,000, as compared with $10,309,000 in 1924.

The New England States were canvassed for statistics on the personnel, investment, and yield in the fisheries and fishery industries for 1924. In that year 24,513 persons were employed, the investment was $28,562,000, and the yield of the fisheries was 406,822,000 pounds valued at $18,818,000 to the fishermen.

At the present time the bureau is completing a canvass of the major geographical sections of the country once in a five-year period. Annual statistics are vital for the determination of the abundance of fishes, and provide the best insurance against depletion and at the same time against ill-advised legislation hastily provided to meet apparent but not real depletion. The bureau is seeking to obtain such statistics by encouraging their collection by the States, and there seems to be some promise of progress in this respect. The Pacific Coast States have systems for the collection of statistics of such character that it has been possible, by supplementing them with some field work, to compile fairly complete statistics for the years 1923 to 1925. Connecticut has begun to collect complete annual statistics, and some of the States on the Great Lakes are collecting incomplete statistics.

The crab fishery of Chesapeake Bay was the subject of an investigation begun at the solicitation of men in the industry in 1924 and continued to the end of 1925. This investigation was perforce of a statistical nature and directed toward determining the cause of scarcity in recent years and the means for conserving and increasing the stock of crabs. As a result a preliminary report was issued in December, 1925, pointing out that the abundance of crabs has been declining since 1908 and reached its lowest ebb in 1925; that the stock of crabs in Maryland and Virginia is interdependent; and that considerable waste, amounting to 75 per cent in some cases, occurred in the "shedding" of "peeler" crabs. It was recommended, therefore, that a 30 per cent reduction be effected in all forms of crab fishing, and that none but true peeler crabs be permitted to be taken by "shedder" houses. Favorable action on these recommendations already has been taken by Virginia, and it is expected

that Maryland will follow with similar action at the next meeting of her legislature.

Statistics on the abundance and relative sizes of mackerel are being collected and promise in time to yield information of paramount importance to an understanding of the reason for the tremendous fluctuations in the yield of this fishery and means for forecasting abundance several years in advance. This method of attacking the problems of the fisheries already has been demonstrated by European nations to be efficacious and of great value, and this work should be extended to other important but little-understood fisheries.

In its program of technological research, the bureau recognizes that conservation should be applied to fishery products as well as to fish life. If there is waste in preserving and marketing fish or in making use of by-products, true conservation is not effected. Through technological research to bring about more efficient utilization of fishery products, by improving existing and developing new and better equipment, methods, products, and processes within the different branches of the fishing industry, and by showing how properly to utilize wastes and by-products, the bureau is endeavoring to effect the greatest possible conservation of fishery products. Few realize the importance of well-directed, adequately supported technological research. Rapid progress in industry, and this applies particularly to the fisheries industries, depends largely upon such work combined with the application of sound business principles.

Work was continued throughout the year on three major lines of research—preservation of nets, canning of sardines, and the utilization of by-products.

Efforts toward bringing about the commercial development of a new process of preparing sardines developed by the bureau are meeting with success. Two small plants in Maine and one in Canada have erected equipment and are using the new process. The product prepared by these plants is receiving much favor. Another season undoubtedly will see additional development.

Large-scale practical tests of copper oleate and copper oleate-copper paint were conducted in cooperation with fishermen at several points on the Atlantic coast. These tests, which are still under way, show the real saving that can be obtained by the proper use of copper compounds on various kinds of gear. To offset the higher cost of the copper-oleate treatment the bureau now is experimenting with other copper compounds in an endeavor materially to lower the cost of treatment.

Research upon decreasing losses in protein and oil wasted in press liquors now discarded in manufacturing fish meal and oil was carried on throughout the year. Shrimp canners in Texas, faced with the necessity of utilizing their waste products, were advised by the bureau as to the kind of process and equipment best suited for their purposes. It was also possible to show them how a reasonable profit could be made from such operations. Similar attention was given to the utilization of market waste and, in particular, waste from haddock-filleting operations.

The industry itself has shown progress in fisheries technology. In the fresh-fish field there has been a large increase both in the amount

of fish filleted and in the number of concerns throughout the country that have adopted this practice. This improved method of marketing has done much to popularize and increase the consumption of fish. It also tends to eliminate waste by concentrating large amounts of offal in one place, making its manufacture into fish meal profitable.

In the canning field there was marked improvement both in salmon and in Maine sardines. The menhaden industry also took definite steps toward improving the quality of its fish meal and oil by installing refrigerating machinery for brine-cooling fish aboard ship. Steamers so equipped can be operated to much better advantage because it is seldom necessary to return to port without a reasonable load of fish. Also, it is possible to go to the best fishing grounds instead of being compelled to fish close to the factory.

The fishing industry as a whole made definite plans for conducting a national advertising campaign to increase the consumption of fish. This should bring about valuable changes, as most of their efforts are to be expended in improving technological practices.

Very truly yours.

HENRY O'MALLEY,
Commissioner of Fisheries.

LIGHTHOUSE SERVICE

DEPARTMENT OF COMMERCE,
BUREAU OF LIGHTHOUSES,
Washington, July 1, 1926.

Hon. HERBERT HOOVER,
Secretary of Commerce.

DEAR MR. SECRETARY: In response to your request, I furnish the following report upon the work of the service during the past fiscal year:

MORE IMPORTANT ACTIVITIES OF THE LIGHTHOUSE SERVICE DURING THE YEAR

The radio beacon system has been materially extended. Twelve additional stations were established during the year, at the lighthouses at South Pass, La.; Galveston Jetty, Tex.; Los Angeles Harbor, Calif.; Point Arguello, Calif.; Point Sur, Calif.; Cape Blanco, Oreg.; Buffalo, N. Y.; Detroit River, Mich.; Manitou, Mich.; Detour, Mich.; Whitefish Point, Mich.; and Devils Island, Wis. Radiobeacon installations were practically completed at 2 other stations, and are in progress at 11 stations. At the close of the fiscal year this service had in commission 26 radio beacons, and shortly afterwards there were 28 stations, those at Cape Spencer Lighthouse, Alaska, and on Portland Lightship, Me., having been put in operation. These radio beacons are being operated without any additional personnel at the stations. The first station on the Great Lakes was established in June, 1925, and six other stations later in 1925; within a year's time this system of navigation has come into extensive and successful use on the Lakes and there is urgent need for a few additional stations. The first stations on the Gulf coast have also been established this year. Preparations are in progress for testing the usefulness of radio beacons in congested waters, and this will be done in Long Island Sound. Apparatus is being tested for synchronizing the signals from adjacent radio beacon stations so as to prevent their interference with each other. Very favorable results continue to be obtained from bearings on the radio beacons taken with radiocompasses on shipboard. Very notable instances of the value of the radiocompass on shipboard occurred during the year, especially the rescues in mid-ocean by the steamers *Roosevelt* and *Westphalia*, of vessels located by this means.

Progress was continued in extending the automatic system of operating lighted aids. During the year automatic lighting apparatus was installed at 83 stations. At the end of the fiscal year the total number of automatic lights on fixed structures in commission was 1,093 (not including some partially automatic), and in addition there were 751 buoys with automatic lights, or a total of 1,844 in

the Lighthouse Service. There are also 12 fog bells operated automatically.

Large economies have been effected through these installations of automatic apparatus, which is operated efficiently at much less cost of maintenance. Further important economies have been made by the grouping of minor lights under the care of keepers of near-by stations or of a single light attendant. A large saving in the cost of radio and other equipment and supplies was effected by the transfer of surplus material from the Navy and other departments. Material savings will result from transfers of real estate authorized by recent legislation.

At the end of the fiscal year the Lighthouse Service was maintaining a total of 18,130 aids to navigation, a net increase of 266 during the year, notwithstanding the fact that 694 aids were discontinued during the year. Of the total aids 6,460 are lighted and 8,901 are floating.

There was a net reduction during the year of 81 in the number of employees in the Lighthouse Service, and the total number on June 30, 1926, was 5,880. This number is slightly less than the total number of 5,899 in 1918, eight years ago, in which time there has been an increase of 2,457, or 15 per cent, in the number of aids to navigation maintained. The number of employees is now only 102 more than the total number in 1910, although in these 16 years there has been an increase of 6,417, or 55 per cent, in the number of aids to navigation maintained by the Lighthouse Service. The number of aids to navigation maintained for each 100 employees has increased from 203 aids in 1910 to 308 aids in 1926.

The most important lighthouse construction in progress during the year was the light and fog-signal station at Cape Spencer, Alaska, which is now nearly completed; this station was placed in commission in December, 1925. The construction of a lighthouse to replace the lightship at Martin Reef, in the northern part of Lake Huron, was in progress, being about one-half completed. Work was continued on the important station on Milwaukee Breakwater, and the construction of the new station at Point Vincente, Calif., was completed. A small tender for work on the Columbia River was completed during the year. Three other vessels are being constructed, a lightship, and two tenders for the Mississippi River.

A large number of radio receiving sets were during the year donated by public-spirited persons for the benefit of the light keepers and vessel men, the Secretary of Commerce having publicly indicated this opportunity to benefit a deserving and rather isolated class. These sets are being distributed where they will be of most benefit.

The Department of Commerce was charged with fostering air commerce by the act of May 20, 1926. In accordance with the provision of this act for utilizing existing agencies so far as practicable, the Lighthouse Service was at the end of the fiscal year cooperating in the matter of marking and lighting airways. Earlier in the year it had, at the suggestion of the Navy Department, cooperated in a project, which has been carried out, for painting the roofs of lighthouses with characteristic marks along certain defined airways over Chesapeake Bay.

Several surplus lighthouse lenses have been transferred to the Air Service of the War Department for aviation purposes.

As is the case every year, there were many instances reported where members of the Lighthouse Service effected rescues, or aided those in distress. During the year one gold medal and two silver medals were awarded for rescue work to persons in this service by the Secretary of the Treasury.

During the year, both in special legislation and in the appropriation bills, Congress enacted legislation making reasonable provision to improve the status of employees of the Lighthouse Service. This together with the enactments of the previous two or three years, places this work and its personnel in a greatly improved position, and substantially meets the serious difficulties that have been encountered. Congress also made provision for the disposition of a number of lighthouse reservations, no longer needed, by transfer to other parts of the Government, or to States and local governments for public park purposes, with provision for the future use by the United States, and other sufficient safeguards.

At the end of the year an extensive exhibit of the work of this service was prepared for the Sesquicentennial Exposition at Philadelphia.

AIDS TO NAVIGATION

During the fiscal year there was a net increase of 266 in the total number of aids to navigation maintained by the Lighthouse Service. On June 30, 1926, the total number of aids was 18,130.

Improvements in aids to navigation have been made during the year, as follows: 77 fixed lights were changed to flashing or occulting; the illuminant of 10 lights was changed to incandescent oil vapor; the illuminant of 76 lights (including 5 lighted buoys) was changed to acetylene; the illuminant of 16 lights (including 2 lightships) was changed to electric incandescent; 12 radio beacons were established; 3 gas-operated fog signals were installed at light stations and on buoys; 2 diaphones and 1 electric siren were established at important stations; and the fog signals at 7 other important stations and lightships were improved by the installation of more efficient apparatus. The discontinuance of aids is under investigation from time to time as the original necessity for their maintenance ceases; 694 aids to navigation of various classes were discontinued during the year.

The Lighthouse Service has cooperated in the matter of navigational aids for aviation, as stated elsewhere.

The old light tower at Cape Henlopen, Del., was undermined by the sea April 13, 1926. This tower was about 160 years old and the second oldest light tower in this country. On account of expense of protection and diminished importance it had been replaced by an automatic light in 1924.

During the year 31 new aids were established in Alaska, and the total number is now 759, including 269 lights, 19 gas buoys, 14 fog signals, 308 buoys, and 149 daymarks. In 1910 the total number of aids in Alaska was 160.

The aids to navigation in the outlying United States territory at Guantanamo Bay, the American Samoan Islands, and the island of Guam are maintained under the supervision of the naval commandants by means of allotments made from appropriations for the Lighthouse Service.

ENGINEERING CONSTRUCTION

The more important items of construction completed during the fiscal year, stated in order of the districts, were: Completing the improvement of aids to navigation and establishment of new aids in the Hudson River, N. Y.; the establishment of a temporary light at Great Salt Pond, R. I.; the establishment of an acetylene light in Newark Bay, N. J.; the establishment of acetylene lights at Round Beach and White Rock Reef, Conn.; the establishment of 12 acetylene lights completing the inland waterway route, Norfolk, Va., to Beaufort, N. C.; completing the improvements to aids and establishing new aids to navigation in the St. Johns River, Fla.; establishing lighted beacons at East Washerwoman Shoal and Nine-Foot Shoal and day beacons on the Florida Reefs; the construction of a combined dwelling and fog-signal building at Sand Island Lighthouse, Ala.; the establishment of radio beacons as listed elsewhere; completing the improvements to aids to navigation in Calumet Harbor, Ill.; completing improvements to aids to navigation in Ludington Harbor, Mich.; the establishment of acetylene lights at Cape Uganik, Gambier Bay entrance, and Goat Island, Alaska; the establishment of an acetylene light at South Point, Santa Rosa Island, Calif.; and completing the work of establishing a light and fog signal at Point Vincente, Calif.

Other important works in active progress at the close of the fiscal year included the following: Completing the depot at Chelsea, Mass.; rebuilding the Harbor of Refuge Lighthouse, Del.; improving the lighthouse depot at Portsmouth, Va.; improving aids to navigation in Galveston Bay and Houston Channel, Tex.; improving aids to navigation at Fairport Harbor and at Sandusky Harbor, Ohio; improving aids to navigation in Livingstone Channel, Detroit River, Mich.; establishing a light and fog signal at Martin Reef, Mich.; establishing a light and fog signal at Milwaukee, Wis.; completing the light and fog signal at Cape Spencer, Alaska; improving the light and fog signal at Grays Harbor, Wash.; improving aids to navigation in Columbia River, Oreg. and Wash.

General repairs required for upkeep of aids to navigation in efficient working condition were continued during the year, but the funds available were not sufficient for the proper upkeep of this large amount of public property and much repair work was therefore deferred.

IMPROVEMENTS IN APPARATUS AND EQUIPMENT

Work was continued on the installation and use of radio beacons for protection of navigation in fog, as stated elsewhere. Tube transmitters are being installed at all new stations established and are being substituted for older types at other stations as opportunity offers. Several tests and service trials have been made of lower power transmitters, and these show that for many stations the high powers originally installed are not necessary or desirable. A number of radio transmitters are being built at the Detroit Lighthouse Depot, using parts from surplus apparatus received by transfer, thus effecting a considerable economy.

The extension and improvement of automatic lighting apparatus were continued. A system of two independent automatic light installations, for increasing reliability of the aid, in the case of more important unattended lights, is being developed.

Improvements have been made in apparatus used in connection with electric illumination of light stations. Developments during the year included an acetylene stand-by equipment, to be turned on automatically in case of failure of the electric light. A special electric lamp, for use in connection with flash panel lenses, is being developed, the primary object being an increase in the duration of the flash and a better arrangement of the light source.

In certain localities where there are considerable numbers of minor lights progress was made in their conversion from fixed to flashing by installing automatic apparatus and in having them cared for in groups, effecting an increase in the efficiency of the aids and a reduction in the cost of maintenance.

The installation of air fog signals to replace steam signals was extended, with increased economy and efficiency. Seven such replacements were made during the year. There are now 79 steam signals in service, as compared with 131 in 1911.

On June 30, 1926, 332 light stations had telephone communication, an increase of 7 during the year.

The work of converting buoys using oil gas to acetylene buoys was continued during the year.

Two types of small gas buoys have been designed during the year; these can be handled by a large launch, for use in locations where the regular tenders can not be operated.

A loose-leaf sketch book showing various apparatus used in the service has been prepared and issued to lighthouse districts.

An automatic time clock was installed for operating electric range lights.

It has been found that painting the inside of boilers with white sinc and oil paint about 18 inches above and below the water line zerves to prevent pitting of the boilers.

ADMINISTRATION

The general organization of the service remained unchanged during the fiscal year.

Important legislation was enacted particularly affecting this service, of which the following is a summary:

The act of May 22, 1926, contained the following provisions, which will be of value in improving the morale and increasing the efficiency of the personnel of this service: (*a*) Extending the benefits of the Public Health Service so as to apply to light keepers located at isolated points who have been heretofore unable to avail themselves of such benefits; (*b*) provision for medical supplies and hospital services for the crews of vessels of the Lighthouse Service, including the detail of medical officers; (*c*) authority for officers and crews of vessels of the Lighthouse Service and light keepers and depot keepers of the Lighthouse Service to purchase commissary and quartermaster supplies from the Army, Navy, or Marine Corps; (*d*) provision for including the four bureau officers under the lighthouse retirement law of June 20, 1918.

The act of May 22 also provided for the sale of apparatus or equipment manufactured by or in use in the Lighthouse Service, which is not readily procurable in the open market, and also provides for the establishment and maintenance of aids to navigation on the Allegheny River, Pa., and on the Rock River, Ill.

The act of May 22, 1926, also provides for the transfer of certain lighthouse reservations no longer needed for lighthouse purposes to other departments of the Government, and for the conveyance of other surplus reservations to States or cities for public park purposes, and of one unused lighthouse reservation to the Daughters of the American Revolution for historical purposes. The same act authorized the sale of lighthouse property at Cleveland, Ohio, and the acquiring of a suitable site in that city for the construction of light-keepers' dwellings. This act also contained authority for the release of a small plot of land and of a right of way.

The act of March 12, 1926, authorizing the sale of certain military reservations, contains a provision for the transfer to other Government departments of any portions of these reservations which may be required by the Government for permanent use. Parts of these reservations can be advantageously used by the Lighthouse Service, and application has been made for their transfer.

The act of May 18, 1926, authorized the exchange of Lighthouse Service and Treasury Department properties at Detroit, Mich., and Key West, Fla., which will be beneficial to this service in providing depot and office facilities.

The act of April 13, 1926, authorized the transfer of Barnegat Light Station, N. J., to the State of New Jersey.

The appropriation act for the fiscal year 1927, approved April 29, 1926, authorizes the use of general lighthouse appropriations for replacement of and necessary additions to existing equipment, increases the limit of cost of outbuildings to $1,000, and authorizes the transportation of personal effects of transferred employees, traveling expenses for medical examinations in disability retirement cases, and the purchase of food supplies for sale to keepers at isolated light stations.

Systematic inspections of the service, both on its technical and its business sides, were continued during the year. The superintendent on general duty made general inspections of stations, vessels, depots, etc., and the examiner made examinations of the office business methods and accounts, depot stores and other property, records, etc., in various lighthouse districts. Special inspections were made by the commissioner and other officers from Washington.

Various economies in the maintenance of the service have been effected, the most important, as already mentioned, being the introduction of automatic apparatus, the grouping of minor lights, and the transfer of surplus material and real estate. Other economies have resulted from the installation of kerosene tanks at light stations and depots and the purchase of illuminating oil locally in bulk and improved methods of its delivery to light stations by the various districts; and the discontinuance of aids to navigation found to be no longer necessary. A considerable saving has been made in the cost of acetylene cylinders by purchasing them in large quantities. The development of improved apparatus and equipment used in the mechanism of aids to navigation and in various operations of the service at depots and in field work has proved valuable in increased efficiency, and has also resulted in substantial economies.

There has been effective cooperation with other branches of the Government in many ways, and the personnel on vessels and at stations are encouraged to render aid to those in distress. Cooperation

with local school authorities has aided in providing school facilities for the children of light keepers at isolated light stations.

A conference of superintendents of lighthouses was held in Washington January 11 to 15, 1926, this being the ninth of such conferences. These conferences cover the entire operation of the Lighthouse Service, on both its technical and administrative sides, and have been found useful in improving methods and apparatus and exchanging information. They are held at intervals of two or more years.

At the request of the authorities in charge of the Territorial Fair held at Honolulu, Hawaii, August 31 to September 9, 1925, the Lighthouse Service exhibited types of illuminating apparatus, etc. The Lighthouse Service has also cooperated in connection with other exhibits of the department in the display of important lighthouse apparatus and equipment at the National Sesquicentennial Exposition which is being held in Philadelphia.

A lighthouse exhibit, consisting of illuminating apparatus, fog-signal apparatus, etc., was made at the American Marine Association Exposition held in New York City November 9 to 14, 1925.

PERSONNEL

On June 30, 1926, there were 5,880 persons employed in the Lighthouse Service (all authorized employees, including some vacancies). This is a net decrease of 81 during the fiscal year. This decrease included a reduction of 61 light keepers, light attendants, and lamplighters, made possible by automatic installations and by combining the care of larger groups of lights.

The last annual report of the United States Employees' Compensation Commission gives the number of reported cases of injury subject to compensation for the calendar year 1924 of employees of the Lighthouse Service sustained while in the performance of duty, as follows: Cases resulting in death, 7; cases resulting in permanent total or partial disability, 1; and of temporary total disability, 88. This number indicates the hazardous nature of the field work of the Lighthouse Service. The authorized maximum compensation for disability on account of injury is too low, and action is desirable to provide a more adequate scale. Medical treatment by the Public Health Service, without charge, was received by approximately 1,340 employees of the Lighthouse Service during the year.

Legislation of much value to the personnel was enacted by Congress during the year. Besides the special legislation already mentioned, general enactments included an increase in the maximum annuity under the civil-service retirement law of May 22, 1920, and more liberal provisions for medical services and supplies under the employees' compensation law, and for expenses incident to medical examinations required by the Employees' Compensation Commission.

Radio receiving sets are being provided for light keepers through private donation, as has been mentioned.

Incidental to the regular work of the service, many opportunities arise for rendering aid to those in distress because of the location of the light stations and vessels. During the fiscal year upward of 102 instances were reported of saving life and property or rendering valuable aid, often at a great risk to the lighthouse employees. Many of these acts were especially meritorious, and in such cases the employees were individually commended by the Secretary of Commerce.

Silver life-saving medals were awarded in August, 1925, by the Secretary of the Treasury, as provided under congressional authority, to two employees of the Lighthouse Service for gallant conduct in saving human life, as detailed in last year's report. A gold medal was awarded by the Treasury Department on April 12, 1926, to Humphrey Jamieson, master of relief lightship *No. 90*, Massachusetts, in recognition of the gallant conduct displayed by him in endeavoring to resue the crew of the wrecked bark *Wanderer*, August 26, 1924.

On November 6, 1925, the lighthouse tender *Columbine*, Capt. N. C. Manyon, commanding, saved from drowning seven men aboard Coast Guard patrol boat *No. 245*, who were in great danger of being lost at the entrance to San Juan Harbor, P. R., during a very heavy sea. The *Columbine* in her efforts to approach the patrol boat was several times in danger of being overwhelmed by the waves. The officers and crew of the *Columbine* have been commended by the Secretary of Commerce for their courageous conduct, and the commandant of the Coast Guard has praised the work, saying that they undoubtedly saved the lives of the crew of the patrol boat.

LIGHTHOUSE DEPOTS

The lighthouse depots are a very essential feature of the efficient conduct of the work of the Lighthouse Service; they are the supply, repair, and vessel headquarters for the various districts. The depots are generally well distributed along the coasts of the country, but several of them are not adequate for the work or are not suitably located.

At the depot at Chelsea, Mass., the construction of a storehouse and office was completed. The district office was moved to this building during the year.

During the year work on the extension of the depot at Portsmouth, Va., including the wharves and buildings, was in progress. The work consists in widening and dredging the slips, the reconstruction of the wharves, repairs and improvements to the old warehouse, and the construction of concrete roadways over the reservation. This depot is headquarters for 12 tenders and lightships, and the enlargement was greatly needed and will facilitate the work.

Provision is needed for improved depot facilities in several other districts, particularly at or near Newport, R. I.; Key West, Fla.; Honolulu, Hawaii; Goat Island, Calif.; and New Orleans, La. Other work needed consists of dredging at the entrance to Woods Hole Depot, Mass., and Tongue Point Depot, Oreg.; rebuilding the wharves at the Edgemoor Lighthouse Depot, Del; and completing improvements to wharves and providing additional storage buildings at the general depot, Staten Island, N. Y. Additional work is needed for the completion of the important depots at Charleston, S. C., and Ketchikan, Alaska. There is also needed in the future a better located depot in the first district at Portland, Me., and depot facilities elsewhere in that district.

A temporary storehouse at the Edgemoor Lighthouse Depot, Del., to replace the storehouse destroyed by fire on April 28, 1925, has been erected.

VESSELS OF THE LIGHTHOUSE SERVICE

REPLACEMENT OF VESSELS

The replacement of old and worn-out vessels is not keeping pace with the deterioration in the 112 vessels of the service. The appropriation act of April 29, 1926, provided funds sufficient to build one new lightship.

From a careful survey of the condition of the lightships and tenders it is found that in addition to the vessels now building or being reconditioned, 9 lightships and 2 tenders should be replaced, and 1 additional tender built within the next five years, as follows:

New lightships to replace San Francisco lightship *No. 70*, eighteenth district; relief lightship *No. 5*, second district; Fenwick Island lightship *No. 52*, fifth district; Fire Island lightship *No. 68*, third district; Cross Rip lightship *No. 66*, second district; Umatilla Reef lightship *No. 67*, seventeenth district; Vineyard Sound lightship *No. 41*, second district; Scotland lightship *No. 69*, third district; Portland lightship *No. 74*, first district; new tenders to replace tender *Pansy*, third district, and tender *Water Lily*, sixth district; and a new tender for tenth district.

LIGHTHOUSE TENDERS

Lighthouse tenders during the year have steamed a total of 495,890 nautical miles, or an average of approximately 9,016 miles for each tender, in the various maintenance, construction, and inspection work. The total quantity of fuel consumed by tenders during the year was 50,717 tons of coal, 32,523 gallons of gasoline, 5,400 gallons of kerosene, and 61,614 barrles of fuel oil. The total cost of maintenance of tenders during the year amounted to $2,211,663, exclusive of repairs which amounted to $249,700.

The construction of two tenders, one for the upper and one for the lower Mississippi River, is under way. The small tender *Larch* for the Columbia River, Oreg., was completed and placed in service. The conversion of the tender *Kukui* from coal to oil burners is now under way. It is also proposed to convert the tender *Manzanita* to oil burning when funds will permit.

A suitable tender was designed to replace the *Daisy* in the third lighthouse district, which is no longer fit for the work required. The contract for this tender was awarded after the close of the fiscal year.

At the end of the fiscal year 12 tenders were equipped with radiocompasses, an increase of 1, and 30 with radiotelegraph.

Preparations were made for the reconditioning of the former mine planters to be used as tenders, *Acacia* and *Lupine*. This work was commenced early in the next fiscal year.

The following tenders have either been extensively overhauled or such work has been started during the fiscal year: *Kukui*, *Mayflower*, *Woodbine*, *Camellia*, *Ilex*, *Cypress*, *Sunflower*.

The following was the number of tenders of the Lighthouse Service on June 30 of the years specified, omitting vessels indefinitely laid up, those not having regular crews, and those less than 50 feet in length: 1910, 51; 1915, 45; 1920, 55; 1922, 54; 1923, 55; 1924, 58; 1925, 55; 1926, 56. There are in addition 9 small depot tenders

without regular crews. On June 30, 1926, the following was the status of tenders: In actual service, 48; being prepared for service, 1; undergoing repairs, 7.

LIGHTSHIPS

Lightships are maintained on 46 stations. During the fiscal year 57 lightships were in commission, of which 12 were relief ships, and they averaged 264 days on station per vessel. The total cost of maintenance of lightships during the year was $1,064,787 exclusive of repairs, which cost $147,970.

Many of these lightships have passed the age of useful service and some of them are in such condition as to be beyond economical repairs. The work of construction on new lightship *No. 111* is now nearly completed.

Two old lightships, Cornfield Point *No. 48* and Ram Island *No. 23*, which were condemned last year, were sold on August 6 and 22, 1925, respectively.

Old lightship *No. 60* on Eleven Foot Shoal Station, Lake Michigan, was condemned during the fiscal year, and sold January 15, 1926.

The old lightship on Scotland Station, *No. 11*, off Sandy Hook at the entrance to New York Bay, was permanently relieved on October 30, 1925, after 23 years of service on this station. This vessel has been in service since 1853, 72 years, being the oldest vessel in the Lighthouse Service.

Radio-communication apparatus was maintained on 22 stations and 7 relief vessels during the fiscal year; at the end of the fiscal year 11 stations and 5 relief lightships were equipped as radio beacons.

The following lightships have been extensively overhauled or such work has been started during the last fiscal year: *No. 49*, *No. 73*, *No. 101*.

The following was the total number of lightships on June 30 of the years mentioned: 1910, 68; 1915, 66; 1920, 62; 1921, 64; 1922, 61; 1923, 60; 1924, 60; 1925, 59; 1926, 56. Lightship stations: 1910, 51; 1915, 53; 1920, 49; 1921, 49; 1922, 49; 1923, 47; 1924, 47; 1925, 46; 1926, 46.

Of the present lightships, 42 have self-propelling machinery, and 13 are provided with sail power only. One has no means of propulsion.

The Hedge Fence lightship, stationed in Nantucket Sound, Mass., was rammed and sunk on station by a passing steamer on November 11, 1925. The crew escaped. The lightship was raised and repaired, and the cost, $34,385.45, was paid by the owners of the colliding steamer, who also reimbursed the crew for personal property lost.

Very truly yours,

GEORGE R. PUTNAM,
Commissioner of Lighthouses.

COAST AND GEODETIC SURVEY

DEPARTMENT OF COMMERCE,
COAST AND GEODETIC SURVEY,
Washington, July 1, 1926.

Hon. HERBERT HOOVER,
Secretary of Commerce.

DEAR MR. SECRETARY: In response to your request I furnish the following condensed report upon the work of the bureau during the past year:

At the outset, in submitting this report, it is important to note the outstanding increase in the demand from shipping interests for our charts and other nautical data. This increase was 29 per cent for the year. With this larger demand laid upon us by a marked increase in shipping, we have not the personnel and other facilities to take care of some important parts of this work properly, and unless provision is made for additional personnel and funds the public interest will be further seriously impaired.

PRODUCTION OF CHARTS

The continued growth of shipping of all kinds has placed on this bureau additional burdens that it can not carry with the present personnel. Coupled with this situation there has been a continual increase in the volume of information received by the bureau for chart construction and correction. In 1925 there was an increase of 245 per cent over the amount of information received in 1919. The necessary utilization of these data for correcting existing charts is leaving less and less time for the construction of new charts. There has been no corresponding increase of facilities in the chart division to meet this constantly growing volume of material. As a matter of fact, there has been a decrease of one authorized position since 1920.

The bureau has exerted every effort to cope with this situation by increasing its productive capacity. The average elapsed time for production of all new charts in 1920 was 27 months. For 1926 the average elapsed time was only 8⅓ months. The average cost of producing the new charts completed in 1920 was $1,771. For 1926 this cost was $1,395, and this was achieved in spite of a 40 per cent increase in salaries as a result of reclassification.

Nevertheless, the situation is becoming very serious. The bureau is compelled to lower the quality of its service to the public. The chart should be a true picture of the area covered in order to safeguard the mariners using it. When it falls short of this ideal the chart places the mariner in jeopardy. The bureau will continue to strive for increased efficiency to overcome the present handicap, but if

the public is to receive the service to which it is entitled and asks for there must be an increase in the personnel of the chart division. Three cartographic engineers and three lithographic draftsmen are seriously needed to maintain our existing standards.

IMPORTANCE OF INSTRUMENT WORK

The accuracy of the bureau's work and the efficiency with which it is performed are directly affected by the quality of its instrumental equipment. Hundreds of different types of instruments for purposes ranging from the measurement of elevations or angles with the utmost precision to that of compiling such data on cartographic sheets are used in our work. These instruments either are purchased or built in the survey's shops, the repair and adjustment of this stock being as far as possible made by the instrument division.

It is of the utmost importance to this bureau that an adequate force be provided for such work, as our experience has been that the delicate and precise measuring instruments used in our various activities are extremely difficult to obtain through commercial channels. There are but few firms in the world competent to undertake such work and their prices are almost invariably high as compared with the cost for similar work in our own plant. In a number of instances after receiving bids which were considered excessive for special instruments we have decided to build them ourselves, and have been able to effect a very considerable saving, usually at least 25 per cent, and in the case of a special engraving machine a much higher percentage. Practically all of the original models of the bureau's highly accurate and special instruments have been designed and built in the Washington office.

The value of developing such instruments, not only to this Government but to the world, is indicated by the number which have been copied or adopted outright by other governments and private organizations. Several of the bureau's models are now catalogued by American and European manufacturers. Colleges and universities constantly request information regarding such equipment and include visits to the bureau as part of their undergraduate courses in engineering.

It would be a matter of genuine economy to be able to perform all instrumental development work ourselves. We can perfect the bureau's instruments at smaller expense if we are able to supervise the work constantly and incorporate such changes as may suggest themselves as construction progresses. The needs of this bureau for new equipment are manyfold. We are constantly compelled to increase our activities, due to normally increasing demands, the recent taking over of seismological work being an instance, and additional types of instruments are as constantly required.

So many requests are received for information regarding our instruments and methods that I feel this branch of our office is performing a distinct public service in research and development of precise instruments, not only for hydrographic and geodetic surveying, but for all other activities of this bureau. We are frequently requested to cooperate with other organizations whose activities are closely allied to ours.

Much difficulty has been experienced in acquiring suitable theodolites for geodetic surveying. After canvassing the markets of the entire world it was decided to design an entirely new instrument in our own office, which would possess all the qualities of a desirable instrument from the standpoint of this bureau's work. Its construction will be undertaken during the coming year.

Our present instrument force long ago reached the limit at which output could be increased by the use of labor-saving devices and modern tools. It has been necessary to send a considerable amount of repair work to commercial shops, the quality of which service has been generally unsatisfactory. The cost is much higher than when performed in our own shop, and the delays incident to the awarding of contracts, shipment, and delivery of the completed article are also a source of expense which could readily be avoided. Little work in the development of new instruments can be undertaken at present, as our workmen are now fully occupied in repair and adjustment of the present stock, which is constantly being augmented by the acquisition of newly purchased instruments. Advances in the instrument making art soon render existing models obsolete. Failure to make use of the most improved types means loss of efficiency and a consequent excessive cost. If we are to remain the world's leading hydrographic and geodetic organization and are to produce a maximum of work at a minimum of expense, an adequate force of skilled instrument makers must be provided.

The one remedy for this serious situation is to have a sufficient force to take care of ordinary demands, thereby avoiding unnecessary expenses which are constantly being incurred under existing conditions.

COASTAL SURVEYS

This designation embraces the various field operations which are the first steps in the production of the nautical charts and coast pilot publications of the bureau. Hydrography, topography, triangulation for local control, tidal and magnetic observations, and the collection of coast pilot data are the usual activities in all but special cases.

The application of acoustics to both depth and position determinations in hydrographic surveys has been steadily extended.

ATLANTIC AND GULF COASTS

A field examination was made and data were collected for the Coast Pilot from Cape Cod to Sandy Hook and for the Inside Route Pilot from Norfolk to Key West. Revision surveys are in progress on the south side of Long Island eastward from Far Rockaway, N. Y., and in Raritan Bay, N. J. The Delaware River shore line and the triangulation control at Camden, N. J., have been revised, and shoal soundings off Cape Henry, Va., were investigated. The survey of the South Carolina coast from the vicinity of Cape Fear River southward and out to the 100-fathom curve, has been carried on continuously in conjunction with experimental work on echo sounding. Intensive triangulation has been established along the St. Johns River, Fla., up to Jacksonville, for use in maintaining in position the aids to navigation. A reconnaissance of the Gulf coasts of

Florida from Tampa to Key West has been made for the purpose of planning revisional surveys. The resurvey of Tampa Bay and approaches in detail, including all shoal water areas within the bay, is practically completed.

PACIFIC COAST

A field examination was made and data collected for the Coast Pilot of California, Oregon, and Washington. Newport Bay, Calif., has been surveyed and an examination made in San Pedro Channel. The gaps between previous hydrographic surveys in the vicinity of Santa Rosa and Santa Cruz Islands have been filled. Soundings were made off the docks at San Francisco as the result of reported shoalings. South and Bonita Channels at the entrance to San Francisco Harbor were examined with the wire drag for reported dangers and a wire-drag survey of Greenwood landing, California, was started. Offshore hydrography to the 1,000-fathom curve, in progress at the beginning of the year on the Oregon coast, has been extended southward to the vicinity of Port Orford, while a topographic revision of the shore line has been extended from Marshfield to Port Orford. A resurvey of the Oregon and Washington coasts, in the vicinity of the Columbia River, has been begun and will be extended to the 1,000-fathom curve. As the result of local assistance, two surveys of the bar at Willapa Bay, Wash., have been made within the year. A revision survey in the Straits of Juan de Fuca, from Point Wilson westward and extending beyond Port Angelus, is nearing completion.

ALASKA

The field work in Alaska during the year was a continuation of work in those unsurveyed areas frequented by large passenger vessels. Until these areas have been fully surveyed, transportation there will continue to be hazardous and we may expect, at any time, marine disasters such as have occurred all too frequently in the past.

In southeastern Alaska surveys were made in Chatham Straits from Cape Decision to Port Malmesbury and in the vicinity of Port Alexander; in Pybus Bay; in Cordova Bay along the shore of Long Island and through Kaigani Strait; in Port Refugio; and in various parts of the main ship channels. Along the outer coast of southeastern Alaska the previous surveys were extended northward until now the entire coast has been completely surveyed from Dixon Entrance to Cross Sound. Along the southeast side of the Alaskan Peninsula surveys were completed in Chignik and Kujulik Bays and their approaches, Ikatan Bay and the area between Cold and Belkofski Bays. Work was started in Balboa Bay. The only new work taken up in Alaska during the year was a survey of Shuyak Strait between Afognak and Shuyak Islands at the urgent request of steamship companies which are now sending their passenger vessels regularly to this area to handle business which has grown up in connection with the new fisheries.

A reconnaissance of the islands of the Alaska Peninsula west of Unalaska was made at the request of the United States Coast Guard for the convenience and protection of their Bering Sea patrol ships.

HAWAIIAN ISLANDS

Surveys were extended on the south coasts of Oahu and Kauai Islands. This included intensive development of the reefs and of the roadsteads in which ships anchor to load and discharge. Hydrographic investigations were made on Penguin Bank and in the waters west of Niihau Island.

PHILIPPINE ISLANDS

In the Philippine Islands surveys were carried on in the regions north of Luzon Island, in the Sulu Sea, along the Sulu Archipelago, and in Malampaya Sound. A reconnaissance for triangulation in the Cagayan Valley has been made. This project will eventually connect with the strong scheme of triangulation in the vicinity of Lingayan Gulf and is being done in cooperation with the Bureau of Lands. A current survey of San Bernardino Straits was completed.

PORTO RICO

The examination of the waters east of Porto Rico and in the Virgin Islands was nearing completion at the close of the year.

GEODETIC WORK ACCOMPLISHED

To complete the skeleton network of the western part of the country, the following arcs of triangulation were needed at the beginning of the fiscal year 1926: An arc along the forty-ninth parallel from longitude 115° westward to Point Roberts, comprising the western extremity of the boundary between Canada and the United States; an arc from the vicinity of Umatilla, Oreg., northward to the Canadian boundary in the vicinity of Oroville; an arc extending from a point just to the eastward of the Black Hills in South Dakota, westward through Wyoming to the vicinity of Bozeman, Mont.; an arc extending from the vicinity of Needles, Calif., to the vicinity of Salt Lake City, Utah; and an arc extending from the vicinity of San Luis Obispo, Calif., across the Sierra Nevada Mountains, Death Valley, and into Nevada.

During the summer of 1925 all this triangulation was completed except the last-mentioned arc and a portion of the forty-ninth parallel through the Cascade Mountains. This work will be completed early in the fiscal year 1927, after which the triangulation net west of the ninety-eighth meridian can be readjusted.

Astronomic azimuths, longitudes, and latitudes were observed at stations in South Dakota, Wyoming, Montana, Idaho, Washington, and Canada.

Triangulation stations were selected along the arc from Umatilla, Oreg., to Oroville, Wash.; along the arc from San Luis Obispo, Calif., to Las Vegas, Nev., along an arc from Albert Lea, Minn., southward through Iowa and Missouri into Arkansas; and in Mississippi and Alabama.

First-order leveling was executed in South Dakota, from Sioux Falls westward to Rapid City. A line of levels was run from Colo-

rado Springs southward through Pueblo, west to Salida, and thence northward to Leadville, Colo. Field expenses for this work were paid by the Geological Survey.

First-order leveling was run from Laws, Calif., southward to Mohave, and also in Los Angeles County. Field expenses for the latter were paid by the Geological Survey.

In connection with earthquake study first-order triangulation was executed along the thirty-ninth parallel through part of Nevada, along an arc northward from San Francisco Bay to Point Arena and the Ukiah latitude station, and near Santa Barbara Channel, Calif. A base line was measured eastward of San Luis Obispo, Calif.

The bureau cooperated with the city of Rochester, N. Y., in extending a first-order horizontal control system over the city and its suburbs.

The arc of first-order triangulation extending from Dixon Entrance, Alaska, to Skagway was completed by measurement of the Glacier Point base, and by extending the triangulation from the head of Lynn Canal to Skagway. Stations were selected for an arc to extend from the vicinity of Fairbanks, Alaska, eastward to Eagle, at the international boundary.

NECESSITY FOR CONTROL SURVEYS

Control surveys are essential to the efficient planning of many major activities of the Nation. Among these are the development of hydroelectric power, the improvement of inland water courses, the extension of highways, the irrigation of arid lands, the drainage of swamps, the soil surveys, the surveys of national parks and forests, and the location of important boundaries in cities and States.

In early years, when land was cheap, accurate surveys were considered unjustified expense. The country was roughly surveyed for settlers, and without regard to geographic positions of boundary corners. The base topographic map resulting from these earlier surveys is of undoubted value, but it lacks accuracy because of the absence of adequate vertical and horizontal control. When such topographic surveys are extended from two widely separated places and eventually joined, gaps, overlaps, and offsets will occur in the resulting maps.

The base topographic maps being made by the Government will eliminate most of this trouble. Although special surveys for some engineering projects and industrial enterprises will continue to be necessary, the new base map will meet most of the engineer's needs.

Accurate topography is vital in aviation maps. Congress has established an Aeronautics Branch in the Department of Commerce to stimulate development of commercial aviation. Route maps must be made, showing proper geographic positions, terminal points of flights, and all intermediate topographic features essential for determining locations. The ordinary land map will not serve, for its numerous topographic details only confuse the fast-traveling flier. Only the bolder features are required, but these must be located with utmost precision. When the new base map has been made for any

area the cartographer can select desirable points for the aerial map. The aviator can then test the map in actual flying, reporting the omission of any important details.

Though there are only a few aerial routes at present, the next decade will probably contain a great expansion in airplane travel. The safety of these planes, and those of our Army and Navy, will depend upon good maps. In addition to having easily identified features, the route maps should possess information as to the elevation of the ground at all points. At night and in thick weather the aviator must depend on the barometer to show his elevation above sea level, but this does not indicate his true elevation above the ground over which he flies. A plane heading inland from sea level might collide with a mountain, though the barometer would show a safe altitude of several thousand feet. Elevations in thousands of feet can be shown in various colors, or in some other manner designed to catch the aviator's eye. All of this accurate information in regard to positions, elevations, and configurations of the earth will certainly reduce disasters.

The foundation for the topographic base map is first and second order triangulation and leveling carried out by the Coast and Geodetic Survey. These classes of work constitute the control system for the charts of our coasts, the maps of the interior, and many engineering operations.

The triangulation and leveling done by the Coast and Geodetic Survey bear the same relation to the surveys, maps, and charts of the country that the steel framework of a modern office building bears to the detailed parts of the structure. When the steelwork of the building has been erected the workmen may operate simultaneously at many places with assurance that there will be complete coordination of the parts. When the control surveys have been made to cover the Nation, topographic, cadastral, and other surveys can be made in innumerable places with a certainty that there will be no difficulty in fitting them together.

The control surveys should be completed in the very near future. It is estimated that the total cost of the first and second order triangulation and leveling for our entire area would be about $4,000,000. This is a small amount when compared with the great benefit to be derived.

MAGNETIC WORK

Four magnetic observatories located at Tucson, Ariz.; Cheltenham, Md.; Sitka, Alaska; and Honolulu, Hawaii, have been kept in continuous operation through the year. The observatory at San Juan, P. R., was completed and operation was started on January 1, 1926. Continuous magnetic and earthquake records have been obtained. The records have been used to reduce field results to standard values, to furnish material for studies in terrestrial magnetism, and especially during the past year in the investigation of disturbances of radio and cable transmission. The Bureau of Standards, Carnegie Institution of Washington, large electrical companies, and others have been using magnetic observatory data from this bureau in the attempt to solve the reason for unusual radio transmission conditions during the winter. Observatory re-

sults from Tucson were used in standardizing certain investigations in Texas to locate formations containing oil.

The field magnetic work included occupation of repeat stations in New England and the Northwestern States and replacement of stations and occupation of new stations in the Northwestern and Middle Western States. Repeat stations provide information about changes in the magnetic elements, and replacement makes stations available both for the use of this bureau and of local surveyors.

A canvass of county surveyors, started in 1924, at the close of the fiscal year had reached all but six States. This has been very effective in bringing the useful information in the hands of this bureau to the attention of those needing it and has also brought much valuable information about the condition of magnetic stations. We now know the condition of more than 50 per cent of our 3,750 magnetic stations.

The whole purpose of this work is to meet the normal demands of the public and it should be accomplished with maximum efficiency and minimum cost. This is not being done and can not under present conditions, as the personnel is too small. There is demand for important information which should be issued at regular intervals. There has been no increase in the office personnel for more than 12 years, though the work has steadily grown, largely due to the growth of our country. A number of methods for accomplishing the work with least cost and time have been worked out and tested, but are not now in use through lack of personnel to operate them. It is not desired to take on new activity or to expand the work, but simply to carry on the most work in a more efficient manner. This can be accomplished only by a moderate increase in the personnel.

SEISMOLOGY

During this year the work continued as supplemental to magnetic work, inasmuch as the appropriation for the fiscal year did not provide for carrying on investigations previously authorized by Congress. Entirely inadequate provision has been made for the next fiscal year. The demand for information is increasing steadily and it has been met only in a small way by the personnel that does other work. The aim is practical—to find means of preventing great loss of life and property at time of earthquakes. The first step is to collect and publish complete and correct earthquake information for earthquakes occurring within the United States or near enough to its borders to affect its area. This requires adequate instrumental observations at points not covered by other agencies, and cooperative service similar to that organized by the Weather Bureau. That bureau continues to cooperate, and there has been excellent cooperation and much help from many sources after earthquakes have occurred, but in some regions more intensive observations are needed. Installation of a modern seismograph at Tucson, Ariz., replacing one which was unfitted for its purpose as a necessary part of magnetic work, has proved an important contribution.

The bureau, having been charged with seismological work by Congress, is trying to do adequate work in this subject, as it believes that it can thereby make an important contribution to the welfare of

the country. Two years ago there was a chance to see the danger resulting from an earthquake in the densely settled regions of the East, and the absolute lack of proper machinery for dealing with the emergency was brought out. The public as a whole, insurance men, engineers, builders, and others were at a complete loss as to the steps to be taken in the future. All the various problems must be worked out in the interest of future safety, but these will not be carried on successfully unless the Government takes its part. Earthquakes know no boundaries. Therefore, the work must be nationwide and international.

This bureau can make only a slight contribution under present conditions. It lacks mathematicians to study the results and prepare them for publication, and clerks to do the necessary clerical work. It needs an increased force and additional funds for field work. It can acomplish the work in an efficient manner with only a moderate expansion, but it can not function well with a mathematician giving only part time, assisted by such field officers as may be temporarily spared for the work.

TIDE AND CURRENT OBSERVATIONS

Tidal observations at the primary tide stations of the Coast and Geodetic Survey were continued during the year for furnishing tidal control for the hydrographic surveys in the regions represented. The data from these stations also furnish the determination of datum planes based on tidal definition. Continuous calls are being made on the Coast and Geodetic Survey from engineers in all parts of the country for the elevations and descriptions of bench marks determined by these tidal series. Nine tide primary stations were maintained on the Atlantic coast, four on the Gulf coast, six on the Pacific coast, three in Alaska, and one at Honolulu, Hawaii. In addition, numerous short series of tide observations were made by hydrographic parties for the reduction of soundings. A current and tide survey was made in southeastern Alaska and Puget Sound in the fall of 1925. A comprehensive current and tide survey of Boston and Portsmouth Harbors was begun June 1, 1926, and was in progress at the end of the fiscal year.

Current observations were made on four light vessels on the Atlantic coast and one on the Pacific coast with the cooperation of the Lighthouse Service.

CURRENT SURVEY, SOUTHEASTERN ALASKA

Since 1922 three important harbors have been covered by the Coast and Geodetic Survey with comprehensive current and tide surveys—New York Harbor, San Francisco Bay, and Delaware Bay and tributaries. Although other important harbors awaited comprehensive surveys, it was thought advisable during this fiscal year to make current observations in the narrow passages of southeastern Alaska and Puget Sound, in order to furnish current predictions in our Pacific Coast Current Tables, which heretofore have been extremely meager in many places.

For example, no data were available for predictions of slack water in North Inian Passage, where currents attain a maximum velocity of about 7 knots; the predictions for Wrangell Narrows, maximum velocity 6 knots, were based on one-half day of observations; no data were available for predictions for Snow Passage and Deception Pass, where velocities of 5 knots are attained. These passages are extensively used by American shipping and by lumber interests for towing of log booms.

It is evident that a current at strength of this velocity is of danger to shipping, even to the larger vessels. It is, therefore, necessary to know the time of slack water in these passages when a vessel can go through safely. This is of especial value to tug masters with unwieldy log tows. If the master can have knowledge in advance of the time of slack water, valuable time will be saved awaiting the time of slack water on arriving at some unfavorable phase of current; and for tows especially it is imperative that arrival be so timed as not to enter the passage at strength of current and become dangerously involved.

In order to obtain the necessary data for making predictions for these important places, information repeatedly requested of the bureau by shipping interests, a current survey in this area was made early in the fiscal year 1926. Definite knowledge of the current phenomena for these waters is now available. The observations from this survey have been reduced, and advance predictions made. These predictions will appear in the Pacific Coast Current Tables for 1927, now in press.

TIDE AND CURRENT SURVEY, BOSTON AND PORTSMOUTH HARBORS

The current and tide survey of Boston and Portsmouth Harbors, begun at the end of this fiscal year and to extend into the next, is in line with the current and tide surveys being made of our important harbors in the order of their commercial and miltary importance. The data from these surveys will be used for furnishing better determined values for the tide and current tables issued in advance annually by the Coast and Geodetic Survey and for preparation of a special publication dealing with the tides and currents of these two harbors. These data from current surveys are good for all time, and do not have to be repeated, unless, of course, some considerable changes are made in harbor development; the ordinary developments in harbor improvements have little effect on the tidal régime affecting the predictions used for practical purposes.

OCEAN CURRENTS

For a number of years the Coast and Geodetic Survey, with the cooperation of the Lighthouse Service, has made at small cost long series of current observations on the light vessels stationed along both coasts of the United States. From these observations correlations have been made between the wind and wind-produced currents, information of considerable value to mariners, particularly along the Pacific coast, where sailing lines are long and periods of thick weather of comparatively frequent occurrence. Owing to lack of funds for

extensive studies of ocean currents no observations have been made in physical oceanography outside the continental shelf. Observation in the Gulf Stream is of considerable value and may be considered as one of the important matters in oceanography. Considerable reconnaissance work was done by this bureau many years ago, but lack of appropriations has prevented further detailed work. Systematic current and related oceanographic observations should be made in the Gulf Stream as one of our vessels becomes available and our appropriations for party expenses, tides, is sufficiently increased to cover the cost of this work.

COOPERATION WITH OTHER AGENCIES IN TIDE AND CURRENT WORK

In August, 1925, a cooperative arrangement was made with the Canadian Hydrographic Office for the exchange of tidal predictions for Halifax, St. John, and Quebec for 1928. A similar arrangement, in which the predictions for 16 stations are exchanged, exists between the Coast and Geodetic Survey and the British Admiralty. This exchange is being extended in scope each year to the mutual benefit of the two parties.

The Carnegie Institute is furnishing this bureau the tide records of their stations at Apia, Western Samoa.

In connection with a sanitary survey of the Potomac River in the vicinity of Washington, a portable automatic tide gauge was maintained during the month of August, 1925, at the Potomac Boat Club near the Aqueduct Bridge, Washington, D. C., in cooperation with the sanitary engineer of the Public Health Service. The results of current observations in the vicinity of Washington were also desired by the sanitary engineer, but no comprehensive observations had been made at this time.

The Coast and Geodetic Survey cooperated in the maintenance of tide stations at Los Angeles, Honolulu, and in a deep well at Longport, N. J. Arrangements are being made for cooperation with the Navy Department in maintaining tide stations at San Diego, Calif., and Portsmouth, N. H.

The Weather Bureau station and the commandant of the naval submarine base at Key West cooperated with the Coast and Geodetic Survey in the establishment of a new tide station at Key West at the submarine base.

ADDITIONAL VESSELS NEEDED

The need for an additional, full-powered survey ship for duty on the Atlantic coast is urgent because of the magnitude of offshore and coastwise work required to bring our charts up to date, and because of the elimination of two old vessels which acquisition of such a vessel will permit. The present arrangement is uneconomical viewed from every angle, still these antiquated craft must be used in an effort to meet the demands of the mariner.

Annual savings made possible by this replacement would be as follows: Operating expenses, $11,000; pay of crew, $22,300; repairs, $10,000 during the first two years; total $43,300, for the first two years. Savings would probably be $40,000 per year thereafter.

This would amount to nearly 14 per cent of the cost of the new vessel. This saving would be effected not only without any reduction in the quantity of work accomplished annually, but with increased opportunity to take up work in localities dangerous to the older vessels.

The bureau has not acquired any new tenders within the last 25 years. Of the three such craft formerly used, two have worn out in service and have been scrapped. The third is still in use, but it is unsafe because of structural weakness from age and because of worn-out machinery.

Three new tenders at an approximate cost of $58,000 each are urgently needed.

Very truly yours,

E. Lester Jones,
Director, Coast and Geodetic Survey.

BUREAU OF NAVIGATION

DEPARTMENT OF COMMERCE,
BUREAU OF NAVIGATION,
Washington, July 1, 1926.

HON. HERBERT HOOVER,
Secretary of Commerce.

DEAR MR. SECRETARY: In response to your request I furnish the following condensed report of the work of the bureau during the past year:

American shipping registered for the foreign trade and enrolled and licensed for the coasting trade, including the fisheries, on June 30, 1926, comprised 26,343 vessels of 17,311,147 gross tons, of which 3,052 seagoing vessels of 11,895,058 gross tons were 1,000 tons or over. On June 30, 1925, we had 26,323 vessels of 17,399.376 gross tons, a decrease of 88,229 gross tons. This decrease, however, is due in part to the scrapping, loss, and sale foreign of wooden ships, the number of such vessels under private ownership being reduced from 736 vessels of 880,362 gross tons on July 1, 1925, to 685 vessels of 832,971 gross tons July 1, 1926, while wooden vessels of 1,000 gross tons and over under the United States Shipping Board have been reduced from 13 vessels of 35,687 gross tons July 1, 1925, to 2 wooden vessels of 4,445 gross tons July 1, 1926.

Of vessels of all classes of 500 tons and over there has been a decrease in the foreign trade of 135 vessels of 267,704 gross tons, while in the coasting trade there has been an increase of 54 vessels of 118,112 gross tons, making a net loss of 149,592 gross tons.

Following is a brief analysis of our shipping on June 30, 1917, as the United States entered the war and at the close of the fiscal year 1925 and on June 30, 1926:

June 30—	Grand total		Seagoing				Great Lakes		All others	
			Shipping Board (over 1,000 gross tons)		Private owners					
	Number	*Gross tons*	*Number*	*Gross tons*	*Number*	*Gross tons*	*Number*	*Gross tons*	*Number*	*Gross tons*
1926..	26, 343	17, 311, 147	1, 056	5, 162, 334	1, 996	6, 732, 724	2, 626	2, 844, 473	20, 645	2, 571, 616
1925..	26, 323	17, 399, 376	1, 218	5, 839, 650	1, 925	6, 216, 552	2, 677	2, 853, 019	20, 503	2, 490, 146
1917..	26, 397	8, 871, 037	19	76, 160	1, 552	3, 564, 160	3, 001	2, 779, 087	21, 825	2, 451, 630

Lloyd's Register points out that a new low record in world shipbuilding since the war is shown by returns of vessels of 100 gross tons and over covering the maritime countries for the quarter ended June 30, last. At that time work under construction amounted to 1,970,000 gross tons, a reduction of about 400,000 tons compared with June 30, 1925. For the last quarter of the year, however, as compared with

the same period in 1925, there is a gain for the United States of 15,000 tons and a similar one for Holland. On June 30, 1926, there were building in American shipyards, including the Great Lakes, 220 vessels of 199,055 gross tons as compared with 187 vessels of 185,654 gross tons June 30, 1925.

On June 30, 1926, there were laid up 1,082 American seagoing vessels of 3,922,394 gross tons, a decrease of 66 vessels of 402,047 gross tons from the previous year. The Chamber of Shipping of the United Kingdom reports that on the same date there were laid up in United Kingdom ports 1,357,793 gross tons of British shipping as against 1,205,953 gross tons the previous year, and that while the tonnage of the world has increased from 49,000,000 gross tons in 1914 to 64,784,000 tons in 1926, an increase of 32 per cent, the trade offering is lower than pre-war.

NAVIGATION LAWS

Under section 4 of the act of July 5, 1884, the Commissioner of Navigation is directed to investigate the operation of the laws relative to navigation and annually report to you such particulars as may admit of improvement or may require amendment.

REORGANIZATION OF MARITIME BUREAUS AND ACTIVITIES

There is now before the present Congress H. R. 7245, "A bill providing for the consolidation of the functions of the Department of Commerce relating to navigation, to establish loadlines for American vessels, and for other purposes."

The need of bringing within the administrative control of the Bureau of Navigation the personnel of the customs service already engaged under the direction of the Department of Commerce in administering the great bulk of the navigation laws is becoming more urgent as important new laws are placed on the statute books, constantly placing on the Department of Commerce and customs officers new duties and responsibilities.

As illustrating the importance of uniformity and accuracy in navigation work in the customhouses attention is invited to the decision of the United States Supreme Court on June 7 last in the case of the *Northern Star* which held in effect that a mortgage on a ship acquires a preferred status only upon compliance with all the conditions specified in the mortgage act of 1920 with the administration of which through customs officers the Secretary of Commerce is charged. Failure of the collector of customs in that case to indorse a mortgage on the vessel's documents in accordance with the act deprived the mortgage of its preferred status.

Under the present organization the Secretary of Commerce must administer this law which affects the title to, or preferred status of mortgages or liens on every vessel documented under our flag through the employees of another department, over whom he has no direct supervision and whose efficiency or lack of it he has no authority to reward or correct.

Another example of the effect of the present unbusinesslike organization of the navigation services is the admeasurement of vessels.

This service affects over $2,000,000 direct revenue to the Government, in addition to all Panama Canal tolls from vessels passing through the canal. These vessels are taxed on the basis of our admeasurement.

The proper administration of this highly technical service is of prime importance to our merchant marine. On the tonnage of a vessel as ascertained is based the collection of navigation fees, tonnage taxes, canal tolls, and port charges in American and foreign ports.

Sufficient importance has been attached to this work by maritime nations to justify them in requiring long apprenticeships before the actual admeasurement of a vessel, and in the establishment of an elaborate system of review by highly trained central authority.

To perform this work in the United States, however, the Commissioner of Navigation, whose decision on admeasurement questions is by statute made final, must rely on employees of the Treasury Department, in whose selection, appointment, or remuneration he has no voice. They are usually selected from a customs register with little, if any, knowledge and experience in admeasurement. At many ports there are changes of assignments to this work. At some ports there are no men familiar with these duties or able to understand the technical terms of the law or of the instructions sent them by the bureau.

The obvious solution of the difficulty is the transfer of the selection, appointment, and remuneration of these employees to the Department of Commerce, which is responsible for their work. This will necessarily result in more responsive action, engender professional pride, and consolidate efforts, all of which will attract competent men and, through central direction, render expert and adequate service to the benefit of shipowners and the credit of the department.

LOAD LINE

The section of H. R. 7245 mentioned above establishing load lines for American vessels is essential (1) in consideration of the safety of the vessel and crew and the avoidance of the damage and extensive repairs inevitable with inadequate freeboard; and (2) because the leading maritime nations already have different load-line provisions and their laws require our ships loading in their ports to comply with their several detailed requirements in the absence of similar regulations of our own. The United States is now the only maritime nation of importance whose commerce is liable to be hampered by these provisions.

RADIO SERVICE

Preparations are under way for the next International Radiotelegraph Conference which is to be held in Washington. According to the plans this conference is to be held sometime during the year 1927. For several months the committee representing the directly concerned departments of the Government have been studying our radio problems and in cooperation with commercial interests proposals are being prepared for consideration at the forthcoming international conference. The last International Radiotelegraph Conference was held in London in 1912. Since that time there has

been great development in the use of radio extending to transoceanic high-powered service, broadcasting service, exceptional growth in marine and other service, and marked improvement in radiotelegraph and telephone apparatus, in view of which it is naturally expected that there will be many important problems for consideration at the next conference.

Representatives of this Government attended the International Telegraph Conference held in Paris in 1925 where it was agreed that following the Washington International Radiotelegraph Conference there should be held another conference having as its purpose the amalgamation of the telegraph and radiotelegraph conventions. At present our Government is a party to the radiotelegraph convention but has not become a party to the telegraph convention.

Owing to the inadequate control over radiocommunication under existing law the department has found it advisable to have national radio conferences each year since the inauguration of broadcasting for the primary purpose of encouraging cooperation with the department and joint interests in the matter of self-regulation of the radio industry. The fourth conference was held in November, 1925. While self-regulation had been remarkably successful up to that time, the department was finding it more and more difficult to meet the demands made upon it and it appeared evident that the only satisfactory solution of this increasingly difficult problem was through obtaining from Congress adequate authority to insure orderly conduct of the radiocommunication service. To this end the conference recommended that Congress enact a law which would give the protection desired.

An attempt was made by Congress to provide the needed control over radio; a bill was passed by the House which was materially amended by the Senate committee and passed by the Senate the day before adjournment. There was not sufficient time after its passage by the Senate for the conferees to adjust the differences between the two bills before adjournment. It is expected that a compromise bill will be enacted into law early in the next session which will provide the control that should be exercised over a service of so great importance to the public and which is employed so extensively for various useful purposes.

Radio has become a real competitor in the field of international communication. Through this commercial radio network the United States is now in touch with the following foreign countries: Great Britain, France, Germany, Norway, Poland, Italy, Sweden, Argentina, Brazil, Holland, Japan, Colombia, Panama, Costa Rica, Nicarauga, Honduras, and Guatemala.

In the operation of these services we also touch our island possession, Hawaii. Plans are under way to include China and the Philippine Islands.

No other branch of the radio service is of as much interest to the public as broadcasting. The use of the radiotelephone for entertaining the public originated in this country in 1921. Interest in it immediately spread to the other countries of the world. While there has been a slight decrease in the number of radio broadcasting stations in the past year this does not indicate lack of public interest. The decrease was due largely to the efforts of the depart-

ment to carry out the recommendations of the last national radio conference to the effect that the number of broadcasting stations be limited and that no new stations be licensed until it would be in the interest of public service to add new stations. At the close of the year there were 528 licensed broadcasting stations as compared with 571 last year and 535 the previous year. According to the most dependable information we have there are 349 stations used for broadcasting in foreign countries. These stations are distributed as follows: Canada, 47; Sweden, 42; France, Germany, and Spain, each, 21; United Kingdom, 20; Russia and Australia, each, 18; Cuba and Mexico, each, 17; Brazil, 12; Argentina and New Zealand, each, 10; and in 49 other countries there are from 1 to 9 stations each. The decrease in the number of stations has undoubtedly not diminished service to the public. This has been more than compensated for by the increase in power of existing stations. Records from the department show that the average power per station in watts for this year is 715.8 as compared with 312.4 last year and 190.5 the year before. The increases in power have undoubtedly made it possible for many of those living in rural districts to obtain service which they had not formerly enjoyed.

The growing public interest in radio is probably best illustrated in the amount of money representing radio sales each year. The editors of a prominent radio publication have taken the trouble to prepare statistics which they believe to be fairly accurate. These figures show that in 1922 radio sales amounted to $60,000,000; in 1923, $120,000,000; in 1924, $350,000,000; and in 1925, $450,000,000.

As compared with broadcasting, only a small percentage of our people are concerned with the most important radio service—that used to protect life and property on the high seas. It is therefore not surprising that when our broadcasting stations are shut down for temporary periods now and then because of an SOS call those who do not realize the importance of this service complain of an interruption, not realizing that their slight deprivation of pleasure may mean the saving of many lives on some vessel threatened with disaster. At the close of this fiscal year there are 1,954 American merchant vessels equipped with radio apparatus as compared with 1,901 the previous year. There is not a vessel engaged in the ocean service leaving our ports with passengers that is not provided with radio apparatus, regularly inspected by our inspection force at the most important ports to insure the protection of the passengers and crew carried by these vessels.

The importance of safe navigation and safety of life is further recognized by the growing use of the radiocompass. This instrument makes it possible for vessels to navigate safely through fog and has been on several occasions of inestimable value in locating vessels in distress which had incorrectly reported their position. At the close of the fiscal year 1925 there were 83 American vessels equipped with radiocompasses. There are now 230 American vessels equipped with radiocompasses.

During the year just ended there were 13,009 clearances of American and foreign vessels from our ports which are required by law to be equipped with radio. In 1925 there were 12,141 clearances, an increase of almost 1,000.

In 1926 we made 9,197 inspections as compared with 8,603 inspections in 1925, which was an increase of approximately 600 inspections for the same period. This work is considered of greatest value to the traveling public and because of its life-saving feature it is given first consideration. The inspections made during the last fiscal year developed 325 cases of defective apparatus, lack of proper equipment or personnel, or other causes which would have constituted violations of the law had the vessels sailed without proper inspection. Our inspection work also extends to all commercial and private stations on land and in this connection opportunity was had during part of the year to make use of the radio test car.

It was found that the car enabled us to perform our work in a much more satisfactory and efficient manner and at a considerable saving in time and expense. These cars can be used to advantage in each district and should be provided. The car we are using is equipped with the most modern types of apparatus, including field strength measuring equipment, frequency measuring apparatus, and other instruments necessary for use in the regular performance of the duties imposed upon the service.

There has been a considerable decrease in the number of amateurs licensed during the past year as compared with the previous year. In 1925 we licensed 10,074 amateur stations and in 1926 licenses were issued to 8,037. As these licenses are issued for a period of two years, the figures indicate a total of 18,111 amateur stations. However, during the year 3,209 were discontinued, which leaves an actual total of 14,902 active amateur stations, a substantial reserve operating force to draw from in an emergency.

The records of the department show that the amateurs have discontinued using spark transmitters and are now making use of modern equipment only, such as continuous wave transmitters and tube receivers.

ENFORCEMENT OF THE NAVIGATION LAWS

During the year there were reported to the department for mitigation or remission of penalties 10,778 violations of the navigation laws, an increase of 1,234 from 1925.

From close observation the bureau is satisfied that there is an increasing compliance with the navigation laws in the districts in which, through its inspection vessels and navigation inspectors, it has direct supervision of their enforcement. On the Pacific coast, the Great Lakes, and the Mississippi River and tributaries, however, it has no inspection vessels or navigation force available for the purpose.

On the Pacific coast there are 6,000 documented American vessels of over 3,000,000 gross tons and 21,840 small motor boats; on the Great Lakes 2,600 documented vessels of over 2,800,000 tons and 28,600 small motor vessels; and on the western rivers 1,900 documented vessels of over 160,000 tons and 17,500 small motor boats.

There is need of closer and direct supervision of these vessels by the department in the administration of the laws intended for the safety of those on board and the preservation of cargoes and movement of commerce.

Owing to the geographic and climatic conditions it is not deemed possible to employ inspection vessels on these waters.

In addition to the lack of inspection, in the general administration of the navigation laws through officers of the customs, there necessarily is a lack of uniformity at the various ports. This result is inherent in the present dual system of administration in our department and performance in another. This is of importance to our shipping interests.

To meet the lack of inspection and endeavor to secure uniformity in the administration of the law, the most economical and efficient method appears to be the appointment of five traveling inspectors, two to cover the Pacific coast, two for the Great Lakes, and one on the western rivers.

Much if not all of the expense of this employment will be met through the additional returns from penalties for violation of the navigation laws, while the benefit to the public through safeguarding life and property and to the merchant marine through uniformity in customhouse practices would return many times the total amount of the expenditure.

SHIPPING COMMISSIONERS

During the year 534,493 officers and men were shipped, reshipped, and discharged before shipping commissioners, as compared with 552,124 for the previous year. The average cost per man for this service was 23 cents. Collectors of customs acting at ports where shipping commissioners offices have not been established shipped and discharged during the year 53,789 officers and men, as compared with 53,582 officers and men during the previous year. American consuls shipped and discharged 39,500 officers and men.

The above work by customs officers would be materially improved and systematized should the personnel of the marine divisions of the customhouses be transferred to the Department of Commerce.

Of 273,494 officers and men shipped before shipping commissioners 122,497 were native Americans; 40,494 naturalized Americans; 162,991 in all, or 59.6 per cent. This does not give an entirely accurate idea of the nationality of crews on our vessels, as under the law vessels may sign on a portion of alien crews before United States consuls for the round trip.

The work of the shipping commissioners is being systematized so far as possible to secure an exact and equitable construction of the laws intended to secure to the seaman fair and just treatment and to the shipowner and the public the safety of the ship and cargo and the prompt movement of commerce.

PREVENTING OVERCROWDING OF PASSENGER VESSELS

During the year passengers were counted on 9,687 trips of excursion steamers, the number of passengers aggregating 6,596,766. Of this number our navigation inspectors made 8,287 counts of 3,454,436 passengers. The records show an increase in this form of recreation with a reduction in loss of life, due to some extent to the restrictive laws and the close Federal supervision given to the construction, equipment, and inspection of these vessels and the number

of passengers they carry. For instance, during the past year on 337 occasions it was necessary to stop passengers going on vessels, the safety point having been reached. This involved 288,937 passengers. The service is well organized and meets with general cooperation on the part of the public, the owners of vessels, and their officers.

PASSENGER ACT OF 1882

During the year 1,334 vessels entered our ports, bringing to the United States 215,639 steerage passengers. This is a slight increase over 1925, when 187,127 such passengers arrived in the United States. In all but 9 instances these vessels were fully equipped and kept in the condition required by law. The violations reported were through lack of cleanliness of the quarters at the time of arrival. In most instances this was found to be due to the carelessness of the passengers about to leave the ship. During the voyage the sanitary conditions were in all cases satisfactory.

NAVIGATION RECEIPTS

The receipts from tonnage during the fiscal year amounted to $1,825,719.39, compared with $1,813,755.66 from the same source last year. The taxes and also the navigation fees and fines are collected by collectors of customs in the administration laws through the Bureau of Navigation. The receipts during the past year compared with 1917, the last pre-war year, were as follows:

June 30—	Tonnage duties	Navigation fees	Navigation fines	Total
1926	$1, 825, 719. 39	$227, 079. 09	$127, 872. 98	$2, 180, 671. 46
1925	1, 813, 755. 66	216, 878. 77	61, 628. 34	2, 092, 262. 77
1917	1, 393, 743. 16	159, 808. 03	49, 962. 37	1, 603, 513. 56

The accounts for these various collections are rendered by collectors of customs, checked in the Bureau of Navigation against their deposits in the United States Treasury.

PUBLICATIONS

Publications of the bureau comprise the Navigation Laws (quadrennial with annual pamphlet supplement), Merchant Vessels of the United States, Code List of Merchant Vessels, and List of Radio Stations (all annual), and American Documented Seagoing Vessels of 500 Gross Tons and Over and Radio Service Bulletin (both monthly). The publications no longer are issued gratuitously but are for sale by the Superintendent of Documents, Government Printing Office, Washington, D. C.

Appendixes and statistics of the merchant marine formerly printed as a part of my annual report are now published as a separate document known as Merchant Marine Statistics.

Very truly yours,

D. B. Carson,
Commisisoner of Navigation.

STEAMBOAT INSPECTION SERVICE

DEPARTMENT OF COMMERCE,
STEAMBOAT INSPECTION SERVICE,
Washington, July 1, 1926.

Hon. HERBERT HOOVER,
Secretary of Commerce.

DEAR MR. SECRETARY: In response to your request I furnish the following condensed report upon the work of the bureau during the past year:

PROCEDURE

Section 4403 of the Revised Statutes of the United States provides that the Supervising Inspector General shall "produce a correct and uniform administration of the inspection laws, rules, and regulations." To accomplish this requires a strong and effective central control, and, while under the law the local inspectors do have original jurisdiction, in many instances the Supervising Inspector General must constantly counsel with them and advise them in order to obtain uniformity. This has been true especially with reference to investigations and trials conducted of accidents to vessels, violations of the navigation laws, etc., and during the past year the bureau has had forwarded to the office at Washington the complete casualty files as the cases have been completed so that they could be reviewed and the local inspectors advised of their errors and cautioned as to future procedure. This practice has very materially raised the standard of conducting investigations and trials.

Another step forward in the conducting of investigations has been the action taken in permitting them to be conducted openly. This has entirely eliminated the belief that the Government was trying to hide something instead of getting at the truth.

It has also been the desire of the bureau to improve the standard of examinations of licensed officers and to do this it has realized that examination questions for the use of the inspectors must be prepared in the central office. The bureau has been engaged upon the preparation of these questions for the past 18 months and had hoped to conclude the work long before this, but, owing to the limited force in the central office, it has not been possible to do so. These questions will, however, be ready for use before the end of the present calendar year.

COOPERATION

This service is increasingly making an effort to keep in touch with the activities of other departments. For many years this service has done work for other departments of the Government; for the War Department, for which it inspects boilers at cantonments and fortifications; for the Treasury Department, for which it inspects boilers at hospitals of the Veterans' Bureau; and for all of the de-

partments in the matter of examining and testing boilers of heating plants; and for the Public Health Service in the matter of the examination of drinking-water apparatus on board ship and in many other and sundry ways too numerous to mention.

Realizing the importance, also, of keeping in touch with activities of societies engaged on work that touches the merchant marine, the bureau is cooperating with the forces engaged on standardization; it is working with the National Fire Protection Association; it is keeping in touch with the American Bureau of Shipping, with Lloyd's, with the National Council of Safety, and with all activities looking to the preservation of human life.

Not only have we endeavored to cooperate with departments and societies but also with the people themselves, and, whenever it has been necessary, the Supervising Inspector General has proceeded to make personal visitations to adjust any differences that have arisen. Since January 1, the head of this office has visited the local districts of Boston, Albany, New York, Philadelphia, Baltimore, Norfolk, Jacksonville, Tampa, Mobile, New Orleans, Pittsburgh, Cleveland, Chicago, Grand Haven, and Milwaukee.

BOILER INSPECTION

From time to time there has been some criticism of the rules of the board of supervising inspectors concerning the inspection of boilers, but, if real constructive criticism be made of that code of rules, it will be found that they measure up very well with the rules of leading classification societies. The bureau has, however, an open mind upon the subject, and, if it be found that improvement can be made and we have the authority, it will be done.

Much of the criticism has had to do with the factors of safety and the pressures that may be allowed and in criticizing conditions in these respects the limited discretion of the board of supervising inspectors has been entirely overlooked. Repeated efforts have been made to have sections 4433 and 4418, Revised Statutes, amended so as to enable this service to make modern its rules and regulations in regard to working and hydrostatic pressure of boilers, and legislation looking to this end is again recommended.

MOTOR-BOAT INSPECTION

It is generally conceded that the motor-boat law should be amended so as to cover craft not now subject to inspection, but there is a diversity of opinion among those interested as to just what class of vessels should be inspected. When it can be finally determined as to the types of vessels that ought to be inspected, it would seem to this office that the requirements relating to inspection might well be left to the board of supervising inspectors, which would proceed to formulate the type of inspection that would not destroy the great motor-boat industry, but would make the operation of such vessels safer.

FIRE CONTROL

An extensive investigation has been conducted with reference to fire indicating and extinguishing systems on board vessels, the study of these features of vessel construction having been found necessary

by reason of the several serious fires that have occurred on coastwise ships, and valuable suggestions and data have been collected for the use of the board of supervising inspectors at its next annual session in determining a solution of the problem.

With this same question comes up the prevention of explosions in connection with the loading of oil tankers, and this matter will also receive the attention of the board at its next session.

INCLINING TESTS

Reference was made in the last annual report to the work being done by this service in the inclining of ships. This work has increased to such an extent that two men are not sufficient to properly take care of it and make the reinspections contemplated to be made by the traveling inspectors. Additional personnel will have to be arranged for in the very near future to take care of this important work.

THE SUPERVISING INSPECTORS

It is again urged that the supervising inspectors of this service be placed under the classified civil service and legislation looking toward this end is earnestly recommended.

PERSONNEL

The following positions were embraced in the Steamboat Inspection Service at the close of business on June 30, 1926:

At Washington, D. C.:	
Supervising Inspector General	1
Deputy Supervising Inspector General (who is Acting Supervising Inspector General in the absence of that officer)	1
Traveling inspectors	3
Clerks	11
Messenger	1
In the service at large:	
Supervising inspectors	10
Local inspectors of hulls	46
Local inspectors of boilers	46
Assistant inspectors of hulls	75
Assistant inspectors of boilers	75
Clerks to boards of local inspectors	95
Total	364

A glance at the above table will show the relatively small number of persons engaged in the tremendously important job of inspecting vessels of the American merchant marine and of licensing officers and men. Increasingly, a demand is being made upon this office for a larger force of inspectors and clerks at certain places and it is only a question of time before it will be necessary to ask for a larger force, because as time goes on and better methods are adopted greater detail is required and safer conditions are, as the result, obtained.

In connection with this question of personnel there also comes up the matter of better pay. It is the desire of this office to increase the salaries of inspectors and clerks so as to attract to this service a highly qualified personnel.

Under the law, there is provided in the central office a Deputy Supervising Inspector General who is the chief clerk of the bureau.

While he has been charged with the duties as chief clerk, the duties of that position are actually performed by another employee, the time of the Deputy Supervising Inspector General being entirely taken up with other matters. It is recommended that a chief clerkship be established in the central office to correct this condition.

STATISTICS

The force inspected and certificated 7,377 vessels, with a total gross tonnage of 15,016,556, of which 7,055 were domestic vessels, with a total gross tonnage of 11,619,240, and 322 were foreign passenger steam vessels, with a total gross tonnage of 3,397,316. Of the domestic vessels there were 5,581 steam vessels, 950 motor vessels, 18 passenger barges, and 506 seagoing barges. There was a decrease of 34 in the total number of vessels inspected, and an increase of 472,403 in the total gross tonnage of vessels inspected as compared with the previous fiscal year. There were 1,000 cargo vessels examined to carry persons in addition to crew under the act of Congress approved June 5, 1920. Letters of approval of designs of boilers, engines, and other operating machinery were granted to 20 steam vessels, with a total gross tonnage of 707. There were inspected for the United States Government 73 hulls of vessels and 2,009 boilers. There were 2,575 reinspections of steam vessels, motor vessels, and barges.

Licenses were issued to 22,459 officers of all grades. There were examined for visual defects 6,962 applicants for license, of whom 15 were found color blind or with other visual defects and rejected. Certificates of service were issued to 8,925 able seamen, and 584 were rejected. Certificates of efficiency were issued to 7,852 lifeboat men, and 4,960 were rejected.

Steel plates for the construction of marine boilers to the number of 2,958 were inspected at the mills. There were tested at the mills by assistant inspectors 6,308 steel bars to be used as boiler stays and braces, of which 70 were rejected. There were examined and tested 175,132 new life preservers and kapok collars for life preservers, of which 1,987 were rejected. There were inspected 12,920 new cork-ring life buoys, of which 256 were rejected. There were inspected at factories 442 new lifeboats, all of which passed; 269 new life rafts, of which 2 were rejected; and 192 new boat davits, all of which passed.

The total number of accidents resulting in loss of life was 314. The total number of lives lost was 368, of which 103 were passengers. Of the lives lost, 156 were from suicide, accidental drowning, and other similar causes, leaving a loss of 212 fairly chargeable to accidents, collisions, founderings, etc. There was an increase of 58 in the number of lives lost as compared with the previous fiscal year.

Passengers to the number of 350,370,065 were carried on vessels required by law to make report of the number of passengers carried. Dividing this number by 103, the total number of passengers lost, shows that 3,401,651 passengers were carried for each passenger lost. The number of lives directly saved by means of the life-saving appliances required by law was 752.

Very truly yours,

D. N. HOOVER,
Supervising Inspector General.

PATENT OFFICE

DEPARTMENT OF COMMERCE,
PATENT OFFICE,
Washington, July 1, 1926.

HON. HERBERT HOOVER,
Secretary of Commerce.

DEAR MR. SECRETARY: I have the honor to submit the following report of the business of the Patent Office for the fiscal year ended June 30, 1926:

After three years of steady progress, during which the arrears were reduced from over 80,000 cases to 45,000 cases, a decrease of 35,000, the Patent Office for several months has been unable to handle the work as fast as it is received.

For two years, beginning with the fiscal year 1925, the Patent Office was provided an annual appropriation of about $180,000 for the employment of 100 temporary examiners. For the coming year the appropriation for this purpose is only $25,000, with the result that the strength of the examining corps, exclusive of principal examiners, has been reduced from 560 to 485. This force is obviously inadequate, especially in view of the increasing demands upon the office. These increased demands are indicated by the fact that in two years the new cases have increased by 10,000 and the amended cases by 48,000. Therefore, the force should be augmented at the earliest possible date by not less than 7 principal examiners and 40 assistant examiners.

Attention is called to the continued high turnover in the examining corps. Out of a technical professional force now reduced to about 485, 104 resigned during the fiscal year because of inadequate salary scales. It is urgent that these scales be revised to allow increases in the salaries of principal examiners up to the median rates allowed by law, and to allow the more rapid promotion of examiners of professional grades 1 and 2. It would certainly lessen the resignations and provide a much more efficient force if sufficient appropriations were made to promote all juniors from grade 1 to grade 2 after two years' satisfactory service, and to promote all assistants from grade 2 to grade 3 after five years' acceptable service.

Attention is again called to the urgent need for providing increased quarters for the Patent Office.

CONDITION OF WORK

During the first six months of the fiscal year the number of patent cases on hand was reduced from 44,556 to 41,275, or a reduction of

3,281. However, during the last six months this gain was almost entirely dissipated, since on June 30 the number of patent cases awaiting action had risen to 43,765.

The largest number of cases awaiting action in the history of the office was on August 17, 1923, when there were 74,523 patent applications, 2,401 design applications, 3,120 trade-mark applications, or a total of 80,044. This was reduced on June 30, 1926, to 43,765 patent applications, 426 design applications, and 1,282 trade-mark applications, or a total of 45,473, a reduction in three years of 34,571 cases.

The length of time an applicant must await official action after filing his application is less than it has been for a number of years past. This is shown by the following statement giving the condition of work in April, 1921, and on June 30, 1926, as follows:

April, 1921	June 30, 1926
2 divisions under 2 months.	12 divisions under 2 months.
4 divisions under 3 months.	42 divisions under 3 months.
6 divisions under 4 months.	47 divisions under 4 months.
10 divisions under 5 months.	All 53 divisions under 5 months.
37 divisions over 5 months.	*None over 5 months.*
32 divisions over 6 months.	
26 divisions over 7 months.	
14 divisions over 8 months.	
9 divisions over 9 months.	
3 divisions over 10 months.	
Designs, over 5 months.	Only 25 days.
Trade-marks, over 5 months.	Only 27 days.

These gains in dates have been made notwithstanding an increase during the last two years of 10,000 new applications per year and about 48,000 amended applications. The loss during the past six months has been due to the large increase of work and the fact that there are now 50 fewer examiners in the corps than there were six months ago.

DISPOSITION OF OLD MODELS

The act of February 13, 1925, provided for the disposition of the old models filed in this office prior to 1880, the work to be performed under the direction of a committee consisting of the Commissioner of Patents, the secretary of the National Museum, and a patent attorney (William G. Henderson, Esq., being appointed), and that the models of historical interest be kept in the Patent Office or in the National Museum, and that all others be returned to the original depositors or their descendants or destroyed. These models, 155,000 in number, had for years been packed away in 7,500 boxes, making them inaccessible. Work was started the first part of October, 1925, and continued until the latter part of June, at which time the unpacking was completed. The National Museum has taken charge of about 50,000 models, retaining those of historical interest and distributing others to various museums and institutions throughout the country; 2,500 models are being returned to the claimants as heirs of the patentees. The rest of the models were sent to the General Supply Committee of the Treasury Department for sale at auction, from which $6,540 was realized. The following statistical statement will be of interest:

Appropriation for disposal of models	$10,000.00
Amount actually expended for salaries and equipment	3,611.88
Unexpended appropriation	6,388.12
Received from the sale of models	6,540.00

It will thus be seen that instead of its costing the Government $10,000, the amount actually spent was only $3,611.88, and since the undesired models sold for $6,540 there is a net amount of $2,928.12 to be turned into the Treasury over all expenses, so that in effect the entire appropriation of $10,000 was saved, plus the surplus of $2,928.12.

IMPROVEMENTS IN THE OFFICE

Arrangements are now being made to photostat assignments filed for record instead of typewriting them. This will leave on record a facsimile photographic copy, including the signatures to the deeds, and at the same time will save each year about $10,000 over the cost of making the typewritten records. At the same time the photostat division of the office is being remodeled in order to produce more efficient results and make better photostats. Incidentally, it may be stated that this division makes a profit each year of over $25,000 in furnishing to the public over 1,000 photostats per day.

Arrangements are also being made to begin the checking up of the patents in the public search room, for which $20,000 has been appropriated. It is planned to check up all the 2,500,000 copies of patents used by the public for search purposes, to supply the missing copies, and to place in each subclass a list of the patents belonging in that class, so that in the future the public searchers may verify their searches. This is vitally important to the industries of the country, as searchers come from all parts of the Union to search these records.

On the recommendation of the Secretary's committee on Patent Office procedure, the printing of the preamble of the specification has been omitted. The omission of seven lines of printed matter in each patent in each instance is insignificant, but in the aggregate it amounts to an estimated saving of from $8,000 to $10,000 per year. The report of the Secretary's committee is being studied to make use of various other suggestions contained in it to increase the efficiency of the office. In fact, the report will be of immense value. At this time I desire to express the appreciation of the officers of this bureau to the committee, which was composed of men of wide experience in patent, engineering, and industrial problems. Although its members were busy men of affairs, they came again and again to Washington and gave generously of their time and made a most exhaustive study of the Patent Office and its needs. I recommend that the report be printed.

STATISTICS

Following is an appendix giving the usual statistical report.

APPENDIX

STATISTICS

Applications received during the fiscal year ended June 30, 1926[1]

With fees:		
Applications for patents for inventions	80,682	
Applications for patents for designs	4,257	
Applications for reissues of patents	340	
		85,279
Applications for registration of trade-marks	[2]21,839	
Applications for registration of labels	1,979	
Applications for registration of prints	933	
		24,751
Total, with fees		110,030
Without fees:		
Applications for inventions (act Mar. 3, 1883)	118	
Application for reissue under rule 170	1	
		119
Grand total		110,149

Applications for patents for inventions with fees

Year ended June 30—		Year ended June 30—	
1917	68,690	1922	88,243
1918	62,399	1923	77,645
1919	62,755	1924	76,024
1920	81,948	1925	77,926
1921	84,248	1926	80,682

Applications for patents, including reissues, designs, trade-marks, labels, and prints with fees

Year ended June 30—		Year ended June 30—	
1917	81,538	1922	113,597
1918	73,307	1923	100,724
1919	75,657	1924	99,574
1920	102,940	1925	103,591
1921	107,656	1926	110,030

Patent applications awaiting action

June 30—		June 30—	
1917	16,058	1922	67,367
1918	14,769	1923	72,475
1919	17,735	1924	60,334
1920	34,355	1925	44,556
1921	49,334	1926	43,765

[1] Including applications in which fees were refunded and transferred.
[2] Includes 4,479 applications for the renewal of trade-mark registration.

Patents withheld and patents expired

	1925	1926
Letters patent withheld for nonpayment of final fees	8,905	10,048
Applications allowed awaiting payment of final fees	18,678	15,918
Patents expired	34,006	34,332
Applications in which issue of patent has been deferred under section 4885, R. S.	177	168
Applications in process of issue	3,102	3,063

Patents granted and trade-marks, labels, and prints registered

	1922	1923	1924	1925	1926
Letters patent	38,083	39,004	38,963	45,218	46,464
Design patents	2,862	1,452	2,443	2,692	2,763
Reissue patents	258	255	228	237	268
Trade-marks	12,247	13,169	16,203	14,542	14,236
Labels	1,560	1,549	1,350	1,400	1,676
Prints	541	592	666	615	868
Total	55,551	56,021	59,853	**64,704**	**66,275**

Receipts and earnings, fiscal year ended June 30, 1926

Unearned balance at close of business, June 30, 1925		$171,550.26	
Receipts for fiscal year ended June 30, 1926		3,437,021.01	
Earnings from sale of Official Gazette and other publications through Government Printing Office		28,100.00	
Total			$3,636,671.27
Earnings:			
Inventions	$1,609,030.00		
Reissues	10,240.00		
Designs	49,975.00		
Design extensions	15,310.00		
Trade-marks	216,860.00		
Labels and prints	15,264.00		
Total		1,916,679.00	
Final fees		932,365.00	
Appeals	26,655.00		
Oppositions	8,540.00		
Disclaimers	520.00		
Total		35,715.00	
Copies of patents	323,738.08		
Photoprints	11,164.60		
Photostats	39,645.45		
Manuscript copies	58,474.48		
Certified copies, etc	8,783.10		
Recording articles of incorporation	928.00		
Registration of international trade-marks	450.00		
Registration of attorneys	590.00		
Total		443,773.71	
Drawings		20,800.77	
Assignments		80,341.05	
Total		3,429,674.53	
Earnings from sale of Official Gazette, etc		28,100.00	
Total earnings			3,457,774.53
Refunded			28,692.66
Unearned balance June 30, 1926			150,204.08
			3,636,671.27

Expenditures, fiscal year ended June 30, 1926

Salaries		$2,347,966.58
Salaries, additional employees		168,638.28
Scientific library		7,906.04
Investigating public use		663.40
Photolithographing:		
Current issue	$64,088.39	
Reproductions	99,475.96	
Photographic printing	8,649.73	
Photostat supplies	24,903.08	
Dry mounts	5,438.72	
Total		202,555.88
Printing and binding:		
Specifications	764,770.82	
Official Gazette	234,867.03	
Indexes	15,362.15	
Total		1,015,000.00
Miscellaneous		70,000.00
Furniture and filing cases		19,968.98
Stationery		15,705.03
Contingent expenses, including telephones, postage on foreign mail, etc		9,547.92
Total		3,857,952.11

Earnings and expenditures

Expenditures	$3,857,952.11
Total earnings	3,457,774.53
Deficit	400,177.58
Total net surplus to date	7,327,848.98

Comparative statement

June 30—	Receipts	Expenditures	Surplus
1917	$2,317,519.72	$2,095,138.68	$222,381.04
1918	2,103,660.56	[1] 2,131,616.18	−27,955.62
1919	2,113,350.17	[1] 2,178,578.30	−65,228.13
1920	2,615,697.33	[1] 2,436,561.37	179,135.96
1921	2,712,119.69	[1] 2,640,373.96	71,745.73
1922	2,894,286.58	[1] 2,722,205.37	172,081.21
1923	3,026,486.36	[1] 3,112,022.07	−85,535.71
1924	3,042,276.22	[1] 3,273,341.37	−231,065.15
1925	3,271,253.89	3,775,476.97	−504,223.08
1926	3,457,774.53	3,857,952.11	−400,177.58

[1] Including increase in compensation (bonus).

Litigated cases

Oppositions instituted	795
Cancellations instituted	168
Interferences declared (including 282 trade-mark)	1,683
Inter partes cases disposed of before final hearing (including 945 trade-mark)	2,226
Inter partes cases heard (including 302 trade-mark)	557
Inter partes cases disposed of after final hearing (including 306 trade-mark)	520
Inter partes cases awaiting decision (including 1 trade-mark)	73

Oldest case awaiting action, Oct. 1, 1925.

To board of examiners in chief:	
Appeals in interference cases	288
Ex parte appeals	1,616
	1,904
Appeals in interference cases disposed of	225
Ex parte appeals disposed of	1,205
	1,430
Interference cases awaiting action	183
Ex parte cases awaiting action	999
	1,182
Oldest interference case awaiting action, Feb. 26, 1926.	
Oldest ex parte case awaiting action, Apr. 5, 1926.	
To the commissioner:	
Appeals in interference cases (including 16 trade-mark)	144
Appeals in opposition cases	77
Appeals in cancellation cases	17
Ex parte appeals	207
Interlocutory appeals	280
Ex parte appeals in trade-mark cases	28
Total	753
Petitions	3,877
Total	4,630
Cases disposed of by commissioner:	
Appeals in interference cases (including 17 trade-mark)	111
Appeals in opposition cases	67
Appeals in cancellation cases	18
Ex parte appeals	190
Interlocutory appears	273
Ex parte appeals in trade-mark cases	28
Total	587
Petitions to commissioner	3,877
Total	4,464
To Court of Appeals of the District of Columbia:	
Appeals in ex parte cases (including 3 trade-mark)	43
Appeals in interference cases (including 5 trade-mark)	45
Appeals in opposition cases	24
Appeals in cancellation cases	5
Total	117

As to the volume of business, the office received during the year 85,279 applications for patents, reissues, and designs; 17,360 trade-mark applications and 4,479 applications for renewal of trade-mark registrations; 2,912 label and print applications; 221,511 amendments to patent applications, 7,658 amendments to design applications, and 23,650 amendments to trade-mark, label, and print applications.

The number of letters constituting the miscellaneous correspondence received and indexed was 346,540. In addition 44,460 letters were returned with information.

The number of printed copies of patents sold was 3,169,922, bringing in $316,992, and 1,308,865 copies of patents were shipped to foreign governments, and 755,354 copies furnished public libraries.

The total number of copies of patents furnished was 5,711,930 (including those for office use).

The office received for record 43,375 deeds of assignment, containing on an average 435.17 words per deed.

Typewritten copies of 13,465,400 words were furnished at 10 cents per hundred words. The office certified to 10,131 manuscript copies, and furnished 9,906 miscellaneous certified copies. The office also furnished 185,176 photostatic copies of manuscript pages; 65,844 photographic copies, and 264,393 photostatic copies of publications and foreign patents, for sale; 9,143 photostat-manuscript pages were furnished for Government departments, without charge; 146 certified manuscript copies and 3,016 photostatic copies were furnished for Government departments, without charge; 27,812 photostats and 38,802 photographic copies for use of the Patent Office; in all, 480,397 photostat and 104,646 photographic copies.

Very truly yours,

THOMAS E. ROBERTSON,
Commissioner of Patents.

BUREAU OF MINES

DEPARTMENT OF COMMERCE,
BUREAU OF MINES,
Washington, July 1, 1926.

HON. HERBERT HOOVER,
Secretary of Commerce.

DEAR MR. SECRETARY: In response to your request, I furnish the following condensed report on the work of the Bureau of Mines during the fiscal year ended June 30, 1926:

DUTIES

The Bureau of Mines was established by act of Congress in the Department of the Interior on July 1, 1910, and was transferred by Executive order to the Department of Commerce on July 1, 1925. Its purpose, as prescribed by Congress, is to conduct scientific and technical investigations concerning the mining, preparation, and use of mineral substances with a view to the increase of health, safety, and efficiency in the mineral industries. Thus the field of the bureau's activities extends from the development of mineral deposits to the utilization of marketable products. The bureau studies mine hazards; gives training in rescue and first-aid methods; strives to improve mining conditions that relate to health and comfort; endeavors to increase safety in the use of mine explosives and equipment; seeks to increase efficiency in the utilization of coal; points out methods of lessening waste in the production, transportation, treatment, and use of petroleum and natural gas; and conducts research bearing on the development and improvement of methods of mining, milling, and treating ores and nonmetallic minerals in order to recover more of the mineral content, to lessen the cost of production, and to expand the field of economic utilization.

The bureau tests fuels purchased for the Government, is intrusted with the management of the Government fuel yards at Washington, and operates plants for the production and repurification of helium gas, conducts research on helium, and supervises exploration for new sources of the gas.

In its capacity as a technical agent for the Government in matters relating to mining, and in order that it may be of greater service in advancing safety and efficiency in the mineral industries, the bureau cooperates with the War Department, Navy Department, Department of Agriculture, Shipping Board, Public Health Service, and other Government establishments. It also cooperates with numerous State, municipal, and private organizations.

When the bureau was transferred to the Department of Commerce, the division of mineral resources of the United States Geolog-

ical Survey, Department of the Interior, was transferred to and incorporated in the bureau, as were part of the coal division and part of the minerals division of the Bureau of Foreign and Domestic Commerce. With these changes in effect, the bureau is giving more attention to economic problems of the mineral industries and is carrying on the work the Geological Survey had done in compiling statistics of mineral production.

SAFETY IN MINING

Coal-mine explosions.—The development of means to prevent or minimize coal-mine explosions depends primarily upon the determination of the precise causes and the contributory conditions. To this end, engineers of the bureau investigated all coal-mine explosions during the past year and, where the circumstances justified, laboratory studies or tests at the experimental mine at Bruceton, Pa., were made to aid in determining the probable cause, the means of propagation, and the factors tending to retard the progress of the explosion.

A bulletin, entitled "Causes of and Lessons from 218 Coal Mine Explosions," embracing data from and abstracts of the reports of the bureau engineers who investigated the disasters, is now in course of publication.

To aid in preventing explosions, bureau engineers, with the active cooperation of coal-mine operators, made investigations at various mines to study conditions and practices that contribute to the liability of an explosion of gas or coal dust, even though the mine might not have had a disaster. Such studies resulted in confidential reports to the operators; the reports contained recommendations for minimizing the explosion hazard of the mines.

Rock-dusting of coal mines.—Investigations of the bureau have demonstrated the effectiveness of rock-dusting as a preventive of disastrous explosions in bituminous coal mines, and mines throughout the country are adopting this precaution. The bureau is endeavoring to obtain additional data on rock-dusting wherever possible, and to give the coal-mining industry the benefit of its extensive research.

The scenes for a motion-picture film entitled "Story of Rock-Dusting" were photographed at a large bituminous mine in Illinois and at the bureau's experimental mine near Bruceton, Pa.

Chemists at the Pittsburgh experiment station made analyses of a large number of samples of shale, limestone, dolomite, gypsum, and other materials that coal-mine operators submitted for examination to determine the suitability for rock-dusting. The methods the chemists devised for these analyses, and a table giving the composition of all samples of shale submitted, were published as a chapter in Bulletin 21, Mining and Metallurgical Investigations of the Carnegie Institute of Technology and the Bureau of Mines.

Inflammability of coal-dust particles.—Data on the inflammability and the characteristics of combustion of fine dusts, similar to the data already known for gases, are greatly needed. Experiments at the Pittsburgh station, in which coal dusts of graded fineness were

blown into a flask and ignited by a white-hot body, showed that exceedingly fine dust is less inflammable than somewhat coarser dust. This result, published in Bulletin 22, Mining and Metallurgical Investigations of the Carnegie Institute of Technology and the Bureau of Mines is contrary to expectations and no doubt depends in considerable degree on the laboratory technique employed. Further progress in this study depends on improved methods of experimentation, and a systematic effort is being made to develop the necessary improvements.

Coal-mine fires.—The bureau investigates all serious mine fires that are brought to its attention, seeking to obtain data on how the fires occurred, and what fire-fighting methods were employed. The data obtained are used in publications on the subject and serve as a guide for the control of the mine-fire hazard.

On three occasions during the year the analysis of gases from fires was employed to obtain information concerning mine fires that followed explosions. This information was considered in planning and carrying out rescue and recovery operations. Simultaneously, much information was obtained that will aid a better understanding of mine fires and indicate their progress.

The laboratory of gas investigations at the Pittsburgh station continued to serve the bureau engineers and investigators, State mining departments, and mine operators by analyzing gas samples collected in connection with research on and investigations of mine fires and explosions. Chemists from the laboratory visited two mines at which explosions had occurred, also other places where immediate results were needed, and made analyses there.

During the year 1,082 samples were received and analyzed: the analyses involved 12,856 determinations. The results of the analyses furnish data for reports written by the bureau's investigators, for advice to mine operators, and for control of test mediums in approving mining machinery and equipment.

Catalysis of methane.—A study of the oxidation of methane by aid of simple catalysts was conducted under the fellowship agreement with Carnegie Institute of Technology. The primary object of this work was to obtain information that might be of use in developing a detecting or indicating device to be used in conjunction with miners' electric cap lamps and would warn the miner if he entered dangerous concentrations of methane in mine workings. The development of a device of this kind would eliminate to a marked degree the use of the flame safety lamps, which (mainly through misuse) have been the source of ignition for many explosions and disasters.

Work in the experimental mine.—At the experimental mine at Bruceton, Pa., near Pittsburgh, various tests relating to gas and dust explosions are made, and other special investigations are conducted. During the past fiscal year the chief investigations were:

(*a*) Large-scale explosion tests of coal dust and gas to determine their explosibility under various conditions. During the year 122 explosion tests were made, the largest number ever run in one fiscal year. Tests were also made to determine roughly the explosibility of oil-shale dust. An extensive report on the coal-

dust-explosion testing at the experimental mine was completed and is now in press. A report on tests of coal dust from four Utah mines is in course of publication.

(*b*) The testing of two types of rock-dust barriers was completed and the testing of a third was begun. These tests were made to determine whether the barriers were effective in stopping explosions of coal dust and the efficiency of the barriers in comparison with those developed by the Bureau of Mines. Another purpose of the tests was to develop a standardized method of testing, for use in a schedule of tests for the official approval of barriers.

(*c*) Tests of the efficiency of rock-dusting and the methods of applying generalized rock dusting to prevent ignition and propagation of explosions of coal dust, and of coal dust and gas, were carried on in the mine. Bureau engineers made investigations in commercial mines for purposes of comparison.

(*d*) Results of tests to determine the coefficient of friction of ventilating currents have been compiled in a report entitled "Ventilation Factors in Coal Mines," which has been submitted for publication.

(*e*) Tests to determine the speed of uniform movement of flame in mixtures of natural gas and air and other gases were made in a tube 12 inches in diameter and 100 feet long. This work was done in cooperation with the British Safety in Mines Research Board, and is to be followed by more extensive tests that will give information on fire-damp explosions in mines, the comparative effect of mixtures of methane and of natural gas with air, and the conditions under which such explosions stir up and ignite coal dust. The testing of mixtures of natural gas and air, with ignition at the open end of the tube, was completed and the testing of other hydrocarbon gases was begun.

(*f*) Tests of the strength of mine stoppings to resist explosions, begun at the request of the leasing section (now under the United States Geological Survey), were completed in the experimental mine so far as was practicable, and an informal report was submitted. However, further testing was deemed advisable and as it was believed that this could be done more rapidly in a surface gallery, plans were made, material ordered, and construction begun for such a testing gallery at the Bureau of Standards, in Washington, D. C.

(*g*) Laboratory studies of coal-dust explosibility. The laboratory-size steel gallery for tests of coal dust was moved into new quarters at the Pittsburgh station and tests were run to determine the variations of length of the flame of black powder, with pure coal dust present and with coal and rock dust present. Plans were made to attempt ignition by other sources than the flame of black powder. Reports were prepared on the explosibility of mine dusts from 17 mines. Five kinds of miscellaneous dusts were also tested for explosibility.

Cooperation with mines safety research board.—Cooperation with the mines safety research board of the British Mines Department continued during the year.

Large samples of coal were exchanged to determine the apparent discrepancies between the results at Bruceton, Pa., and those obtained in the Eskmeals gallery, England. A 10-ton sample of Altofts

silkstone coal, the standard coal used in experiments at Eskmeals, was sent to Pittsburgh and dust from it was tested in the experimental mine. A similar large sample of Pittsburgh coal, the standard coal used at Bruceton, was sent to Eskmeals, and the dust tested in the gallery there in order to compare directly the behavior of the two dusts. The comparison was made on the basis of the amount of rock dust necessary to render the coal dust inflammable under various conditions, with and without the presence of fire damp.

Researches at Pittsburgh relate to the propagation of flame in methane and air, natural gas and air, and various components of natural gas. The tests were conducted in laboratory tubes, and at the experimental mine, in a gallery 6 feet in diameter and 100 feet long.

A member of the Bureau of Mines went to Great Britain in August, 1925, to compare the constitution of coals of Great Britain with that of coals of the United States.

During the fiscal year the cooperators prepared two reports on the work done during the preceding year. These have been published by the safety in mines research board of the British Mines Department as No. 13, Stone Dust as a Preventive of Coal-Dust Explosions; comparative tests, and No. 14, Coal-Dust Explosions: The Effect of Release of Pressure on their Development.

Chemical action of electric spark.—An intensive study of the chemical action of the electric spark on inflammable gases and gas mixtures in air was conducted at Pittsburgh. The sparks used were from inductive circuits and from condensive circuits, and were just below the intensity that would cause ignition. Counted thousands of such sparks were passed in order to cause measurable changes in the gas and to evaluate the effect of single sparks. The results show the nature of the chemical changes induced in the gas mixtures and the extent of the change caused by sparks at the border line of gas explosions. The data are fundamental and bear directly on some causes of mine explosions.

Electrical equipment in mines.—Investigations on the use of electrical equipment in mines, the use of flame safety lamps and gas-detecting apparatus, and studies of underground communications were conducted at the Pittsburgh experiment station. A large proportion of the work of the electrical section was performed under schedules that define permissible equipment and give the tests that the equipment passes before it can be approved as permissible. Permissible schedules have become essential in guiding the efforts of the bureau, in giving the manufacturer of safe equipment a definite goal, and in placing the work of approval on a firm foundation. During the year the bureau issued 16 approvals of mining equipment and apparatus and issued 155 extensions of approvals.

The bureau's permissible list covers virtually every line of activity for which equipment is used in underground coal mining. Electrically operated pumps and coal-loading outfits were added to the bureau's list of approved devices during the year. Manufacturers are giving more and more attention to the designing of permissible mining machinery and the bureau looks forward to the time when operators will be able to equip their mines completely with apparatus that has been tested by the bureau and listed as permissible.

Mine safety board.—The mine safety board was established on May 20, 1924, to consider questions arising within any division of the bureau that require definition of the bureau's collective opinion as to safety practices, safety devices, or safety methods for underground or open-pit mining.

Three decisions of the board were approved during the past year. The first recommends the use of permissible portable electric mine lamps as portable lamps for illumination in all coal mines and the use of permissible magnetically locked flame safety lamps, or equivalent permissible devices, for the detection of inflammable gas. The second recommends the exclusive use of permissible explosives, fired electrically, for blasting in coal mines and the cutting or shearing of coal. The third recognizes that all coal mines are potentially gassy, but recommends for administrative purposes, in respect to the prevention of explosions and fires, three classes of mines—practically nongassy, slightly gassy, and gassy; it specifies the limits of the several classes and the methods of determination by chemical analysis or gas detectors.

Underground communication.—Studies recently completed by engineers of the Pittsburgh station have demonstrated that voice signals can be transmitted in and out of a mine, through more than 400 feet of strata, by the use of dry cells as a source of electrical energy and of modified telephone parts as receiving and sending apparatus. The feasibility of conducting a conversation through considerable depths of earth strata has been proved. Further experiments are needed to determine the best methods of applying these principles to actual conditions in mines and to improve the apparatus for practical use in mine rescue and recovery work. The development of practical means of communication between miners entombed after mine fires and explosions and rescue parties on the surface would naturally be of the greatest aid in the conduct of mine rescue operations.

Metal-mine fires.—During the year bureau engineers assisted in controlling two metal-mine fires, one in the Spruce mine of the Oliver Mining Co., Eveleth, Minn., the other in the Utica mine, Pickands, Mather & Co., Hibbing, Mich. Investigations were made later to determine the cause of each fire and to obtain data on means of preventing similar fires.

Permissible explosives.—As investigation had shown that the use of unsafe explosives had caused many mine disasters, the Pittsburgh experiment station, in 1908, began making tests to ascertain what classes of explosives were least likely to ignite inflammable gas or coal dust. As a result of these tests the Bureau of Mines has approved certain explosives with short, quick flames as permissible for use in gassy or dusty coal mines. Tests of explosives to determine their permissibility for use in coal mines, and tests of other explosives to determine their suitability, are made at Bruceton, Pa. During the year 23 explosives were added to the active list of permissibles, and 23 were transferred to the inactive list. On June 30, 1926, the active list contained 151 explosives.

In order to check the permissibility of explosives as used in mines, 47 samples of different permissibles were collected in the field and tested at Bruceton.

Tests were made to determine the effect of confinement and priming on the rate of detonation of gelatin-type permissibles.

Explosives used in metal mines.—Explosives used in metal mining were tested at the explosives chemical laboratory, Pittsburgh, in order to coordinate their physical characteristics with the results obtained in mines. During the year special tests of 36 explosives were made.

Factors affecting safety of explosives.—To the end that yet safer explosives and blasting methods may be developed, the Bureau of Mines is investigating the factors that affect the liability of an explosive to cause ignition of gas or coal dust. How the chemical composition, physical characteristics, and explosive properties of the explosives themselves, and also the methods of loading them in the bore hole, affect ignition are being investigated in the testing gallery. Results have shown that for explosives of identical chemical composition, those having the higher rates of detonation are more likely to ignite gas. Wet fire-clay stemming or fine rock-dust stemming are safer than dry fire clay. Coal-dust stemming is more dangerous than no stemming at all. The relation between limit charge and concentration of gas has been studied, and the lower limit of the inflammability of natural gas by explosives has been determined.

Photographing the flame of an explosive.—As the duration of the flame from a permissible explosive is less than one one-thousandth second, the use of photography in the study of the flame is particularly desirable. A new method of measuring the rate of detonation or speed of an explosive has been developed, in which a photograph of a detonating column of explosive is taken on a rapidly moving film. The means by which detonation is propagated from one cartridge to another across an air gap has been investigated and the speed of this "shock wave" measured. Photographs of the flames produced when charges of explosives are fired from a cannon show graphically the increased safety of certain explosives and certain methods of loading. A large gallery has been constructed in which the ignition of gas and coal dust by explosives will be studied photographically.

Gases produced by detonation of explosives.—In the course of its study of mine explosives during former years the bureau developed an apparatus for studying the products of detonation under conditions simulating actual mining practice and made tests of a number of typical permissible explosives to determine the effect of confinement on the production of poisonous gases.

During the past fiscal year the bureau has made tests to determine the effect of coal dust on the poisonous and combustible gases produced, the effect of different methods of loading in the bore hole, and the effect of the use of different materials for stemming.

Explosibility of ammonium nitrate.—Disastrous explosions have happened at plants making ammonium nitrate, extensively used in mining and military explosives and in the manufacture of fertilizers. In cooperation with the National Research Council, the Bureau of Mines has studied the properties that influence the safety of ammonium nitrate in storage, handling, and use. Previous investigations by the bureau have shown that ammonium nitrate is not combustible, supports the combustion of oxidizable materials, is not readily deto-

nated by heat, but can be detonated by a No. 8 detonator. The sensitiveness and rate of detonation increase at higher temperatures, and detonation is aided by increased confinement.

A study of the explosions at plants manufacturing ammonium nitrate has led to the belief that combustible materials play an important part in the cause of these explosions. During the past fiscal year the investigation was continued to determine the effect of small quantities of certain easily combustible materials on the explosibility of ammonium, with special reference to the cause of disastrous explosions.

TEACHING SAFETY TO THE MINER

Rescue and first-aid investigations and training work.—The duties of the engineers, foreman miners, and first-aid miners of the mine safety service comprise chiefly: Rendering aid at mine disasters, training miners in rescue and first aid, conducting field contests in first-aid and mine-rescue methods, giving exhibits and demonstrations of the bureau's safety work, and making written reports to mine operators, through the Director of the Bureau of Mines, on safety conditions in mines examined at the operator's request. Various oil and steel companies have evinced much interest in this work, and a great many of their employees have been trained. The number of men trained in first-aid and mine-rescue methods by the bureau during the fiscal year totaled 28,041, of whom 24,224 received training for the first time and 3,817 were given additional training. The great interest in this work is shown by the fact that in 1925 the number of men trained was 3,866 more than in 1924. Since the beginning of this work the bureau has instructed 167,223 miners, and has also given instruction to many city firemen, Boy Scouts, scholars of public schools, and members of organizations not connected with the mining industry. During the past year this training was carried on in 33 States and in Alaska.

An important duty of the mine-safety service is to inspect rescue apparatus owned by mining companies, when the companies request this inspection, and to give advice, when desired, on the condition of the apparatus and the repairs needed. Such inspection is important because rescue apparatus and parts are particularly subject to deterioration, yet they have to be used in irrespirable atmospheres during an emergency or disaster. Unless an apparatus is in proper condition, the life of the wearer is imperiled.

To aid the improvement of safety conditions at small mines that are not able to maintain a safety organization, the engineers assigned to the mine-safety cars have examined many of these mines with the object of furnishing the operators written reports containing recommendations on such modifications of methods and equipment as will lessen the risk of accidents and improve health conditions.

State and local first-aid meets.—Numerous successful State, local, and company first-aid meets were held during the fiscal year. Some of these meets were directly under the auspices of the Bureau of Mines, and Bureau of Mines engineers, foremen, and first-aid miners actively assisted in preparing teams for meets. The Bureau of Mines international first-aid and mine-rescue meet, at Springfield,

Ill., was one of the most successful ever held, and was attended by a large number of mining men.

Assistance at mine disasters.—During the year the mine-safety service rendered assistance at 38 accidents, 36 of which were in coal mines and 2 at metal mines. The four major accidents of the year—at Irondale, Ala., Wilburton, Okla., Helena, Ala., and Horning, Pa—killed 190 men. As an outcome of these disasters, safety measures have been adopted and are being put into effect in many of the mining States.

Safety extension service.—The safety extension service, a subdivision of the safety service, was established by administrative order July 1, 1925. Its chief functions are to bring before the industry the bureau's recommendations on rock-dusting bituminous coal mines, the use of closed lights, advanced mine-rescue training, mine-safety organization, and the purpose of the Holmes Safety Association; and to conduct field demonstrations of the explosibility of coal dust and the use of rock dust as a preventive of mine explosions.

Field demonstrations of the explosibility of coal dust and the use of rock dust were given in Alabama, Illinois, Kansas, Pennsylvania, West Virginia, Oklahoma, and Ohio. Large gatherings of mine officials, miners, State mine inspectors, and others witnessed these demonstrations. The results of such demonstration work are difficult to measure, but the bureau has noted instances of mines beginning to use rock dust after demonstrations had been given.

Advanced training in rescue work after mine fires and explosions was given at Orient, Boswell, Spangler, and Ehrenfeld, Pa.; Thomas and Glen White, W. Va.; and Gillespie, Ill. In addition, the entire inspection force of the State of Ohio was trained at Nelsonville, Ohio. A total of 211 mine officials, State inspectors, and others completed the full course of instruction, which consisted briefly of lectures and demonstrations on the detection, sampling, and analysis of mine gases, and on devices used to protect miners from the gases found in mines after fires and explosions. In addition, the crews trained were given a thorough drilling, including work underground, on proper organization and procedure in the event of an explosion or fire.

A standard system of safety organization for mines was advocated vigorously. State-wide safety conferences were held in Indiana, Illinois, Kansas, and Iowa, at which this standard plan was presented.

In addition, the safety extension service strongly advocated a "No-Accident Prevention Campaign" for the entire coal and metal mining industry. Some of the coal-mining States began such a campaign during the year.

Holmes Safety Association.—The Joseph A. Holmes Safety Association, named in honor of the first director of the Bureau of Mines, has among its members thousands of miners who are making special efforts to advance safety in mining. During the year excellent progress was made in aiding the advancement of the work of the Holmes Safety Association. Thirty new chapters were organized—13 in Pennsylvania, 11 in Alabama, 2 in Wyoming, 2 in Kansas, 1 in Missouri, and 1 in Oklahoma.

A new constitution covering the activities of the Holmes Safety Association was prepared. In brief, this organization has local chapters in mining communities, district councils to assist local chapters in their work, State councils, and finally a national council. The president of the national council is the director of the Bureau of Mines. Under this new plan three new councils have been organized, the first at Uniontown, Pa., the second at Greensburg, Pa., and the third at Barnesboro, Pa. Preliminary work on the organization of such district councils has been done in other parts of Pennsylvania. In addition to the above councils there is a combination State and district council in Alabama which covers the activities of the 38 chapters distributed throughout the mineral regions of Alabama. On July 1, 1926, there were 168 Holmes Safety chapters distributed throughout the mineral regions of the country.

HEALTH, SANITATION, AND VENTILATION

Ventilation of metal mines.—Temperatures, humidity, air movement, and quality of air were studied in eight of the larger metal mines in Nevada to obtain data for the betterment of working conditions underground.

In many deep mines the natural heat of the surrounding rock makes the atmosphere in the lower levels hot and humid. The possibilities of local cooling of the air of those working places and thus promoting the comfort and efficiency of miners are being studied in the mines of the Anaconda Copper Mining Co. at Butte, Mont.

Although natural draft is an important factor in the ventilation of deep mines, little is known about it except in theory. Investigations are being made to confirm the general theory, to ascertain what difficulties may be encountered in applying experimental data, and to determine the effect of natural draft on the operation of mine fans. Tests of natural ventilation have been made at Butte, Mont., for a variety of mine and climatic conditions. A fan is being installed and during the coming year with the fan in operation the tests will be repeated.

The theory of the operation of mine fans in combination has never been definitely established by experiment. Studies to obtain data on this subject and on the operation of fans in general are in progress. Small fans and piping have been installed in a surface laboratory where experiments on the general subject of fan testing are in progress. These are to be followed by laboratory tests of small fans in combination, and, as opportunity permits, the data will be confirmed by tests of large fans.

Bulletin 261, The Resistance of Metal-Mine Airways, is in press.

In many places metal-mine workers are seriously menaced by harmful dust and lack of ventilation. This condition reacts unfavorably on health, safety, and efficiency. To obtain comprehensive and reliable data, the Bureau of Mines for some time has been studying conditions in various metal mines throughout the country.

Work in some mines at Cripple Creek, Colo., has been hindered for years by inflows of irrespirable gas from the inclosing rock. Lives had been lost and mining has been interrupted repeatedly. The extent, character, and quality of the gas are now being studied

in the attempt to develop effective yet commercially feasible methods of combating it. Data have been obtained as to its probable chemical origin, its occurrence and composition, and the methods used to control it. As part of this study, barometric and thermometric observations will be made for a period of several months during the coming year.

Coal-mine ventilation.—Two reports, entitled "Coal-Mine Ventilation Factors," and "Indiana Coal-Mine Ventilation Tests," are in course of publication.

Samples of brattice cloth woven according to specifications supplied by the textile section of the Bureau of Standards have been placed in three different Pennsylvania mines for service tests and for comparison with the jute brattice cloth already in use.

Development of new respirator.—Chemists at the Pittsburgh station have studied various types of respirators designed to protect wearers from injurious dusts encountered in mining and other industries. They tested many of the respirators now in use, and many fabrics and filtering materials, including cheesecloth, canton flannel, bleached and unbleached muslin, filter paper, and absorbent cotton. A new respirator developed as a result of this work has proved serviceable over an extended period, and for reasons of efficiency, low resistance, and comfort is preferred by bureau employees engaged in the dusty work of sampling coal, slags, ashes, rock dusts, and minerals.

A new carbon monoxide recorder.—A carbon monoxide recorder developed at the Pittsburgh station has given excellent service in a number of fields. One recorder installed at the Liberty tunnels in Pittsburgh was discontinued after continuous records for a year showed the ventilation was good under all conditions of traffic; at no time did the carbon monoxide of the tunnel atmosphere exceed 4 parts in 10,000 parts of air; usually it ranged about 1 part. Several gas manufacturers and organizations that have had recorders made after the designs and specifications of the Bureau of Mines report that the recorders have proved satisfactory.

Work on the adapting of the recorders to gases containing high percentages of carbon monoxide and to flue gases from boilers has continued, and recorders are being tried in the investigations of the bureau's fuel-testing laboratory.

Physiological effects of abnormal atmospheric conditions.—In cooperation with the United States Public Health Service and the American Society of Heating and Ventilating Engineers, the Bureau of Mines, at its Pittsburgh experiment station, has been studying for some years the physiological effects of abnormal atmospheric conditions on workers in mining and other industries. Results of investigations in humid atmospheres at temperatures of 45° to 70° F. were thus summarized for the International Critical Tables for 1926:

> At rest in still air with a temperature of 65° to 70° and with 100 per cent relative humidity, subjects stripped to the waist felt from slightly cool to comfortable; under these same conditions with moderately hard work, they felt comfortable. At rest in still air with temperatures from 55° to 60° 100 per cent relative humidity, clothing was required for comfort, while

at moderately hard work under these conditions the subjects were comfortable to cool stripped to the waist, and at 45 to 50° subjects working moderately hard felt cool stripped to the waist.

A point of interest was the extent to which clothing decreases the cooling power of the air at such temperatures as are frequently met. At the ordinary dry-bulb temperature of 70°, with an air velocity of 300 feet per minute, clothing reduces the cooling by 52 per cent. Approximately the same percentage reduction holds true for velocities higher than 300 feet, but for lower velocities the decrease in cooling effect is greater. In general, it was found that at normal humidity the cooling effect of wind is half as much when normal clothing is worn as when only light trousers, socks, and shoes are worn. On the other hand, clothing in a number of instances proved to be advantageous in increasing the loss of heat by evaporation and decreasing the gain of heat by radiation and convection.

Sanitary surveys of mining towns.—Acting assistant surgeons of the Public Health Service continued their sanitary surveys. They gathered data on housing and sanitation in connection with the new oil-shale plant of the Bureau of Mines at Rulison, Colo.; investigated water supplies at several mining towns and camps; and held conferences with State officials in regard to improving the sanitation of mining camps in the State of Utah. A report on sanitary conditions in the State of Alabama was published as Reports of Investigations, Serial 2746. During the past few years the larger mining companies in Alabama and the State Board of Health, through the county health units, have been actively promoting sanitation until all mines of any size are conducting some work to increase health, and the larger companies have extended their activities to cover all phases of health and welfare work.

Lead poisoning in the mines of Utah.—Results of the study of lead poisoning in the mining of lead carbonate ores in the mines of Utah are to be published as Technical Paper 389. The investigation showed that lead poisoning among miners has been more common than was thought. Although the carbonate ores are the most frequent cause of this poisoning, the sulphide ores may cause poisoning when mined dry and in places where ventilation is poor. The investigation also showed that virtually all lead poisoning among miners was due to inhaled lead dust, and that this poisoning can be reduced to a minimum by wet drilling, by sprinkling the muck piles before loading, and by efficient ventilation. Also proper medical supervision will do much to prevent the development of the chronic cases of lead poisoning that were once so common.

Causes of death among miners.—A study of the causes of death among miners was continued. Data have been collected from the records of the States of Nevada, California, Colorado, and Wyoming, and partly collected in Alabama and Utah. The study is being made to ascertain the diseases and the types of accidents most prevalent among miners (the data to be used in devising measures of protection), and is to be continued until information is available for all mining districts in the United States.

Oil pollution of navigable waters.—A report of the work done, together with reports of the other cooperating agencies, formed the

interim report of the interdepartmental committee to the International Conference on Oil Pollution of Navigable Waters, which was called by the President of the United States and met in Washington, D. C., June 8 to 16, 1925. Representatives of the Bureau of Mines and of the United States Public Health Service attended these conferences, in which delegates from Belgium, Great Britain, Denmark, France, Germany, Italy, Japan, Netherlands, Norway, Portugal, Spain, and Sweden participated. The plenipotentiaries appointed by these Governments agreed to certain restrictions on the discharge of oil in navigable waters. Some of the more important restrictions were as follows:

1. The respective Governments may establish areas in waters adjacent to their coasts within which discharge from certain specified vessels of oil or oily mixtures, as defined, shall be prohibited, in accord with the following principles:

(*a*) In the case of coasts bordering the open sea, such areas shall not extend more than 50 nautical miles from the coast, except that, if such extent is in particular instances found insufficient because of peculiar configuration of the coast line or other special conditions, such areas may be extended to a width not exceeding 150 nautical miles.

(*b*) In case a Government desires to prescribe a particular area any part of which may be within 150 nautical miles of the coast of any other country, that Government shall consult the Government of such other country before the area is prescribed.

(*c*) Due notice of the establishment of any area or areas shall be given to the Governments of maritime states, in the form of charts or otherwise, by the central agency established for this purpose.

2. The discharges which may be prohibited in any area prescribed are (*a*) crude, fuel, or Diesel oil, or (*b*) any mixture of such oil and water containing more than 0.05 of 1 per cent of oil, or having an oil content sufficient to form a film on the surface of the sea visible to the naked eye in daylight in clear weather.

3. The vessels which may be affected pursuant to the above provisions are all seagoing vessels other than war vessels, carrying crude, fuel, or Diesel oil, in bulk as cargo or as fuel for boilers or engines. Special provisions may be adopted to meet the case of small vessels of limited bunker capacity, but such vessels shall be required to take all reasonable precautions to prevent oil pollution.

4. The respective Governments agree to take the necessary measures to ensure that vessels classed as war vessels shall take every possible precaution to prevent oil pollution.

Physical and X-ray examinations of miners.—Physical and X-ray examinations of miners to determine the physiological effects of the various conditions encountered in different mines were continued in connection with the work on dust and ventilation. During the year about 800 physical and X-ray examinations of miners were made in the Tri-State district of Kansas, Missouri, and Oklahoma, and in Alabama. A large amount of valuable data has been obtained from the coal and iron mines of Alabama, the lead-zinc mines of Oklahoma, and the gold mines of Nevada and California.

Studies of stream pollution.—In the study of the disposal of waste waters from mines, the drainage from a number of mines on two small watersheds in different parts of Pennsylvania was traced until a sizable stream of water was reached, the quantity of water at different seasons of the year and the extent of the pollution were determined, and the cost for treatment was estimated.

A summary of part of the work done was published as Serial 2725, Stream Pollution by Acid Mine Drainage. Some of the conclusions drawn from the study are as follows:

1. For mine drainage wastes the only solution is neutralization by some means. This may or may not result in recovery of salable by-products.
2. With present-day practice the question of waste disposal resolves itself simply into one of two things—whether it is more economical, everything considered, to treat these wastes at their source, or to bear with the damage done by them later, if untreated. Before a decision can be made, it seems advisable to investigate suggested methods further with the idea of obtaining more accurate data on costs and practicability in general. It is evident that the cost of neutralization of mine waters would necessarily be added to the cost of the coal to be paid by the consumer.
3. The problem is not one that can be easily solved, and regulations governing disposal are too important and far-reaching in effect to permit of hasty or ill-considered action. Undoubtedly further work should be done, as there are no data available except for more or less limited or local conditions.
4. Methods now suggested should be tried if possible at some place where most difficult conditions are likely to be encountered, in order to determine whether they are practicable.

Results of a study, made in cooperation with the United States Public Health Service, of "Stream Pollution by Wastes from By-Product Coke Ovens" were published in Public Health Reports for September 26, 1925. This paper summarizes the results of the work on the disposal of phenol wastes as follows:

1. The discharge of phenol wastes into streams may create a serious public nuisance by the effect of these wastes upon municipal water supplies, fish, etc.
2. In the absence of preventive measures, this nuisance will tend to increase as a result of the expansion of the industry.
3. Various methods have been more or less fully developed for preventing nuisance in the disposal of these wastes. They may not yield a profit to the industry, but are practicable at a cost that does not seem unduly burdensome.
4. Unless one or two processes patented in Germany for phenol recovery by benzol scrubbing prove otherwise, coke quenching seems to be the best and most efficient method for phenol-bearing waste disposal.
5. At least one method of benzol scrubbing seems promising enough to be tried out on a practical scale.
6. In view of the serious character of the nuisance resulting from the discharge of these wastes, it seems proper that industrial concerns should be required to keep them out of streams.
7. There is some promise of the development of some methods now in the experimental stage which may enable manufacturers to achieve this result at less cost than at present.

Approval of new gas masks.—The Bureau of Mines has developed various types of masks for protection against noxious gases and fumes that may be present in atmospheres encountered in mines, metallurgical or chemical works, and other places.

Two gas masks were approved during the fiscal year. They are the All-Service gas mask, approved July 1, 1925, and the GMD ammonia gas mask, approved March 10, 1925. The All-Service gas mask is devised to afford protection in air against all gases, vapors, and smokes. Gas masks do not, however, supply the oxygen necessary to life and hence can not protect the wearer from atmospheres deficient in oxygen. They can only remove relatively small percentages of poisonous gases in air that is otherwise suitable to breathe.

Ethyl gasoline.—The investigation of the health hazards in the use of ethyl gasoline was terminated after two years of work. The results indicate that as far as can be determined from experiments

with animals there is no apparent danger from the normal use of ethyl gasoline. This conclusion is in agreement with the findings of the Surgeon General's committee.

Use of synthetic atmospheres by divers and caisson workers.—Experiments on the use of synthetic atmospheres (helium-oxygen mixtures) in compressed-air work, conducted by the Bureau of Mines in cooperation with the Navy Department, have demonstrated the value of these mixtures in increasing the efficiency of divers and decreasing the hazard to their health. Salvaging operations on the steamship *Lakeland* and U. S. submarine *S–51* occupied the larger part of the time of the personnel. During these operations it was possible to try out certain findings, the main ones being slight changes in decompression schedules and, recently, the use of helium-oxygen mixtures during decompression. The inside inspection of the *Lakeland* was done in approximately 190 feet of water with no injury to divers. This is the first time that such extensive work has been done at that depth.

Research work at the Pittsburgh station has been confined to the rate of saturation and desaturation of the blood during compression and decompression. The results give new information on this subject and point to the necessity of changes in present schedules for decompression.

A paper published in Anesthesia and Analgesia, for June, 1926, summarizes some of the results of this investigation as follows:

1. Oxygen poisoning, produced by breathing high partial pressures of oxygen, can be prevented by controlling the amount of oxygen present in the atmosphere supplied to animals exposed to high barometric pressures.
2. Helium-oxygen mixtures can be breathed by men without apparent discomfort and by animals without demonstrable ill effects.
3. A helium-oxygen atmosphere theoretically has an advantage over a nitrogen-oxygen atmosphere for persons exposed to high barometric pressure, as divers and caisson workers, due to the fact that helium has a lower coefficient of solubility and a greater diffusivity than nitrogen.
4. Animals exposed to 10 atmospheres of helium-oxygen mixture for one to five hours can be decompressed in one-third to one-fourth the time necessary for animals exposed to nitrogen-oxygen mixtures at the same pressure and time to obtain similar physiological effects.
5. The possibilities of the use of the helium-oxygen atmosphere may be for extended depth and time of submarine operations; also for the prevention of caisson disease in tunnel and caisson workers, and by using the mixture as a wash gas during decompression among tunnel workers.

EFFICIENCY IN MINING

Coal-mining methods.—The bureau is studying the mining methods used in the anthracite region of Pennsylvania. A bulletin entitled "Mining of Flat Thin Beds in the Anthracite Region of Pennsylvania" is in course of publication. Collection of data on the mining of highly inclined beds is in progress.

Studies of the mining of coal at the face in typical Alabama coal mines are being made with the object of formulating recommendations for improved practice.

To determine the character and extent of the ground movement caused by mining and the robbing of pillars in coal mines, a number of monuments have been placed on the surface above a Wyoming mine where pillars in a pitching coal seam are being drawn.

Changes in the elevation of these monuments are being determined at regular intervals.

An investigation of underground loading devices for coal mines was made under a cooperative agreement with the Carnegie Institute of Technology, which is publishing the results as its Bulletin 28, Mechanical Loading for the Coal Mines of the Pittsburgh District.

Coal-mine leases.—An investigation of the leasing of coal lands in Illinois was completed. Reports entitled "Coal Mine Royalties and Leasing Conditions in Williamson and Franklin Counties, Ill.," and "Coal Mine Royalties and Leasing Conditions in Vermilion and Edgar Counties, Ill.," were published by the Bureau of Mines as Reports of Investigations, Serials 2726 and 2743, respectively. A similar report covering Macoupin, Sangamon, and Montgomery Counties is in course of publication.

Efficiency in blasting coal.—The bureau is investigating the basic factors involved in breaking down coal at the face—those that govern the production of lump coal in typical mines working different coal beds. Results of two of these investigations have been published by the Carnegie Institute of Technology as Bulletins 11 and 19 of the cooperative coal-mining investigations. Improvements in details of practice effected an 8.5 per cent increase in the proportion of lump coal produced. Results of a third investigation, made in cooperation with a coal company in southern Illinois, were published as a report of investigations. Through the tests the company was able to increase its production of 6-inch lump coal and thus decrease the loss in the form of slack.

Iron-ore mining.—In certain parts of the Birmingham (Ala.) district special methods of development and mining must be employed to mine ore that is badly folded and faulted. A report being prepared contains recommendations on methods of mining and handling the ore which give promise of ultimate successful application.

Mine drainage.—Work on drainage problems in the iron mines of the Birmingham (Ala.) district was completed, and a report is being prepared for publication. The work comprised a detailed study of rainfall and run-off, the source of the surface, subsurface, and ground waters, and their mode of entry into the mines. The effects of ground movement and mine subsidence on the formations overlying the ore bed and on the surface were also investigated, and the relation between all phases of the movement of water on the surface and underground, as well as the effect of mining upon drainage, were determined.

Blasting in metal mines.—The study of methods of blasting in metal mines of the Southwest was continued. A large number of test rounds in drifts were blasted to verify previous results and obtain additional data. A method was evolved for classifying ground in respect to explosive required, per foot of advance, to break drift rounds under the conditions existing at Bisbee, Ariz. Employment of such a system should make possible a more economical use of explosives. Data on the mechanics of breaking the drift rounds and the kind of stresses which the explosives must overcome were collected. Further work is planned in ground more difficult to break.

To determine the possibility of toxic gases being produced in the blasting of heavy sulphide ores, samples of the gases evolved were taken from a series of rounds. Analyses of these samples showed dangerous amounts of sulphur dioxide and hydrogen sulphide. Sulphur dioxide has been known in such gases, but the presence of the more toxic and dangerous hydrogen sulphide was not suspected until the sampling was done. This information should be of value to doctors who are called to treat cases of gas poisoning among miners blasting sulphide ores. A report of investigations, entitled "Gases from Blasting in Heavy Sulphides," gives the quantity of toxic gases produced with a variety of metal-mine explosives. The proportion of these gases in a mine atmosphere after blasting has a direct bearing on the provision of adequate ventilation.

A bulletin that describes various methods of drilling and blasting in the open-cut copper mines of the West and compares the costs is in course of publication. An investigation of the relation between primary and secondary blasting in such mines is contemplated for the coming year.

A technical paper, entitled "Accidents Due to Explosives in Metal Mines of the Southwest, as Shown by Records in Arizona," is in press.

Technical Paper 383, Blasting to Lessen Bowlders in Hard Ore Stopes, is in press.

Preservation of mine timber.—Field experiments on the preservation of mine timber are being conducted in cooperation with the Forest Products Laboratory of the Department of Agriculture and the Cleveland Cliffs Iron Co. Timbers treated with zinc chloride, with sodium fluoride, and with borax have been installed in permanent drifts of the Athens mine, Negaunee, Mich. To determine the effectiveness of the several preservatives the timbers will be observed periodically until they fail or become unserviceable. A report embodying the results will ultimately be prepared.

Liquid-oxygen explosives (LOX).—Much attention has been given recently to liquid-oxygen explosives, composed of liquid oxygen and a suitable absorbent. Such explosives are not suitable for use in dusty or gassy coal mines, but may possibly be employed in metal mining and in engineering work. Knowledge of the fundamental properties of liquid-oxygen explosives that was gained through experiments by the bureau at its Bruceton (Pa.) laboratory has been applied in the mines of the Cerro de Pasco Copper Corporation in Peru, where it was found possible to break hard ground with LOX. However, a disadvantage of the use of LOX underground is that sulphur dioxide is produced in the blasting of pyritic ores, and carbon monoxide is always produced except under the most favorable conditions. Open-cut mining seems to offer a more favorable field.

Experiments at the Bruceton (Pa.) laboratory during the year dealt with experiments to establish a relation between oxygen content and explosive strength of gas-black cartridges of varying size and density, gases produced by detonation of LOX, flame photography of LOX, effect of purity of oxygen on explosive properties, and tests to determine the suitability of a number of brands of fuse.

METALLURGICAL INVESTIGATIONS

IRON ORES—IRON AND STEEL

Beneficiation of high-silica iron ores.—Many iron-bearing deposits throughout this country have too low an iron content to be considered iron ores at present. This is especially true in the South. Consequently, the Bureau of Mines for some time has been investigating the concentration and beneficiation of low-grade ores to permit their use in present blast-furnace practice.

In the Birmingham (Ala.) district these ores may be divided into three classes—high-silica red iron ores, high-silica specular gray hematite, and low-grade brown ores. The bureau undertook to ascertain ways and means of reducing the silica content of the ores, although it realized that some time may elapse before concentration on a commercial scale is attempted by those companies that have ample reserves of good ore. To companies not so fortunate with respect to ore supply, the utilization of high-silica ores may become an urgent problem in the near future. As a result of the work it has now done on this problem, the bureau feels that enough fundamental data have been obtained to enable the industry, whenever it may desire, to devise commercially feasible processes for beneficiating these ores. In its experimental laboratory at Tuscaloosa, in cooperation with the University of Alabama, the bureau has worked out a process that it believes to be applicable.

Experimental blast furnace.—At its North Central mining experiment station, Minneapolis, Minn., the bureau has developed an experimental blast furnace for investigating, at much smaller cost than with full-size equipment, problems of vital interest to the iron industry. The furnace was developed to try out new raw materials and to obtain fundamental data on blast-furnace reactions and the melting of manganiferous iron ores.

Through holes at various levels in the furnace the reactions that occur within can be studied. Interesting data have been obtained on the relation between the descent of the stock and the combustion at the tuyère level. Promising research with the experimental furnace is being extended to commercial furnaces, and the data obtained are correlated with those from the experimental furnace. Results of test runs with this furnace indicate that by changes in design the construction and operating costs of commercial blast furnaces can be materially reduced.

Fundamental reactions in iron blast furnaces.—More knowledge of the fundamental reactions taking place in the interior of the iron blast furnace should lead to improvements in the smelting of iron. A clearer conception of the reactions between gases and solids is essential. Study of the flow of gases and stock should reveal how better contact between gases and stock can be obtained and more efficient working made possible.

During the fiscal year the bureau studied the composition of the furnace gases across a series of planes between the tuyère level and the stock line, the composition of the solid materials and the degree of reduction of the iron oxides removed from each plane, and also determined the temperatures and pressures at the various planes. A

similar study at a southern foundry furnace has been completed. For the purpose of extending the work, and mainly for obtaining com parable data, the second phase of the work is being conducted at a 700-ton northern furnace, where northern practice and conditions may be studied.

A number of investigations pertaining to the physical properties of coke and ore have been made. These have laid special stress on combustibility, reactivity with carbon monoxide, and the reduction of iron oxides.

A paper on the combustibility of coke points out that various cokes do not differ much in combustibility. The size of the coke has more effect on the length or shape of the combustion zone than do small differences in combustibility. The investigators believe that where coke is charged by volume, changes in density of the coke affect the rate of driving, and variations in this rate often may be attributed to the combustibility of the coke; they also believe that the capacity of the furnace depends on the rate of gasification of carbon at the tuyère, but this rate is limited by the speed of reduction in the upper part of the shaft. The rate of reduction is a function of the size of the ore particles. The work done by the bureau has shown that the flow of stock in the shaft is not uniform, and is regulated by the gasification of carbon in the localized zones of combustion at the tuyères. The capacity of the furnace may be increased by changes that permit better contact between gas and solid.

Ferromanganese from low-grade ores.—The dependence of the United States on imported high-grade manganese ores and manganese alloys is fully realized by steel makers and other users of manganese. Normally the high-grade manganese ore produced in this country furnishes less than 2 per cent of the total amount of manganese consumed. If the importation of high-grade manganese ore and the alloys produced therefrom were discontinued, numerous industries would be vitally affected. Steel makers consume by far the largest amount of manganese.

As a part of the work of the experimental blast furnace at the North Central station, the bureau has produced about 150 tons of an alloy containing 5 to 15 per cent manganese and averaging about 0.6 per cent phosphorus. The bureau is now endeavoring to ascertain whether metallurgical treatment can be developed for separation of the iron, manganese, and phosphorus. Preliminary tests indicate the iron can be reclaimed in the form of steel containing negligible amounts of sulphur; the manganese will be converted into an oxide and recovered in a slag that can be used as an artificial ore in the production of ferromanganese. This last phase of the work is the primary purpose of the investigation.

During the year further laboratory studies on various phases of several methods for producing ferromanganese from the low-grade manganiferous iron ores of the Cuyuna range have resulted in the formulation of a program for the coming year. The main object will be to investigate pyrometallurgical methods based on selective oxidation and selective reduction.

Direct production of steel.—In the past, considerable work has been done on direct processes for the production of steel, and numerous

patents have been granted. The Bureau of Mines has thoroughly investigated the production of sponge iron and the utilization of it in the form of pig iron and steel. The bureau is now making a survey of all the work done on direct processes, seeking to determine what fundamental information is needed to develop them. Gaps in the present fund of information will be filled through laboratory experiments.

The bureau is particularly interested in the use of noncoking coals in the reduction of low-grade ores. Although present supplies of good iron ore and coking coal seem adequate for the immediate future at least, any development that would utilize a noncoking fuel in connection with the metallization of low-grade iron ores would make available vast quantities of dormant materials—a matter of national importance.

The bureau, at its Northwest experiment station, developed an internally fired rotating sponge-iron furnace in which solid fuel mixed with the ore acts as a reducing agent, reduction being largely accomplished by gases generated within the bed or charge. A second type of process, on which the bureau has worked from time to time, involves the generation of a reducing gas and its subsequent circulation through an ore bed. This type of process is now being studied because the bureau has developed an internally fired furnace.

The development of such a process involves attention to methods of making strongly reducing gases—such as are generated in the tuyère zone of the blast furnace—and, secondly, to the quantity of gas required to reduce a pound of iron ore held at a known temperature. Lack of fundamental information may be largely responsible, it is believed, for the limited success of direct processes. At any rate, such information is essential to the development of properly designed equipment.

Work on this problem to date has consisted in passing measured quantities of gases through vertical columns of iron-ore particles of various sizes, held at known temperatures. More data are necessary to draw conclusions upon the relation between over-all rate of reduction and such factors as composition of gas, temperature of gas and solid, size and structure of ore particle, velocity and pressure of gas, uniformity of particle size, and the effect of spacers when fine ore is used.

Case carburizing of steel.—All manufacturers who employ case-carburizing processes have experienced annoying and sometimes costly trouble from certain batches of steel showing an erratic or abnormal behavior. Such steel may warp badly or have numerous soft spots on what should normally be a uniformly hard surface. Virtually all users and most manufacturers are vitally interested in knowing how these abnormal results may be avoided. Inasmuch as the trouble seems to be a result of the method manufacturing the steel, the problem comes within the scope of the work of the Bureau of Mines. The advisory committee on metallurgical work to the bureau and the Carnegie Institute of Technology recommended that this problem be studied.

Excellent progress has been made in a year of study. Tests have shown that virtually all abnormal steels can be made more nearly normal by suitable heat treatments, and that both normal and ab-

normal steels will have soft spots if improperly quenched, whereas proper quenching eliminates soft spots in both abnormal and normal steels. The degree of deoxidation has a vital effect on normality. Both normal and abnormal steels have been made under reproducible conditions. More work is necessary to prove the conclusions reached as to the cause of abnormal steel.

NONFERROUS METALLURGY

Milling in the tri-State zinc district.—The tri-State district, comprising parts of Missouri, Kansas, and Oklahoma, annually produces zinc and lead having a value of at least $50,000,000, and the milling loss is roughtly 35 per cent of the mineral in the crude ore. Almost all the zinc occurs as sulphide (blende) in a flint gangue. During the year the Mississippi Valley experiment station continued to investigate milling conditions in the district, with the object of improving present practice. Fundamental milling principles and possible improvements in the operation of the concentration devices already in use were studied. The two main sources of loss of zinc in the tri-State mills are the "chats" and the slime, hence the investigation of these losses has comprised the isolation of the chats and of the slime, and the treatment of each after isolation. Thorough desliming and flotation are solving the slime problem.

During the year, flotation was firmly established as an essential part of tri-State milling, and more progress was made in adopting it than probably in all previous years combined. This progress may be attributed to improved milling in the jig and table rooms and the extraordinary advance in the knowledge of flotation itself.

Determination of specific gravity of ores by sink-and-float method.—For some ores, a garnet "ore" for example, a chemical analysis is worthless, because the garnet contains no element that is not present in the gangue; the only method available for analyzing such ores is by the use of heavy solutions. For other ores the use of heavy solutions is sufficiently accurate and is much more rapid than chemical analysis. The sink-and-float method of studying ores opens a field that is new and is exceptionally important.

Several heavy solutions have been used. Some do not have sufficiently high specific gravities, some are decomposed by moisture absorbed from the air, some have too high a melting point, and others evaporate rapidly.

At the Mississippi Valley experiment station five iron ores, one garnet ore, and one fluorspar mill tailing have been studied to determine the possibility of gravity concentration. The sink-and-float method has been demonstrated in the laboratories of several fluorspar mills, where it is regarded with favor as being rapid and also accurate enough for mill control.

Two heavy liquids—acetylene tetrabromide and thallous malonate-formate—have proved most satisfactory. Acetylene tetrabromide, specific gravity 2.93, is liquid at ordinary temperatures; carbon tetrachloride or benzene may be used to dilute it to give lower gravities or may be used to wash out the acetylene tetrabromide from the sample of ore. Thallous malonate-formate, specific gravity up to 4.5, has a much wider range of gravity than acetylene tetra-

bromide and is soluble in water which is used as a diluting and washing agent.

Samples of various ores containing metallic and nonmetallic minerals are to be studied, and data compiled on the dissemination of the valuable minerals and the association of these with the gangue. It is proposed to collaborate the results of these sink-and-float tests with those of microscopic studies at the intermountain station.

Pyrite in flotation circuits.—To conduct investigations regarding the substitution of calcium cyanide in the differential flotation of zinc and lead and the possibility of using cyanide for the differential separation of copper minerals from heavy sulphite gangues, the Bureau of Mines during the year entered into a cooperative agreement with the American Cyanamid Co. The work already has demonstrated that cyanide either alone or in combination with other reagents is an efficient reagent in dropping pyrite in flotation circuits. Preliminary work has shown that cyanide can be used to advantage in eliminating pyrite from the flotation concentrate of certain copper ores.

Hydraulic classification.—During the past year the bureau, in cooperation with the Idaho Bureau of Mines and Geology, has investigated the hydraulic classification of mill feeds as related to table concentration.

The primary object of the work was to improve the efficiency of table concentration and to determine whether hindered-settling classification of the ore pulp would be beneficial in connection with treatment on tables. The work involved the determination of the basic principles of hindered classification, and development of a classifier that would embody these principles.

In laboratory studies of the density of sand and water mixtures, the mineral particles were agitated by uprising water in transparent columns and pockets. The information obtained led to the development of a new type of classifier. Commercial-size classifiers of this type are now being used in mills in the Coeur d'Alene lead-zinc district and elsewhere. The results show that proper classification of sands will increase table recoveries, improve the grade of the concentrate, and increase table capacity.

Crushing, grinding, and sizing of ores.—In order to aid the development of more efficient practice in milling, the bureau has undertaken to measure the work done in crushing or grinding ores. The problem involves accurate determination of the reduction of size of the particles of ore.

A method developed for measuring the surface of quartz particles depends on the rate of dissolution in hydrofluoric acid. The true surface of sieve-sized quartz has been determined for a series of sizes from minus 200 plus 270 mesh to minus 3 plus 4 mesh. The results show that the true surface is not a direct relation to sieve size. Surface measurement of different sizes of sieve-sized Ottawa sand, which is composed of rounded grains of quartz, shows that the surface of this sand is in direct relation to sieve size.

A crushing device utilizing the drop-weight principle has been developed for accurately measuring the work done in crushing. A series of 14 crushing tests of various sizes of quartz have been made and the surface area of the crushed product has been determined.

These results show that the new surface produced in crushing is directly proportional to the work done in crushing—a confirmation of the Rittinger law.

Flotation of pure minerals.—The bureau is studying the floatability of copper sulphides and of some nonmetallic minerals or rare-metal nonsulphide minerals, such as chromite, fluorite, and ferberite. Two phases of the work have been completed. In the first, a table of comparative rates of floatability was established for galena, sphalerite, and pyrite. In the second, data were obtained which show the effect of addition reagents on the floatability of quartz and calcite, separately and when combined with galena.

A paper on the latest developments in the flotation of oxidized ores is being prepared.

Calcination and gravity separation of lead carbonate ores.—A process has been devised for separating lead and zinc in oxidized ores that are not amenable to any other method of treatment. Briefly, the process consists of crushing the ore to the necessary size, usually determined by a few preliminary experiments, then calcining at temperatures of about 500° C. This treatment drives off the CO_2 from $PbCO_3$ and the PbO remaining is easily recovered by gravity concentration. Products ranging from 55 to 80 per cent lead have been made and corresponding recoveries obtained.

Combined roasting and flotation of lead-zinc sulphide.—By combining roasting with flotation the Bureau of Mines hopes to obtain a better recovery of the various metals and to be able to treat those ores that are more difficult to concentrate.

By this method iron may be well removed from a complex mixture of galena, sphalerite, and pyrite. Separation of the galena and sphalerite calls for very close control of the temperature through control of the composition of the gas, and the addition of a small amount of salt. An ore that modern flotation has not treated successfully and various typical products from different plants have been obtained for trying out the process.

Resistance of mill balls to wear.—The problem of finding materials that will better withstand wear and abrasion is becoming important. One of the large items of cost in the operation of ball mills is that of mill balls. It is estimated that in the Rocky Mountain district alone the grinding of ores wears away more than 200,000 pounds of mill balls daily. The Bureau of Mines is now endeavoring to find the characteristics of the material most suitable for mill balls.

"Blue ore" of the Black Hills, S. Dak.—At the request of interested mine owners of the Black Hills, S. Dak., the bureau undertook to solve the problem of treating the "blue ore" of that district. All the mills in the part of the district where this ore occurs were shut down because of inability to make a satisfactory recovery of the gold in the ore. A long series of experiments on this antimony-arsenic-gold-silver ore revealed the basic principle that makes recovery of the precious metals practicable. Under a cooperative agreement with the bureau, the mine owners interested undertook to provide funds for erecting a 1-ton demonstration plant at the South Dakota School of Mines. This plant was installed and operated under the control of the bureau's engineers.

The plan for the treatment of the ore comprises roasting for a short time at a temperature between 300 and 400° C., the time depending on the size of the ore. Ore as fine as 16 to 20 mesh requires 10 to 20 minutes; 6 to 8 mesh ore, 20 to 40 minutes. Lime is added to the ore, preferably before the roast. The roasted ore is moistened with lime solution containing 10 to 14 per cent water; then it is held in bins three days in order that the conversion of soluble sulphates to insoluble calcium sulphates and the oxidation of the base metals, mainly iron, may be complete. Finally, the ore passes to ball mills for fine crushing in cyanide solution in regular all-slime treatment. The process gives promise of being suitable for other antimony-arsenic ores, such as that at White Caps, Nev. An excellent recovery of gold from the White Caps ore has been obtained with this process.

Copper precipitation by sponge iron.—During the year the bureau undertook to determine the relative merits of different forms of sponge iron and iron scrap as precipitants of copper.

Sponge iron precipitates copper from leach solutions more rapidly than scrap iron because of the much greater area of surface per unit weight. In addition, sponge iron can be made from certain waste products and thus turn them into an asset; for example, magnetite, which occurs with some copper ores and must be separated from the concentrate, can be metallized; or if pyrite is roasted to furnish acid for leaching, the calcine is easily reduced to sponge iron to furnish the precipitant.

In the experiments on the merits of different forms of sponge iron and different scrap irons as copper precipitants, the investigators noted such facts as time required for precipitation, best mechanical means for precipitation, consumption of iron per pound of copper precipitated, grade of the resulting products, completeness of precipitation, and influence of temperature and acidity.

During the preceding year the Southwest station, Tucson, Ariz., had studied reaction rates and the effect of time, acidity, temperature, and impurities on the precipitation of cement copper. During the past year the station studied precipitation in the McDougal-type apparatus that had proved satisfactory at the Intermountain station in work on the precipitation of lead by sponge iron. It was found that a high-grade precipitate could be obtained simultaneously with a high recovery of copper from the solution. With a given ratio of metallic iron to copper and a given rate of flow of solution, the percentage of total copper precipitated from solution was virtually independent of the concentration of copper in the head solution. In this type of apparatus the solution and sponge iron are fed continuously and automatically, and the cement copper is automatically discharged from the machine. Thus there is a decided reduction in the manual labor required.

Smelter problems.—The bureau has begun a study of the various factors that affect losses of copper in slags and the conservation of heat in smelting. In cooperation with the department of chemistry, University of Arizona, the bureau has undertaken to determine the influence of slag-forming constituents on the copper content of the slag. A method that makes use of the standard bomb calorimeter has been developed for determining the heat involved in roasting.

Pyrometallurgy of lead.—An investigation to ascertain the forms in which lead is now being lost in smelting and to work out methods for preventing these losses is in progress. During the year members of the bureau investigated a chemical method for determining the various compounds of lead ordinarily present in metallurgical products, and gave some attention to the relative ease of reducibility of the various lead compounds. When this work is finished work on diminishing the amount of lead now being lost in smelter slags is to start.

Hydrometallurgy of lead.—The greatest difficulty in the brine leaching of lead ores has been the fouling of the solutions by sodium sulphate. In its study of the purification of lead leaching solutions, the Bureau of Mines will investigate two alternate methods for the removal of sulphates from the brine. The bureau will also seek to determine the effect of the addition of ferric chloride to brine solutions as solvents of the lead and silver now being lost in concentrator tabling.

Hydrometallurgy of zinc.—An investigation of the hydrometallurgy of zinc embraces: (1) A study of the roasting of zinc ores preparatory to hydrometallurgical treatment, particularly of the factors that govern the solubility of the zinc-sulphide minerals; and (2) a study of the losses of zinc in present hydrometallurgical practice and the devising of methods of prevention. A considerable amount of zinc now being lost could be recovered if there were a satisfactory method of discarding the spent solution and enough wash water could be obtained.

Experiments have been made to ascertain the factors governing the amount of soluble zinc in the calcine made from a product considered difficult to leach. Proper control of the temperature in roasting proved by far the most important variable. In roasting, the temperature should not exceed 750° C., and this temperature should be reached gradually to avoid local overheating. Frequent rabbling is necessary to give uniform temperature and to lessen the time required.

Electrothermic metallurgy of zinc.—In order that zinc ores may be smelted more efficiently and cheaply than by the present retort process, and that complex ores not workable at a profit by present processes may be treated economically, the bureau is studying the electrothermic distillation of zinc.

In cooperation with the Missouri School of Mines and Metallurgy the construction of an experimental dry distillation zinc-smelting plant, using the Fulton process, has been completed. This plant, designed as a demonstration plant, has a capacity of several hundred pounds of zinc a day.

Acid process for the extraction of alumina.—The bureau has examined available information on acid-extraction processes that are applicable to clays, leucite, shales, and alunite, and has made experiments to clear up or corroborate various points in the chemistry or technology of the processes. Bulletin 267, now in course of publication, indicates what may be expected of various processes for the acid extraction of alumina or aluminum compounds from aluminous minerals.

Electrothermic production of aluminum alloys from low-grade bauxite.—Although the deposits of high-grade bauxite in the United

States are few and are being rapidly depleted, there are numerous deposits of low-grade bauxite that are unsuitable for use in the production of alumina by electrolytic methods. Pure aluminum probably can not be made from this low-grade ore by direct electrothermic reduction, but to produce alloys of aluminum with silicon and iron seems quite possible. In this way aluminum could be made much cheaper than by the electrolytic method. The alloys would be suitable as a cheap deoxidizer for steel and might be used in producing aluminum alloys for metallurgical use. The Fixed Nitrogen Research Laboratory of the Department of Agriculture has done considerable work on nitridizing aluminum alloys to produce ammonia and pure aluminum oxide and is anxious to obtain larger quantities of an electrothermically made alloy for further experiments. Here is a promising means of producing fixed nitrogen and pure aluminum oxide by the use of low-grade bauxite.

A furnace has been designed and constructed and is almost ready for further tests.

Recovery of molybdite from ores.—A technical paper, now in press, discusses the utilization of molybdite and molybdenum minerals, and the possible recovery of molybdite by flotation, gravity concentraion, leaching methods, and distillation with chlorine.

A rapidly increasing amount of molybdenum is being used in the manufacture of alloy steels. Until recently ferromolybdenum was used to add molybdenum to steel. At present, however, most of the molybdenum used in steel is added in the form of calcium molybdate. This change marks an important economy in the production of molybdenum alloys for these reasons: (1) Reduction to ferromolybdenum involves considerable loss of metal in the slag, whereas calcium molybdate may be made without appreciable loss; (2) to convert a concentrate to calcium molybdate costs much less than to reduce it to ferromolybdenum; (3) detrimental impurities are easily eliminated during the production of calcium molybdate, thus making a wider variety of ores available as a source of molybdenum.

Ferromolybdenum usually contains 50 to 60 per cent Mo—2 per cent carbon is the maximum for one grade and 0.5 for another. Calcium molybdate is sold containing about 42 per cent Mo. The presence of appreciable amounts of phosphorus, sulphur, or any easily reducible metal is not usually tolerated in either ferromolybdenum or calcium molybdate.

Many molybdenite deposits contain a considerable amount of oxidized molybdenum, recovery of which is an urgent, unsolved problem. Mechanical methods of concentration have been ineffective. Two leaching methods have been carefully tested by the bureau and seem to have commercial possibilities.

The ferric sulphate and sulphuric acid process.—In the course of its efforts to increase efficiency in the mineral industries, the Bureau of Mines has investigated hydrometallurgical methods of treating partly oxidized copper ores, such as are found in the intermountain region and in the Southwest.

Bulletin 260, now in press, deals with the treatment of ores by the ferric sulphate and sulphuric acid process. This process is one for preparing solutions of ferric sulphate or sulphuric acid by means of a

mixture of air and sulphur dioxide passed, preferably in the form of very small bubbles, through solutions containing varying amounts of iron as sulphate. The bulletin presents a study of the chemistry of the process and the mechanical conditions that would have to be observed in practice. A chapter on "Producing small bubbles of gas in liquids by submerged orifices" gives data obtained in a study of methods of making bubbles in liquids—a study that was undertaken in order to obtain data for the design of the mechanical parts of a practicable commercial plant using the process.

A technical paper covering the work of the pilot plant in producing acid ferric sulphate was presented before the American Institute of Mining and Metallurgical Engineers at Salt Lake City, September, 1925.

As a result of the studies made, the leaching of low-grade mixed ores of copper has been successfully accomplished by means of a regenerative process using sulphur dioxide and ferrous sulphate, both of which are by-products generally discarded in metallurgical operations. In the complete cyclic process developed, the copper is precipitated by means of sponge iron in a McDougal-type precipitator. The resulting ferrous sulphate solution is treated with roaster gas to produce ferric sulphate and sulphuric acid for leaching. This work was conducted on a pilot-plant scale; ore charges of 1 ton were used and the plant was operated over a period of six months. As a result of the tests made with the pilot plant, several large companies are considering the use of the bureau's process for treating their low-grade ores. At the close of the fiscal year two companies are cooperating with the bureau in the installation of this process on a semicommercial scale.

This process represents several years' research at the Pacific and Southwest experiment stations. It promises to cheapen greatly the production of ferric leaching solutions. The equipment required is simple and inexpensive, and the ability to prepare sulphuric acid in addition to solutions of ferric sulphate will widen the field in which ferric solutions can be used.

Physical chemistry of the reduction of metal oxides.—The bureau is studying the physical chemistry of the reduction of metal oxides that it may be able to work out the equilibrium diagram for the reduction of these oxides by carbon or reducing gases.

At its Pacific experiment station, Berkeley, Calif., the bureau for some years has intermittently studied the reduction of metallic oxides. The great importance in metallurgy of the reduction equilibria of these oxides makes systematic research desirable. Satisfactory determinations of the free energy of formation of the heavy-metal oxides are especially to be sought. Of these oxides, zinc oxide is among the most interesting and important. Not only are accurate equilibria measurements highly desirable because theoretical results may be directly applied in the metallurgy of zinc, but the new use of zinc oxide as a catalyst in the formation of methanol and other compounds makes the problem of reduction equilibria of considerable general interest to chemists.

A technical paper on the equilibrium in the reduction of zinc oxides by carbon monoxide has been completed, and three papers dealing with the subject have been written.

Application of oxygen or oxygenated air to metallurgical fields and problems.—Use of oxygen or oxygenated air would effect a considerable saving in many metallurgical processes. Certain processes that, because of their high-temperature requirements, can not be carried on by ordinary combustion could readily be conducted by the combustion of fuel in an oxygen-enriched atmosphere. At the request of the Director of the Bureau of Mines M. H. Roberts is serving as chairman of a committee to advise the bureau in an investigation to determine the feasibility of manufacturing and using oxygen for metallurgical and allied processes. The investigation has two major divisions:

1. A study of present methods of producing oxygen, in order to determine the feasibility of attempting to produce oxygen or oxygenated air in such amounts and at such a cost as to permit use in metallurgical operations.

2. A study of the feasibility of using oxygen or oxygenated air to increase the efficiency of the metallurgical operations and thus lower the cost of producing metals and assuring the use of lower-grade and cheaper raw materials.

NONMETALLIC MINERALS—REFRACTORIES

Calcination of small-size limestone.—Enormous quantities of limestone fragments under 4 inches in size are wasted at lime plants because this small stone can not be calcined in the kilns most widely used. The Nonmetallic Minerals station, at New Brunswick, N. J., has determined the feasibilty of calcining this stone into lime with a sintering machine. In 1924 the tests with a small experimental machine gave such promise that in 1925 a commercial-size machine was adapted to the work and many tests were made with it. The results are promising enough to encourage plant tests under operating conditions.

Limestone mining.—In a study of the mining of limestone, extensive field work involving visits to 52 limestone mines was completed in 1925. The information gathered is being published as Bulletin 262, which discusses the various mining methods employed, the controlling conditions, and the costs.

Metallurgical limestone.—Early in the fiscal year the Nonmetallic Minerals station began a comprehensive study of the production and utilization of metallurgical limestone. Visits were made to quarries in West Virginia and Maryland and to iron and steel furnaces at Bethlehem, Pa. The study chiefly concerns problems of utilization.

Survey of mica industry.—The need of a detailed report on mica, a mineral in growing demand because of use in radio and electrical equipment, led to a broad survey involving visits to virtually all the producing mines in the country. The report will cover the production, preparation, and use of mica.

Quarrying and use of slate.—The waste in slate quarrying ranges from nine-tenths to fifteen-sixteenths of the gross production. In an effort to reduce this excessive waste it is proposed to try out the wire saw for cutting slate in the quarry, as is now done in some quarries in Europe. Many technical advances have been made in the slate industry since the bureau, in 1922, published Bulletin 218,

The Technology of Slate. Results of study of these developments and their influence on the industry are being prepared for publication.

Anhydrite as a cement retarder.—Experiments with gypsum, anhydrite, and plaster of Paris as cement retarders, begun by the Nonmetallic Minerals experiment station during the previous year, were completed and the results were published. Mixed retarders in general gave better results than single retarders. Anhydrite alone is a poor retarder, but mixed with gypsum it gives satisfactory results.

Effect of steam on the calcination of limestone.—Opinions differ greatly as to the advantage of using a steam jet beneath the grate of a lime kiln, and the Nonmetallic Minerals station is investigating the matter. It has made a long series of tests to determine the percentage of calcination attained at various temperatures, first in a current of air, and second in a current of steam. The results showed a small difference in the degree of calcination attained by the two methods. Tests and studies are being conducted to determine the reason for this difference.

X-ray studies of plaster of Paris and lime.—A study, begun at New Brunswick, N. J., of the deterioration resulting from the reuse of plaster of Paris was continued at the Massachusetts Institute of Technology. Results show that the strength decreases greatly, virtually reaching a zero point at the fifth calcination, and the water-carrying capacity is more than doubled. X-ray examination indicates that the change is probably due to changes in particle size, possibly brought about by particles of uncalcined plaster acting as centers of crystallization. The strength can be greatly increased by the addition of small percentages of promoters. The X-ray method has also been used to determine whether there is any structural relationship between a lime and the stone from which it is made.

Increase in nonmetallic research.—As the great bulk of the output of nonmetallic minerals, including crushed stone, sand and gravel, building stone, slate, and gypsum, and of such primary products as cement, lime, and plaster of Paris, enter into the construction of buildings and roads, this output affects the life of virtually every community and every individual. The vast quantities of these materials used and the increasing call for economy in their use and for better service from them have resulted in a growing demand for technical research. This demand is reflected by the gradual expansion of the bureau's work on nonmetallics.

Concentration of fluorspar ores.—To determine the best methods and equipment to be used in the gravity concentration of fluorspar ores and to obtain data on the principles of ore dressing involved, the bureau has studied the system used in the Tri-State zinc district for jigging unsized material and is endeavoring to have this system applied to the milling of fluorspar.

This work on fluorspar has been in progress in Kentucky and southern Illinois for more than a year, and as a result nearly every mill in the region shows some improvement. The ores consist largely of fluorspar, calcite, and silica, minerals that do not differ greatly in specific gravity, hence milling is a difficult problem in gravity concentration.

Requirements of refractories for open-hearth furnaces.—A study of those conditions in the open-hearth furnace that affect the service of refractories was completed during the year. Before any real progress can be made in the development of better refractories or the better utilization of present refractories, the conditions they must meet and the ways in which they fail must be known. The investigators determined temperatures in various parts of the furnace and the temperature gradients through the walls, port ends, and roof. They also took numerous samples of dust from the checker work and from the atmosphere. The quantity of dust in the atmosphere was measured and the dust was analyzed to determine its source and its effect on refractories. Samples of refractories from shutdown furnaces were examined chemically and petrographically and tested for fusibility. The results of this investigation have been published as Bulletin 23 of the Mining and Metallurgical Investigations of the Carnegie Institute of Technology and the Bureau of Mines.

Flow of heat through refractory walls.—After the bureau had studied service conditions in the open-hearth furnace it took up the effect that air cooling, water cooling, or insulating the outside of a refractory wall had on the temperature gradient through the wall, on the outside temperature, and on the probable life of the refractory. The problem was studied in the laboratory with a small chamber heated by a radiant resistor to open-hearth temperatures. Various test walls were used and the temperature gradients were carefully measured. The results are being prepared for publication.

Service tests for refractories.—There is need of a service test for refractories, particularly their resistance to slag action. At present the only reliable test is made by placing the refractory in a section of a furnace in use, but this method is lengthy and often costly, and can not be used in the development of new refractories. Laboratory tests now used to determine service are for the most part unsatisfactory, as they either neglect the physical properties of the brick or make these properties the basis for the test.

A good service test should duplicate as nearly as possible the conditions existing in the furnace in which the refractory is to be used. During 1925 the metallurgical section of the Pittsburgh experiment station studied the conditions existing in the basic open-hearth steel furnace and the effect these conditions had on refractories. As a result, the metallurgical section was able to develop an accelerated test for open-hearth refractories that is of much promise. Tests made to date indicate that comparable results are obtained on duplicate runs and that the amount of slag action is a direct function of the amount of flux injected.

Requirements for refractories in the metallurgy of zinc.—The cost of refractories, especially those used for retorts and condensers, is a large item in the cost of smelting zinc ores. The specifications that a fire clay must meet in order to be suitable for zinc smelting are very strict. The bureau is now studying these requirements, the refractory materials that meet them, and the geographical situation of deposits of suitable fire clays or other refractory materials, in an endeavor to find ways of improving the quality of the retorts, condensers, and furnaces used in smelting zinc.

The first phase of this investigation was the study of the physical and chemical properties of the materials used for making the retorts and condensers. Work on the second and third phases began in July, 1925. Clays or clay products that give promise of being more satisfactory for the manufacture of zinc retorts are being subjected to the standard tests used. Most of these materials have been selected from deposits other than those in and around St. Louis, which have been largely drawn on in the past.

PETROLEUM AND NATURAL GAS

Construction of pilot oil-shale plant near Rulison, Colo.—At the suggestion of the committee appointed by the President to determine the possibilities of a future supply of oil for the Navy, Congress appropriated $90,000 to the Bureau of Mines in March, 1925, "for development of oil shale including construction of necessary plant, purchase or mining of shale, operation of plant, and for necessary expenses incident thereto." A site was selected for a pilot plant on naval oil-shale reserve No. 3 near Rulison, Colo., and during the fiscal year a trail was built from Rulison to the plant site, plant buildings were erected, and equipment was purchased, including retorts of the Scottish and of the American type, and equipment for an aerial tramway. Preliminary heating of the Scottish retort began on May 25, 1926. The American-type retort was delivered and arrangements were made for erecting it.

Losses of natural gas in pipe lines.—During the year a survey was made in several States of leakage in natural-gas transmission lines, and immense savings were found possible by testing and repairing the lines. The lines examined leaked at the rate of 432,540,000 cubic feet a year at the average operating pressures used. Repairs reduced this leakage to 194,836,000 cubic feet a year, an annual saving of natural gas valued at $64,000. The bureau's work on line losses has so interested a number of gas companies that they are making regular surveys to determine leakage.

Control of gas wells.—An investigation of the control and operation of gas wells was completed during the year. If proper equipment is installed, the potential capacity of gas wells can be determined without wastefully blowing gas into the air during tests, deliveries from the well can be accurately controlled, the rate that water is entering the well can be ascertained, and the water removed without material interference with deliveries of gas from the well. This system of well control has been adopted by several companies in the Mid-Continent field and is giving satisfactory results.

Engineering studies of oil and gas fields.—During the year reports were published covering investigations in the Lance Creek field, Wyoming, and the Chickasha gas field, Oklahoma. Field work was completed and reports written on the Powell field in Texas and the Davenport field in Oklahoma. A report on the Wortham field in Texas is being prepared. Underground conditions in the different fields were studied, and methods of repairing wells to control the movement of water entering the oil sands were recommended to operators. Improved drilling and production methods were also

studied. The importance of this work is exemplified by the results of repair work in the Powell field, where engineers of the Dallas field office directed the stage plugging of wells on a number of leases. The increased production from one lease is estimated at 193,000 barrels and from another at 80,000 barrels. The total increase of production from the wells repaired under the supervision of the bureau engineers amounted to about 1,000,000 barrels. Work on development problems in southern Oklahoma oil fields was completed. A report—Petroleum Engineering in the Papoose Oil Field—which covered an investigation made in 1925, was published in cooperation with the Geological Survey of the State of Oklahoma. A report on the Thrall-Burkett-Seeley area in Kansas was completed and filed. The investigation of water problems in Oklahoma oil fields was concluded. A report on the north Cushing field was completed.

Increased recovery of oil from sands.—Work began on methods for increasing the recovery of oil from depleted sands. According to estimates the present methods of flowing and pumping wells obtain only about 20 per cent of the oil originally in the sand, and the recovery of the remaining 80 per cent is one of the most important problems before the oil industry. As part of the work, a report was prepared that gives the results of a laboratory investigation of the solubility of gas in crude oil and the importance of dissolved gas in reducing the viscosity of oil and thus aiding the movement of oil through the sands.

Safety in the oil industry.—The engineers assigned to safety work in the petroleum industry have made progress in urging the oil companies to adopt safe practices and install safe equipment. A first-aid meet for teams composed of employees of oil companies in the mid-continent field was held at the international petroleum exposition at Tulsa, Okla., and aroused much interest. Meetings of foremen and superintendents in Kansas, Oklahoma, and California, at which bureau employees made important suggestions, helped to increase interest in safety work. Reports dealing with statistical studies of accidents in the oil industry and the use of safe equipment were prepared for publication.

Production methods in eastern oil fields.—The bureau gave some time to a study of the production methods in Pennsylvania, Ohio, and West Virginia oil fields, with particular reference to the possibility of obtaining an increased recovery of oil by the use of compressed air or natural gas or by flooding with water. Production records showing the effect of artificial methods of recovery during a period of years were obtained and plans made for collecting information necessary for a report on improved practices.

Mud fluid for oil and gas wells.—The investigation of the use of mud fluid in oil and gas wells was continued actively; much time was spent in designing and installing laboratory equipment for the necessary experimental work. Several phases of oil-field practice in the use of mud fluid were carefully studied.

Application of vacuum to oil wells.—The staff of the Petroleum experiment station, Bartlesville, Okla., is studying the effect that applying vacuum to wells has on the production of oil and of natural-gas gasoline in the Mid-Continent field. During the fiscal year 1925 a number of oil wells to which vacuum had been applied were studied

in detail, and these studies were continued during 1926; additional tests were arranged in California and Wyoming. A large amount of data has been compiled for a bulletin.

Evaporation losses of gasoline in storage.—Evaporation losses from storage tanks cause enormous waste of gasoline in the United States. A report, Evaporation Losses of Gasoline in the Refinery, was published during the year as Serial 2721; a more comprehensive bulletin on evaporation losses in the petroleum industry has been completed.

Drill-steel investigation.—The bureau concluded its investigation of the tempering of oil-well drill steel, started in 1925. Results confirmed the conclusions that special tempering baths and careful heat control would increase the efficiency of bit performance. A report, Temperature Control System for Dressing and Tempering Fishtail Bits, was published as Serial 2712. During the past year, however, systems of facing drilling bits with special alloys have been introduced, so the demand for a tempering system will probably be less than was originally supposed.

Examination of American crude petroleums.—The Bartlesville station continued its work of several years on analyzing crude-oil samples. More detailed studies of samples of crude oil from the Tonkawa (Okla.) and Santa Fe Springs (Calif.) fields were made. A special chemical study of Salt Creek (Wyo.) crude was continued. An investigation of the sulphur compounds in high-sulphur crude was begun.

Fractional distillation of petroleum.—The investigation, started in previous years, of the fractional distillation of petroleum was continued at Bartlesville. An experimental distillation outfit was installed and thoroughly tested. The results indicated the possibility of great economies in the distillation of crude petroleum. A report of this investigation is being prepared.

Chemical treatment of light petroleum distillates.—An investigation of the treatment of petroleum distillates was continued. In particular the investigators studied the effect of distillation through a well-designed fractioning tower on the characteristics of the resulting product. It has been found that virtually all treating problems can be eliminated by careful handling of the gasoline during distillation.

Engine tests of lubricating oils.—A report that gives the results of dynamometer tests of lubricating oils from California crude is in course of publication as a technical paper. A series of engine tests is in progress to determine the influence of the viscosity-volatility ratio of oils on engine service. Four commercial lubricating oils were selected that had the same effective viscosity at engine-operating temperatures but differed widely in volatility range.

When this work is completed a study of the lubricating service of high-sulphur lubricating oils is planned. The investigations under way are part of a study of the properties of different crude petroleums, the products made from them, and the influence that different refining methods have on these products.

Oxidation of lubricating oils.—The bureau is trying to develop a simple and accurate test for determining the oxidation numbers of lubricating oils. The work is incidental to tests of oils in the dynamometer laboratory, and necessary data for a technical paper on this subject are accumulating as the tests proceed.

Salvages in the oil industry.—An investigation is being made to find what has been done in the salvaging of material and equipment used in the oil industry. During the fiscal year 1925 a bureau engineer traveled through the eastern and Mid-Continent fields collecting data on the subject. During 1926 he visited California to collect up-to-date information. Oil companies spend large amounts annually for new equipment, such as casing, sucker rods, drilling and fishing tools, engines, and hundreds of other articles necessary for oil-field work. New material has frequently replaced partly damaged equipment that was promptly discarded; if such cast-off supplies had been reworked and repaired, they might have been made almost as good as new at small expense. Many large-scale operators now have salvage departments and discard practically no material that can serve a useful purpose.

Recent literature on petroleum and allied substances.—Since 1915 the bureau has been preparing bibliographies of articles on petroleum and allied substances. The San Francisco office sends out mimeographed monthly instalments covering current periodicals reviewed; printed bulletins that cover the cumulation are issued in Washington.

Thermal decomposition of oil-shale kerogen.—The study of the thermal decomposition of oil-shale kerogen continues earlier work at the Salt Lake City station. Its primary purpose is to find whether or not the mineral matter of the shale influences decomposition reactions. The shale kerogen is being prepared in the laboratory at Boulder, Colo., and the decomposition tests will be made in the laboratories of the College of Mining, University of California.

Technology of oil shale.—The Boulder (Colo.) office devoted its entire attention to laboratory tests of the characteristics of oil shale and methods of retorting oil shales and refining shale oil. One investigation dealt with the use of incombustible gases during the retorting period. Other work included determination of the yield of oil from newly discovered oil-shale deposits. An investigation of the use of superheated steam as a means of heating oil shale during retorting showed that a good grade of oil could be produced, but equipment that would withstand the severe conditions of operation was difficult to attain.

Experiments on refining oil shale employed the standard methods for refining petroleum, the methods used by the oil-shale industry in Scotland, and other refining methods that were developed in the laboratory. The effects of the use of strong oxidizing agents for refining shale oil were a special study.

Experiments continued on the distribution of nitrogen and sulphur in representative American shales and the oils produced from them. Results of a special study to determine the character of the nitrogen compounds in shale oil showed that these compounds are more numerous and are of an entirely different kind from those found in petroleum.

Samples of kerogen, the oil-forming substance in oil shale, were extracted from the various types of shale, and analyses of each sample were made. In order to prevent changes in the composition of the kerogen during the extraction process a standard laboratory procedure for carrying out this work was developed.

Removal of paraffin deposits in oil wells.—The field office at Laramie, Wyo., continued tests to ascertain the nature of the paraffin

deposits in oil wells and to find methods for removing accumulated paraffin. The work included laboratory studies to determine the physical characteristics of paraffin deposits in a number of fields and tests with different solvents to determine the effectiveness of each for dissolving the paraffin. One of the companies operating in the Salt Creek field made large-scale tests of one solvent, and the results were very encouraging. Studies of paraffin trouble in the eastern fields and those of Oklahoma, Kansas, and Texas were made. A preliminary report on this work is in preparation.

Water analyses as an aid to petroleum engineers.—Methods of analyzing oil-field waters, and methods to be used by petroleum engineers in interpreting water analyses, in order to determine the source of the water that enters an oil well are covered in a report that has been prepared. Most of the publications on this subject are written for the benefit of chemists who analyze oil-field waters; this paper, written expressly for petroleum engineers, should therefore prove useful.

HELIUM

Helium production plant No. 1.—On July 1, 1925, pursuant to the act of Congress of March 3, 1925, helium production plant No. 1, near Fort Worth, Tex., with contributing pipe line, was transferred from the Navy to the jurisdiction of the Bureau of Mines; the Linde Co. remained in charge of actual plant operations under contract with the Government but under the general supervision of the bureau.

In this plant natural gas that comes through the Government-owned pipe line from the Petrolia gas field, Clay County, Tex., about 104 miles north and west of Fort Worth, is processed for helium. The helium is removed from the gas by operation of a liquefaction cycle, and the gas minus the helium is then returned to the mains for commercial use.

The supply of gas from the Petrolia field has been diminishing steadily for some time, so that the plant could be run at only a fraction of its capacity during the fiscal year. As the fixed charges of plant operation are constant, running at reduced capacity has raised the unit cost of production, or cost per thousand feet of helium, notwithstanding the introduction of certain operating economies. So serious is this situation that the necessity of obtaining further sources of helium-bearing gas is becoming imperative.

Board of helium engineers.—During the fiscal year the members of the board of helium engineers have acted as consultants in the construction of helium production plant No. 2. This plant was designed after experimentation in the cryogenic laboratory at Washington and field trials in a reduced-scale plant to develop a process for producing helium more cheaply and efficiently, and is being erected on the Government reservation about 6 miles north of Fort Worth, Tex.

Cooperative work was carried on with the University of Nebraska on problems of importance to helium production and purification cycles.

Cryogenic research laboratory.—The cryogenic research laboratory was established in Washington for the experimental development of

fundamental scientific data that are essential to the proper design and operation of processes and plants for the production and purification of helium. The scope of the work includes determination of the properties, at extremely low temperatures, of the constituents of various gases and mixtures of gases from which helium is separated, and the properties of the liquid phases of these gases; and experimental work with laboratory-scale plants to determine the best designs for large-scale production and purification plants and to develop new methods that would reduce operating costs. Problems that relate to specific heats, latent heats, thermoconductivity, solubilities, adsorption, vapor-pressure composition relations between liquid and gaseous phases, and pressure-volume-temperature relations are studied in the cryogenic laboratory.

The following problems were under study during the past year: Determination of liquid-vapor compositions for nitrogen-methane mixtures, high vapor pressures of nitrogen, removal of carbon dioxide from natural gas, specific heat of ethane, and heat-insulation materials.

Purification of helium.—Through use in airships, helium becomes contaminated by double diffusion; helium escapes through the walls of the gas cells and air enters through them. At certain intervals, therefore, the helium supporting an airship must be removed, purified, and replaced. A plant for large-scale purification was designed and built at Lakehurst, N. J., for the Navy by Bureau of Mines engineers. The process employed proved so successful that the Army decided to have a smaller mobile purification unit that could be mounted on a railroad car and transported from place to place to serve airships. The Bureau of Mines undertook to design such a plant. Designs for a plant having one-fourth the capacity of that at Lakehurst were perfected, and a plant at McCook Field, Dayton, Ohio, was completed, tested, and turned over to the Army for a final tryout at the end of April, the car being sent to Scott Field at Belleville, near St. Louis, for this purpose. This plant can purify 5,000 cubic feet of helium per hour for airship use, raising the purity from around 85 to about 98 per cent.

Supplies of helium-bearing natural gas.—The first vital consideration in the Government's helium project is to provide adequate and constant supplies of helium-bearing natural gas, and to this end the bureau has maintained a general survey of gas fields in order to discover and estimate possible sources of such gas.

Some time ago helium gas was discovered in a well drilled near Woodside, Utah. A Government helium reserve was therefore established to include the Woodside structure on which the test well was drilled, and steps were taken to safeguard the Government's interest in the reserve. The well was purchased by special authority of Congress and has been sealed.

As the helium-bearing natural gas of the Petrolia field, from which helium production plant No. 1 draws its supply, is being rapidly exhausted through use, the Bureau of Mines has been giving attention to other fields that may merit consideration as sources of helium. A thorough study of this subject is planned for the coming year, when data will be developed on available supplies of helium-bearing gas; economic conditions of gas fields; pipe lines; means of commu-

nication and transportation; commercial activities contributory to the development and utilization of natural gas; and engineering data of various sorts essential to the design, construction, and maintenance of plants for producing helium.

ECONOMICS BRANCH

On January 1, 1926, an economics branch was established in the Bureau of Mines to consolidate within that bureau, as far as practicable, previous work of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce on the economics of coal, petroleum, minerals, and metals. Parts of the coal and minerals divisions were transferred to the Bureau of Mines from the Bureau of Foreign and Domestic Commerce.

As organized January 1, 1926, the economics branch included the coal division, comprising the personnel transferred from the coal division of the Bureau of Foreign and Domestic Commerce and that of the Government fuel yards; the minerals and metals division, which includes personnel transferred from the minerals division of the Bureau of Foreign and Domestic Commerce and part of the bureau's former division of mineral technology; the petroleum economics division, which includes employees transferred from the minerals division of the Bureau of Foreign and Domestic Commerce; and the division of mineral resources and statistics, an existing unit of the bureau.

COAL DIVISION

Coal economics.—The coal division makes studies of the economic problems of the coal industry of the United States, including a number of the important products of coal. This work concerns industrial and commercial economics as distinguished from scientific and technical problems, and includes the uses of coal, reserves, prices, production, distribution, consumption, stocks, and marketing.

A routine feature of the division's duties is the publication of monthly surveys of conditions in the coal industry at the end of each month. The division is now preparing a proposed coal exporters' manual, to contain a description of coal areas of the United States, a statement giving the location, characteristics, and qualities of those American coals that are available for export, and market information regarding them.

At this stage of the division's organization as a unit of the Bureau of Mines, its work is limited by the fact that its present staff is but the nucleus of the force required to perform its logical duties adequately.

Government fuel yards.—The Government fuel yards purchase coal and distribute it to all Federal and District Government buildings and establishments in the District of Columbia, with the single exception of the Washington Navy Yard, as well as to those institutions just outside the District that can be supplied economically. During the fiscal year approximately 270,000 gross tons of coal (262,000 tons of bituminous and 8,000 tons of anthracite) were distributed to about 600 points.

DIVISION OF MINERALS AND METALS

The functions of the division of minerals and metals are to make the following economic studies of minerals: General studies of the distribution of mineral deposits in the United States and in foreign countries, so as to show relations between the two; resources at the present range of prices, and potential resources that may become available with a change in price or changes in technical treatment or increased use; the uses in which the minerals are essential and the consumption at various prices; substitutes at various prices, and substitutes for minerals this country does not produce in sufficient quantity; and the uses for which minerals are nonessential. In conjunction with the division of mineral resources and statistics, analyses are made and bases for forecasting are determined from the statistics of the mineral industry. Most of the studies appear as chapters in the volumes of Mineral Resources.

These studies make it possible to give advice on minerals to such Government agencies as bureaus of the War and Navy Departments that are interested in minerals and metals for national defense, and to supply correspondents and personal inquirers with data as to sources, quantity available, uses, buyers, sellers, and other subjects.

PETROLEUM ECONOMICS DIVISION

The petroleum economics division of the economics branch made a survey of fuel-oil consumption in the five States of the Pacific slope, divided according to industries and territories, for 1924 and 1925, publishing summaries to cover each year. Additional data were gathered for a later national study of the uses of fuel oil in industry and its competition with other fuels. This information included the particular adaptability of fuel oil to each major industry, the early uses of fuel oil in these industries and the growth of the use, the range of prices, comparative costs of the different fuels for various industries, and studies of special conditions in various industries that would retard the substitution of coal or other fuel for oil. As accurate information covering these points had not been available before, the petroleum industry became interested in the work, and arrangements are being made to procure similar information for the remainder of the country. In addition, there was prepared a statistical summary of the California petroleum industry, which analyzed the trends of the various factors affecting the petroleum industry of the Pacific coast and its relation to the industry in the remainder of the country.

The division undertook to determine the amount of fuel oil used for domestic heating, the grade of oil used, and the prices in different parts of the country. Numerous requests for similar information have been received by the bureau from the oil industry, manufacturers of burners, and the general public.

DIVISION OF MINERAL RESOURCES AND STATISTICS

On July 1, 1925, the division of mineral resources of the United States Geological Survey was transferred to the Department of Commerce by Executive order, and was made a division of the

Bureau of Mines by order of the Secretary of Commerce. The refinery statistics section of the petroleum division of the Bureau of Mines was consolidated with the petroleum and natural gas section of the old division of mineral resources. The statistics on crude petroleum and petroleum products, especially the data relating to stocks, were improved thereby; and the issue of one consolidated monthly report instead of two was economical, and proved more satisfactory to the industry. The Bureau of Mines section of accident statistics, which also studied the production and consumption of explosives, was removed from the information service division and placed in the newly established division of mineral resources and statistics.

In the collection of mineral statistics the bureau continued to cooperate with the State geological surveys of Alabama, Florida, Georgia, Illinois, Iowa, Kansas, Maryland, Michigan, Missouri, New Jersey, New York, North Carolina, Texas, Virginia, Washington, and Wisconsin. Continuance of a cooperative agreement made in 1921 between the United States Geological Survey and the Bureau of the Census, regarding the biennial census of manufacturers, provided for a joint canvass on smelting and refining of antimony, copper, lead, tin, and zinc; on carbon black, cement, coke (beehive and by-product); on the production of grindstones, whetstones, and other abrasives; on the production of potash; on the production of salt; and on the production of pig iron and ferro-alloys.

Statistics on mineral commodities.—The section of metals and nonmetals worked chiefly on the collection and publication of statistical material relating to mine and quarry production and the output of metals by smelting and refining plants. Its engineers and field offices continued to collect historical records of metal mining in the western States for later publication. This section prepared its usual annual reports as well as a statement on the production, shipments, and stocks of Portland cement.

In addition to collecting regular statistics for the annual Mineral Resources reports, the section of coal and coke statistics continued its market-information service and issued weekly reports on the production of anthracite and bituminous coal and beehive coke, monthly reports on the production of all coke, and occasional reports on stocks of coal and coke. Arrangements were made with the Bureau of the Census to cooperate in collecting data for reports on stocks of coal and to place that work on a regular quarterly basis.

Because of the numerous strikes in the coal-mining industry, there is frequent call for statistics on the number and importance of these strikes. A statistical analysis of the strikes and lockouts of the last 75 years has been made which shows the number of men on strike, the length of the strike, and the time lost in comparison with other causes of lost time. The section is also preparing a report on those physical conditions in American bituminous mines that affect cost and output per man; it will cover such factors as thickness and inclination of bed, depth of workings, and system of mining, matters on which statistics have never been available. As bearing on the market for coal, statistics are being developed to show the competition of fuel oil, gas, and water power, and the progress of fuel economy.

The petroleum and natural-gas section issued monthly and annual statistical reports on crude petroleum, refined products, and natural-gas gasoline, and annual reports on natural gas, natural-gas gasoline, carbon black, and asphalt. Acting on a suggestion from several members of the industry, it made a canvass to obtain an opinion on the desirability of changing the unit for liquid refined products from gallons to barrels. The vote overwhelmingly favored the barrel unit, and all reports will be issued on this basis in the near future. Meanwhile all back figures are being changed to the barrel unit, and the data will be issued as a companion volume to the annual printed statistical report on crude petroleum. This report is intended to fill a long-felt need for a complete set of printed statistics on refined products.

Foreign mineral resources.—The section of foreign mineral economics compiled data on the fuel reserves of the world; gathered and tabulated information on the production of minerals in foreign countries obtained by direct correspondence with official statistical bureaus, collected and filed reports of American consular officers on the mineral resources and mining industries of foreign countries; collected and filed reports of mining companies operating in foreign countries; and indexed current information in the world's literature on the mineral resources and industries of foreign countries.

Mine accidents statistics.—With the cooperation of State officials and of individual operators, the Bureau of Mines is publishing reports of accidents in the mineral industries. These reports give, by causes and States, the fatalities at coal mines and the fatal and nonfatal accidents at metal mines, quarries, coke ovens, and metallurgical works other than iron blast furnaces. Figures for coal-mine fatalities are published monthly and annually; figures for other accidents are published annually.

The bureau maintains a list of all producers of industrial explosives (except nitroglycerin) and makes monthly and annual canvasses of production, sales, shipments, and stocks.

COAL AND OTHER SOLID FUELS—COAL PRODUCTS

Boiler furnaces.—Conditions in boiler furnaces that affect refractories have been investigated under a cooperative agreement with a committee of the American Society of Mechanical Engineers. The life of refractories used in the settings of power boilers is greatly influenced by comparatively small changes in the furnace temperature, and in the gases and the solids they carry Refractory manufacturers must therefore have the fullest information on these factors, so that they can determine the effects on refractories and the resistance of refractories to destructive forces, and can develop refractories better able to withstand given conditions. Field work has been arranged to cover a variety of typical fuels and their use in different methods of burning. Intensive study has been under way at three power plants—the Sherman Creek station of the New York Edison Co., the Fisk Street station of the Commonwealth Edison Co., and the Seventieth Street station of the Cleveland Electric Illuminating Co. A study of the refractories themselves by observation of furnace linings and of different refractory materials while in use has accompanied the

investigation of furnace conditions. The results should give manufacturers data from which they can develop refractories that will give better service in boiler furnaces, and should serve as a guide to enable power-plant engineers to operate boiler furnaces with minimum deterioration of refractories.

Clinkering properties of coal.—Disposal of the ashes from the burning of all coals takes time and money, but the actual expense varies widely with different coals. To be able to predict the relative clinkering properties of a coal and to translate this information into the ash-handling and operating expense required are desirable. Although Bureau of Mines chemists and other investigators have worked toward standardizing a method of determining the fusion temperature of the ash of coals and although the bureau has determined this temperature for a large number of coals from various parts of this country, comparatively little has been done toward definitely relating this or other properties of the ash to the type or degree of clinkering. Such an investigation has been started in cooperation with interested persons.

Pulverized coal for marine boilers.—To burn pulverized coal in stationary boiler plants is now an established practice, and the quantity burned increases yearly; use of large combustion spaces has added greatly to the success of the practice. Although there has been some attempt in the past to use powdered coal in marine or locomotive type boilers, no great success has been achieved, largely because all the coal particles were not consumed. There have been renewed efforts recently to devise combustion methods that would insure quicker burning of the coal and consequent reduction of the necessary combustion space. The Bureau of Mines is cooperating with the Shipping Board and the Navy Department in tests of some apparatus at the League Island Navy Yard, Philadelphia. Work has been started with a three-furnace Scotch boiler. At present three manufacturers have promised to submit their equipment for test.

Properties of coke.—Better knowledge of the technology of the coking of coal permits better control of the coke produced and the possibility of accenting desirable properties and adapting these to various uses. Consequently it is necessary to have comprehensive data as to all the properties of coke and how far the usefulness of a coke can be measured by them. The American Gas Association arranged that five gas companies should make special test runs with the same coal. Although the main purpose of these tests was to compare the efficiencies obtained with different types of ovens and plants, the runs also yielded five cokes made from the same coal. To find how these cokes differed in properties, a sample of each was sent to the bureau and tested for all measurable qualities. Probably the most interesting property tested was combustibility at higher rates of burning. As these cokes might be expected to have very similar values, a preliminary investigation was made to make sure that the test method previously used by the bureau was the most reliable possible. Gas cokes are widely employed as domestic fuel because gas plants are usually situated in or near cities. It is therefore important for manufacturers and users to know the relative value of different cokes for house heating. An extension of the investigation

is under way to make such comparisons and to determine what properties are significant.

Use of fuels in small domestic boilers.—More general use of coke as a domestic fuel would largely eliminate the smoke nuisance, hence a better understanding of the characteristics of coke is desirable. Some of the bureau's tests of high-temperature cokes are referred to elsewhere in this report. In addition, other characteristics were tested by burning coke under different types of boilers. Low-temperature coke is not as yet plentiful enough to be a commercial consideration; however, a special series of tests was run with such a coke made by the bureau in connection with the bureau's study of low-temperature carbonization of Utah subbituminous coal. With proper damper regulation, the smoke produced never exceeded a thin haze.

When smoky coals are used the accumulation of soot in ranges, boilers, and flues is a source of continual annoyance to the householder and a fire hazard as well. Its removal is disagreeable and dirty. A number of compounds are sold which are claimed to decrease the soot or make it disappear without distinctly firing it in the chimney when they are thrown on the fire. An investigation was started to determine the effectiveness of these compounds and the conditions under which they must be used to produce the best results.

Secondary air devices, another type of auxiliary equipment now on the market, are supposed to insure better combustion of the gases from the fuel bed. Correct proportion, distribution, and control of the secondary air supply are very necessary if the loss of heat in the gases passing out the flue is to be a minimum. Unfortunately the ideal quantity of secondary air required varies with the kind and size of fuel, the depth of the fuel bed, and the rate of burning, and is not the same during one firing cycle. The investigation is proceeding along the lines of determining the efficiency of the devices as means of supplying secondary air, independent of any variations caused by the above factors.

Washability of fine coal on tables.—The bureau is seeking to obtain fundamental data on the cleaning of coal on tables, using float-and-sink tests and chemical analyses. All experiments are made on commercial-size tables. With these fundamental data in hand, the bureau proposes to attack the problem of cleaning fine sizes of Washington coals which have baffled all attempts to product from them at reasonable cost a washed low-ash coal, even though the float-and-sink tests show it is possible.

Some associated experiments on the sizing action of a coal-washing table brought out certain conclusions. The washing table separates the particle of coal and refuse according to size and specific gravity. The distribution according to size will aid or impede the specific gravity separation, depending on the relative size of the particles of coal and impurities. Such grouping of particles as results from hindered-settling classification allows utilization of this sizing action in separating bone from coal; this grouping is of particular advantage when the differences in specific gravity are small.

A four-compartment hindered-settling classifier has been developed that will be described in a later publication. In this classifier

the products are made in reverse order to that of most of the present devices; the slimes and material of lowest settling rate are discharged from the first compartment, and in each succeeding compartment a material of higher settling rate is made. The fourth compartment makes a product ready for the discard. The overflow of the first compartment receives a desliming treatment in the sludge-recovery system before tabling.

As a result of this investigation, methods and apparatus have been developed by which a low-ash coal can be produced from the bony coals of the Northwest, with an efficiency of about 90 per cent. The tonnages handled are low and indicate that the most important part of the problem to be solved is to obtain greater capacity from the table.

This work is being done at the northwest experiment station, Seattle, Wash., in cooperation with the University of Washington.

Coal-mine sampling.—Analyses of coal sampled in the bed exposed in a mine show the characteristics of different coals in the same field, the differences between the coals of various fields, and the possibility of applying a particular coal to a given use. Moreover, these analyses demonstrate to mine operators the grade of coal that may be obtained by extreme care in mining it and preparing it for the market. The Bureau of Mines therefore continues to publish as technical papers the results of its analyses of mine samples and of samples of coal delivered to the Government. Each paper covers one State, or, where mines are few, two or more neighboring States, and contains a brief description of the coal fields, comments on the mining methods, and analyses arranged alphabetically by counties and towns.

The following technical papers were issued: No. 347, Analyses of Alabama Coals; No. 356, Analyses of Tennessee Coals; No. 365, Analyses of Virginia Coals; and No. 366, Analyses of Missouri Coals. The report on the bureau's analyses of Pennsylvania coals was published by the State of Pennsylvania.

Determination of sulphur in coal and coke.—In cooperation with committee D-5 on coal and coke of the American Society for Testing Materials, a careful study was made of the accuracy of various analytical methods for determining the sulphur content of coal and coke. The bomb-washing method and the sodium peroxide fusion methods when properly made proved just as accurate as the Eschka method, which has for a long time been the standard. The cooperative work with the American Society for Testing Materials proposes to standardize methods of analyzing and testing coal and coke and thereby make available the most accurate and workable methods for laboratories that analyze coal and coke.

Coal analytical laboratory.—The work of the coal analytical laboratory at Pittsburgh consists chiefly of routine analyses of coals belonging to or for the use of the United States Government.

Cooperative work is carried on with Maine, Maryland, New York, New Jersey, and Virginia in connection with their purchases of coal on specification basis, with various State geological surveys, with the Pennsylvania Geological Survey in the anthracite coal fields, with the American Gas Association, and with the American Society for Testing Materials.

Samples are exchanged with several commercial laboratories to check their methods of analysis and to improve their standards.

During the fiscal year 9,995 samples were received by the laboratory and 112,272 determinations made. Technical papers covering analyses of coals from West Virginia, Maryland, Indiana, Kansas, Arkansas, Texas, and Oklahoma were submitted.

The problem of comparing illium and vitreosil crucibles with standard platinum crucibles for volatile-matter determination was completed and a report was submitted for publication.

Boiler-water conditioning.—At the Pittsburgh station much attention has been given to various phases of boiler-water conditioning and corrosion. One investigation dealt with the effects the dissolved organic matter in a boiler water have on the carbonate content, as determined by the ordinary double titration with methyl orange and phenolphthalein indicators. Another investigation aimed to define the hydroxide content essential to inhibit the corrosion of iron surfaces under varying conditions.

Origin and constitution of coal.—The microstructure of coal was studied in cooperation with the British Safety in Mines Research Board at the research laboratories of Sheffield University, England, and the methods of study that have been worked out for American coals were applied to English coals. Microscopic examination of thin sections of English coals showed that they contained plant remains of the same general character as those in American coals. The results should tend to reconcile differences of opinion among geologists and paleobotanists of this country and England on the origin and constitution of coal.

Spontaneous combustion of coal.—Laboratory studies of the heating characteristics of coal under adiabatic conditions were concluded. Spontaneous heating of coal could not be detected by the most sensitive methods available when the coal was treated under adiabatic conditions at temperatures below 25° C.

Studies of the effect of moisture content on the tendency of a coal to heat spontaneously showed that the coal will heat or cool, depending on whether moisture is being evaporated from or condensed on it. That is, even at temperatures reached on the hottest summer days, the latent heat absorbed by evaporation of moisture from the coal may well suffice to counterbalance the heat generated by spontaneous oxidation. Some moisture seems to be required for complete development of spontaneous heating.

Recent laboratory work on the extractable constituents of coal shows that the tendency of the various constituents to heat differs only a little. Any constituent of the coal substance will heat spontaneously if enough of its surface is exposed to the action of oxygen; therefore spontaneous heating in storage is probably caused more often by a favoring state of the coal (or storage condition) than by the preponderating effect of any coal constituent.

Heat of carbonization of coal.—A study of the heat of carbonization of coal has been completed. Some carbonization engineers have hitherto believed that the so-called exothermic heat, or heat of reaction, of coal during carbonization is decided enough to be technically important. Results obtained show that this theory can hardly fit coking coals, for with these the heat freed during primary decompo-

sition may amount to as much as 10 per cent of that required for coking; but reactions within the higher temperature ranges are shown to absorb heat, so that, due to coking reactions, the final result is neither a gain nor loss of heat.

Low-temperature carbonization of Utah subbituminous coal.—A study of the low-temperature carbonization of Utah subbituminous coal has shown that carbonization in superheated steam will produce from this coal a solid fuel that will withstand handling and seems suitable for domestic use. This coke has been tested in a small gas producer and has been found to work admirably. It yields little tar in the producer.

Reactivity of coke.—The bureau is studying the comparative ease with which various gas-works cokes may be kindled and their tendency to react, under fixed conditions, with air, steam, and carbon dioxide. Results so far obtained show that there is little difference in the reactivity of cokes made from the same coal by various industrial gas-manufacturing processes.

Gases from low-temperature carbonization.—The gas given off in the low-temperature carbonization of coal was studied to ascertain the composition of the gas when carbonization had been effected by internal heating with superheated steam and by external heating. A Utah subbituminous coal was used for the larger part of the work. Additional samples of gas from Pittsburgh coal carbonized by external heating were also tested.

Low-temperature fractionation methods with chemical examination of the fractions were employed for making the analyses. The results obtained seem to be new in the field of low-temperature carbonization.

Composition of oils from low-temperature distillation of coal.—The chemical identity of the principal hydrocarbons in the oils recoverable from the gas obtained in the low-temperature distillation of Utah coal has been established and their amounts have been closely estimated. These oils consist of saturated and unsaturated aliphatic and naphthenic hydrocarbons with boiling points up to 200° C. Two parts of the unsaturated hydrocarbons were present to one of the saturated hydrocarbons. The physical properties made the material resemble casing-head gasoline. The heavier oils and tars produced under definitely known conditions by low-temperature distillation have been collected for chemical examination during the new fiscal year.

Synthetic motor fuel from water gas.—Equipment has been assembled for use at high pressures and temperatures in the catalytic conversion of coal (through water gas) to methanol and other organic compounds and mixtures suitable for motor fuels and other public needs. The preliminary tests of the syntheses themselves can now proceed.

Smoke abatement.—The bureau has given technical advice in smoke-abatement campaigns, especially in St. Louis, where civic organizations are waging war on the smoke nuisance.

Manufactured gas on Pacific coast.—Relative prices threaten to dislodge oil from its dominant position as the source of manufactured gas on the Pacific coast. The Pacific coast gas research council requested the bureau's cooperation in a study of future fuel sup-

plies and of technical processes applicable to various fuels. A report on the subject was prepared.

Fuel economy in Government buildings.—Substantial economies followed the fuel-economy survey of Government buildings, which was continued during the past fiscal year. Fuel-burning plants of various Government departments were tested to determine their efficiency and ascertain how it might be increased without cost. Tests at the Capitol power plant led to a saving of $9,000 in fuel cost during the year, with a saving of $50,000 a year as a goal. The substitution of modern equipment for worn-out apparatus at the Post Office plant should, it is indicated, save $25,000 a year in operating expenses.

Very truly yours,

SCOTT TURNER,
Director, Bureau of Mines.

INTER AMERICAN HIGH COMMISSION

INTER AMERICAN HIGH COMMISSON,
Washington, July 1, 1926.

HON. HERBERT HOOVER,
United States Section, Inter American High Commission.

MY DEAR MR. CHAIRMAN: During the fiscal year 1925–26 the commission has directed its activities toward the preparation of several publications, in the preliminary work in conjunction with Pan American conferences, participation in the conferences themselves, and in much general work resulting from conventions approved at previous meetings.

Among the comparative studies which are now being made, or which have been printed or are in process of printing at the present time, are the following:

1. Sections Nos. 4 and 5 of the series "Report Regarding the Laws Governing Stock Corporations on the American Continent" have been prepared for publication. Section 4 deals with the most important provisions relating to taxation of companies in the various Latin American Republics. Section 5 outlines briefly the position of corporations under State and Federal laws in the United States. The proof reading of this material is now in progress.

2. The directory of the Inter American High Commission, including the central executive council and all national sections, has been edited. The latest previous revision of the list was made in 1922.

3. "Marine Insurance and General Average Comparative American Legislation and the York-Antwerp Rules" has been completed and is now being printed.

4. A comparison of regulations existing in the various Latin American countries and in this country relative to bills of exchange has been begun, and it is expected will be ready for printing shortly.

Several studies have been prepared relating to standardization of specifications in various trades in cooperation with the Department of Commerce. In the last year 14 sets of these publications have been distributed.

In preparation for the Motor Roads Conference, which was held at Buenos Aires in October, 1925, the central executive council compiled an English-Spanish vocabulary of technical terms used in road building. General work, preliminary to the meeting, was done in our offices, and a representative was sent to attend the conference itself. The historical section of the report of the conference was also prepared by the central executive council.

The usual routine procedure, which is so burdensome in preparation for these meetings, was also shared by the commission in connection with the Pan American Journalists' Conference. Translations and preparation of correspondence, as well as actual participation by a member of the commission in the program itself, comprised our part in the meeting.

Preliminary steps for the Second Conference on Standardization of Specifications, which will be held in 1927 at Washington, have been taken. It has already necessitated translations, correspondence, and the usual routine procedure.

The permanent program of the commission, necessitating intensive study for purposes of revision, has received attention in anticipation of the second general meeting, which is scheduled to be held at Rio de Janeiro in the midsummer of 1927.

In connection with all the subjects of the program there are at all times information and recommendations to be distributed or interchanged among the various sections of the commission. The usual interchange has been effected through the central executive council during the past year.

There may now be added to the list of countries which have ratified the convention on trade-marks Haiti and Costa Rica. The Dominican Republic, Haiti, and the United States have ratified the convention on classification of merchandise. The convention relating to publicity of customs regulations has been ratified by Costa Rica, Dominican Republic, Haiti, and the United States. The commission has cooperated with the United States Chamber of Commerce in an endeavor to obtain ratification of the commercial arbitration convention by Costa Rica and Mexico through the good offices of chambers of commerce of and situated in the respective countries.

Respectfully,

J. HOMER BUTLER,
Acting Secretary.

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