TWENTY-FIRST

ANNUAL REPORT

OF THE

SECRETARY OF COMMERCE

FOR THE FISCAL YEAR ENDED JUNE 30

1933

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SECRETARY OF COMMERCE

1933

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SECRETARY OF COMMERCE

DEPARTMENT OF COMMERCE,
OFFICE OF THE SECRETARY,
Washington, November 1, 1933.

To the PRESIDENT:

I am submitting herewith, for transmission to Congress, the annual report of the Secretary of Commerce for the fiscal year ended June 30, 1933.

As I became Secretary of Commerce on March 4, 1933, the report covers only 4 months of my administration of the affairs of the Department.

REDUCTION IN EXPENDITURES

The daily increasing deficit of the Federal Treasury and the mandate of the people for a reduction in the cost of government dictated that immediate attention be directed to a drastic reduction in the ordinary expenditures of this Department. Accordingly, an immediate survey was instituted with a view to eliminating all unnecessary outlays. As a consequence, while the Department had available for expenditure during the year $44,981,408, of which $39,421,408 was authorized in the regular annual appropriation acts and $5,560,000 in the Emergency Relief and Construction Act, the total expenditures for the year amounted to only $40,038,323. The expenditure for the fiscal year 1932 was $56,239,340. Therefore, our expenses for 1933 were 11 percent less than the funds available and 28.8 percent less than the actual expenses of the previous year.

The Director of the Budget caused a careful estimate to be made of the probable receipts of the Government for the fiscal year 1934 for the purpose of endeavoring to keep the normal expenditures within the revenues through a reduction in the appropriations made available by Congress. Under this apportionment of the Federal revenues for 1934 the Department of Commerce has been allotted $29,000,000 for the year by the Director of the Budget, with the understanding that every effort will be exerted to place the expenditures on a $28,000,000 basis by January 1934, notwithstanding the fact that Congress appropriated $36,601,575 for the activities of the Department for 1933.

REORGANIZATION OF DEPARTMENT

Reductions of such magnitude in expenditures could be accomplished only as a result of careful and painstaking estimate of the

value of the work and services of the Department. A committee was accordingly designated, composed of men experienced in governmental affairs, some not being in the departmental service at the time, to study the organization of the Department and submit recommendations for such changes as might be deemed advisable and which would make more effective the services rendered.

Under the provisions of the act of March 20, 1933, entitled "An act to maintain the credit of the United States Government", the President issued an Executive order on June 10, 1933, for certain regrouping, consolidations, transfers, and abolitions of agencies. Many of the recommendations of the departmental committee were included in this Executive order, which under the law was to become effective 61 days from its date unless the President deferred the effective date. By that order the following changes were provided for affecting the Department of Commerce:

The United States Shipping Board was abolished and its functions, including those over and in respect to the Merchant Fleet Corporation, were transferred to the Department of Commerce;

The Assistant Secretary for Aeronautics was redesignated an Assistant Secretary of Commerce, thus broadening the duties of that official;

The Solicitor of the Department of Commerce was transferred from the Department of Justice to the Department of Commerce;

The fuel yards of the Bureau of Mines were transferred to the newly established Procurement Office in the Treasury Department;

The function of preparation of the Official Register was transferred from the Bureau of the Census to the Civil Service Commission;

The function of the Bureau of the Census of compiling statistics of cities under 100,000 population was abolished for the period ending June 30, 1935;

The National Screw Thread Commission was abolished and its records transferred to the Department of Commerce;

The Federal Employment Stabilization Board was abolished and its records were transferred to the Federal Emergency of Public Works.[1]

The purpose of changing the designation of the Assistant Secretary for Aeronautics was to permit a more effective organization of the bureaus of the Department. It is proposed to group under one Assistant Secretary the bureaus dealing with trade and industry and under the other Assistant Secretary the transportation and maritime bureaus.

Under the provisions of the Legislative Appropriations Act approved June 30, 1932, the Radio Division of the Department was transferred to the Federal Radio Commission, effective July 20, 1932, and the Bureau of Navigation and the Steamboat Inspection Service were consolidated under the title of Bureau of Navigation and Steamboat Inspection, effective August 1, 1932.

In addition, the National Committee on Wood Utilization was dissolved and the Federal Timber Conservation Board completed its work, the functions of both being absorbed by the Bureau of

[1] By Executive order of July 26, 1933, the abolishment of this Board was deferred until 60 days after the convening of the second session of the Seventy-third Congress.

Foreign and Domestic Commerce insofar as it was proper for the Government to assume them. The President's Committee on Home Building and Home Ownership completed its work and passed out of existence with the creation of the Home Loan Bank Board.

FUNCTIONS OF THE DEPARTMENT

The chief service of the Department of Commerce, measured by the proportion of funds so devoted, is in the interest of public protection and safety. It has become customary to regard the Department as concerned almost exclusively with the promotion of trade. Most of its budget, however, is spent in protecting life and property. At least 65 percent of its available funds is devoted to the maintenance of lighthouses, marine and aeronautic inspection, to the prevention of mining disasters, to protection against dishonest weights and measures, and to the performance of other functions, the activities and responsibilities of which do not shrink with the general decrease of business. In times like the present, keener competition for the reduced volume of business naturally results in curtailing expenditures, subjects the general standards and practices of business and transportation to unusual strain, and it is especially necessary that vigilance in the interest of public security be maintained.

The most important activities of those bureaus of the Department which are regulatory in character include maintaining coast, lake, and river lights, charting our coastal waters, registering and inspecting vessels of our merchant marine, inspecting and licensing commercial aircraft, and enforcing the navigation laws. Among the Department's promotive services are helping industry to simplify processes, to increase and improve output, to eliminate waste in production and distribution, and to promote employment. It carries on investigations and research to facilitate the production, transportation, and sale of goods produced by our industries; it assists the mining industry to eliminate waste and to safeguard lives; it conserves our fisheries and promotes fish production; it encourages invention by protecting inventors in their patent rights; at regular intervals it enumerates the population as well as gathers other social, industrial, and fiscal data; it promotes and develops the country's civil air transportation system; and, finally, it supplies trade information to American business.

ECONOMIC REVIEW

Definite signs of business revival throughout the world appeared during the fiscal year ended June 30, 1933. By the close of the period activity in most of the leading countries was moderately improved, but for the year as a whole the volume of business transacted was considerably less than in the preceding year.

Excessive trade restrictions, disorganized finances, debt burdens, fluctuating exchange, and trade declines were among the factors operating to retard the expansion of business. It became increasingly apparent as the year progressed that the ultimate solution of the world's economic problem would be facilitated by international consultations and concerted action to eliminate some of the policies which were hampering revival. In an effort to secure concerted

action a world economic conference was assembled at London just prior to the close of the fiscal year.

Notwithstanding the expansion in the international movement of goods which occurred in the latter part of the fiscal year, the trade totals for the period under review were considerably below those of the previous fiscal year. Partly by reason of price declines and partly because of shrinking volume total world exports of 50 leading countries were valued on a gold basis at only $10,241,374,000 and imports of $11,208,960,000, declines of approximately 25 and 26 percent from the preceding fiscal year.

Falling prices resulting in lower purchasing power and thus in smaller consumption was an important factor in the continued downward trend of business prevailing throughout the early part of the fiscal year. Prices in foreign countries turned upward before the close of the fiscal year, but in most instances the advances were less pronounced than in the United States. Thus five "gold standard" countries had an average increase in the wholesale price level in June of 2.5 percent over the low point for the year. Five of the more important nongold countries had an average increase, on the same basis, of about 5 percent.

In Europe, where unemployment rose to unprecedented heights during the winter of 1932–33, the spring and summer months of this year brought a partial renewal of industrial activity reflected in a much sharper decline in unemployment than in the previous fiscal year. In such industrial countries as England, France, Germany, Italy, and Belgium the number of unemployed had fallen by the end of June to a smaller figure than a year earlier. The influence of Government relief projects, however, must not be overlooked in this connection.

In the United States signs of resistance to further contraction appeared in the first half of the fiscal year and by the final quarter the tide of deflation was definitely stemmed. Confidence was greatly strengthened as a result of the decisive governmental action, business activity quickened, and by the end of the fiscal year substantial progress had been made. Nevertheless the descent from the 1929 level was so sharp and so long maintained that despite the constructive work of the President and the Congress and the wholehearted support of the people, conditions at the close of the fiscal year remained far from satisfactory. The economic structure continued to be badly in need of support and repair.

Major economic indexes

[Based on calendar years 1923-25=100]

Year ended June 30, quarter, and month	Industrial production	Manufacturing production	Minerals production	Railroads, ton-miles revenue freight	Electric power production	Department store sales (value)	Department store stocks	Manufactured goods stocks	Factory employment	Factory pay rolls
1920	89	91	82	96	-------	88	95	86	112	113
1921	74	73	83	90	70	92	97	90	92	98
1922	74	75	69	79	72	84	89	91	84	74
1923	98	98	93	96	88	94	92	87	99	95
1924	98	97	102	97	95	99	101	101	101	102
1925	99	99	98	98	102	100	101	104	96	96
1926	105	106	99	105	116	104	103	104	101	103
1927	109	109	113	111	129	107	103	110	100	104
1928	106	106	103	104	138	107	102	117	97	100
1929	118	118	112	110	154	110	100	120	100	106
1930	110	110	110	104	163	108	99	121	97	101
1931	87	87	91	86	155	99	88	120	80	76
1932	70	69	77	66	146	80	75	108	68	55
1933	67	66	73	52	136	64	58	98	60	41
Percent change, 1933 from 1932	−4.3	−4.3	−5.2	−21.2	−6.8	−20.0	−22.7	−9.3	−11.8	−25.5
Final quarter 1931-32	61	59	70	53	133	73	68	107	62	46
Final quarter 1932-33	79	79	78	58	138	67	55	97	61	42
June 1929	[1] 125	[1] 127	[1] 114	109	155	[1] 113	[1] 98	122	[1] 103	110
June 1930	[1] 98	[1] 97	[1] 112	92	155	[1] 103	[1] 96	128	[1] 90	91
June 1931	[1] 83	[1] 82	[1] 87	76	150	[1] 96	[1] 82	117	[1] 76	68
June 1932	[1] 59	[1] 58	[1] 63	28	131	[1] 69	[1] 67	104	[1] 60	43
June 1933	[1] 92	[1] 93	[1] 84	58	144	[1] 68	[1] 57	99	[1] 65	46

[1] Adjusted for seasonal variation.

At the beginning of the April quarter, activity had reached extremely low levels and had recently shown resistance to further declines. Inventories were abnormally small and in need of replenishment. The return of confidence following the banking crisis, the possibility of direct and indirect inflationary action, and the legislative accomplishments of the first session of the Seventy-third Congress stimulated natural forces working toward recovery and thus contributed to the sharpest advance in business activity in any 3 months' period during the Nation's history. Indexes of activity registered a strong and consistent improvement after March to the close of the fiscal year, but in a few instances, as a result of speculative action, the improvement was more rapid than the basic situation warranted. This condition, however, was in the process of readjustment by midsummer.

Although before the close of the fiscal year our financial structure was subjected to the most severe strain it has undergone in American history, the financial markets during the first quarter reflected increasingly favorable conditions. Monetary gold stocks increased as a result of imports and releases from earmark, currency returned from domestic hoards, the rate of bank suspensions showed a marked drop, and security prices increased substantially. Meanwhile, however, member bank loans declined almost uninterruptedly and bank investments tended upward. The liquidity of bank portfolios was aided by legislation passed during the preceding months.

In the second quarter money rates reached record low levels, new capital issues became exceedingly small, both stock and bond prices became highly irregular, and bank suspensions became increasingly

widespread. An additional factor in the disturbed state of the financial markets was the "war-debt" crisis which was followed on December 15 by defaults on the part of five foreign government debtors.

Overshadowing all other developments of the year was the rapid spread of banking troubles in February and the first few days of March. The general situation throughout the country assumed the nature of a panic—one of the most serious through which the country has passed. On March 6 President Roosevelt found it necessary to proclaim a Nation-wide bank holiday. Following this action Congress was convened in special session and immediately passed the Emergency Banking Act authorizing the reopening of the banks under a system whereby the institutions were first required to satisfy the Treasury as to their solvency.

In the final quarter of the fiscal year confidence was restored and the financial indicators revealed a general improvement. Money rates dropped from their panic levels, money in circulation gradually declined, and the upward movement in security and commodity prices strengthened the position of the entire banking structure. Progress was made in releasing the bank deposits not immediately made available after the crisis. Although 13,770 banks had been licensed to resume operations on an unrestricted basis by June 30, 1933, the several billions of dollars of frozen deposits in unlicensed banks and banks operating on a restricted basis tended to retard the progress of recovery.

Coincident with the upward trend of commodity and security prices following the suspension of gold payments on April 20, the dollar dropped to a steadily increasing discount in term of the gold currencies, and in June the dollar averaged about 19 percent below its gold parity.

Largely as a result of the extraordinary expenses incurred by the Government in its efforts to prevent the collapse of banks and other public institutions, the total interest-bearing debt of the United States increased approximately $3,000,000,000 during the fiscal year. A substantial part of this increase grew out of the operations of the Reconstruction Finance Corporation which up to June 30, 1933, had made loans aggregating close to 2½ billion dollars.

The banking crisis, serious as it was, ranked second to the tremendous problem of the large number of people willing and able to work but unable to find jobs.

Unemployment which had already reached a staggering total by the middle of 1932 continued to increase through the winter months despite widespread efforts to share employment. By March it was estimated that unemployment had reached a total of approximately 13,000,000. Along with the falling off in the volume of business and the increasing supply of unemployed labor, wage and salary rates were further reduced.

Recognizing the inability of industry and trade to reabsorb rapidly these unemployed workers without affecting a reduction in hours and an increase in purchasing power, plans were perfected in the final quarter of the fiscal year for joint action on the part of employers to reduce working time and raise wages. Although this program entrusted to the National Recovery Administration did

not directly contribute to increased employment in April, May, and June, indirectly its imminence had a marked effect. Unemployment decreased steadily throughout the three months and by the end of the fiscal year was about 1¾ million below the March peak. The creation of the Civilian Conservation Corps which aimed to remove from the labor market 300,000 young men between the ages of 18 and 25, also aided in improving the unemployment situation.

For the fiscal year, as a whole, factory employment was approximately 12 percent less than in the previous fiscal year, and 40 percent below the fiscal year 1929. Pay rolls showed a similar but much sharper contraction. The average for 1932–33 was 26 percent below the previous fiscal year and 61 percent below the fiscal year 1929. Industrial disputes continued to be relatively few but with the increased activity in the last quarter became more numerous. Emigration continued to exceed immigration.

These further reductions in employment and purchasing power were reflected in the sales of goods in domestic markets. Distribution of goods at retail declined further from the level of the preceding fiscal year, and showed very little improvement in the final quarter of the fiscal year when productive activity was advancing rapidly and purchasing power reviving. This is not an unusual condition at the beginning of recovery from a major depression since productive operations are inherently more sensitive to changing conditions; nevertheless, the disparity between production and distribution became so great by the close of the fiscal year that a narrowing of the gap became essential to orderly progress.

Department store sales were about one fifth lower in dollar volume than in the preceding fiscal year. Price changes accounted for about half this decline. Department store stocks at the end of the fiscal year were 14 percent smaller in value, and as prices were only about 3 percent lower the volume of merchandise on the shelves of such stores was less than at the end of the preceding year. Sales through the leading chain-store organizations were also lower in value, and for the variety chains the drop was 13 percent. Sales by leading mail-order companies were 14 percent smaller in value, which is a somewhat better record than in the preceding fiscal year. These decreases were, of course, largely influenced by price reductions. The movement of package freight by the railroads dropped 16 percent, or at a slightly higher rate than in the preceding fiscal year. Advertising expenditures were further curtailed with newspaper linage off about a fifth and magazine linage down 28 percent.

The record of commercial insolvencies showed a material betterment in the fiscal year, reversing the trend of the fiscal years immediately preceding. After increasing to record levels in 1931–32, failures decreased 11 percent in number and the liabilities involved were 20 percent lower. In the final quarter of the fiscal year, failures averaged one third less than in the same quarter of the preceding fiscal year while liabilities were only half as great.

The shrinking volume of trade continued to exert an influence on the course of prices and the pressure to dispose of goods in the face of weak demand brought quotations on many commodities to a point even below the costs of production. Domestic prices moved

lower during the first three quarters of the fiscal year, but following the suspension of gold payments in April there was a sharp upward movement, particularly in the prices of sensitive foodstuffs and raw materials. Although monetary action accelerated the movement in the United States, part of the gain was the result of the increased demand for goods which characterized the final quarter of the fiscal year. In June the wholesale price index was about 2 percent higher than in June 1932. Advances in wholesale prices during the latter part of the fiscal year were not confined to the United States, but were general in leading foreign countries. The upward movement was more moderate, however, than in the United States.

At the low point reached in March wholesale prices were 40 percent below the 1926 level. From then to the end of June an average advance of 10 percent occurred, bringing the general level of wholesale prices to 66 percent of the 1926 average. Despite the gain in the final quarter the average for the fiscal year as a whole was 7.7 percent below the previous fiscal year and was less than the prewar level. Prices of farm and food products, as in the years immediately preceding, continued to record relatively greater declines than other products. Farm products prices averaged 15 percent lower, foods 12 percent lower, while all other products recorded an average decline of only 5.4 percent. Compared with the fiscal year 1913–14, the wholesale price index was 8.6 percent less in 1932–33, while farm products were off 36 percent; foods 8.1 percent; and other than farm and food products were 0.3 percent higher.

Retail prices followed the trend of the wholesale price level. Food prices dropped 13 percent to 64 percent of the 1923–25 average. Fairchild's index of department store articles also fell 13 percent. The National Industrial Conference Board's index of the cost of living for a workingman's family dropped 10 percent, or at approximately the same rate as in the preceding fiscal year.

Despite price concessions and efforts to rebuild demand the low volume of purchasing power discouraged consumption and the output of mines and factories reached the lowest point in the postwar period. Production increased rapidly, however, in the final quarter of the fiscal year and for these 3 months averaged 30 percent larger than in the corresponding period of 1932. For the year as a whole the volume of production was about 4 percent smaller than in the preceding fiscal year. By June several of the more important industries were operating at a rate not only far above the level of the previous year, but also higher than in June 1929, the approximate peak of activity in that year. Among these were the food products, leather and shoe, and textile industries.

Conforming to the experience of previous depressions the declines in productive activity were most pronounced in the industries producing durable goods. Continued stagnation in the construction industry throughout the year reacted unfavorably on those industries dependent, in large measure, on new construction. Industries manufacturing the major lines of consumers' goods continued to show a relatively high output and these were among the leaders of the recovery movement in the final quarter of the fiscal year.

A rate of increase without precedent in the initial stages of recovery from previous depressions was established by industrial

activity between March and June 1933. After declining to 60 percent of the 1923–25 average rate of production, industrial activity expanded rapidly in the last quarter of the fiscal year and by June was 50 percent higher than in March. Although the National Recovery Administration was functioning before the end of June, no codes had been put into actual operation. Nevertheless, producers hastened to take advantage of the prevailing level of costs and a considerable part of the increased industrial activity in May and June can safely be attributed to the imminence of codes being adopted. For the fiscal year as a whole the relative decline in the manufacturing and mining industries was approximately the same.

Building activity also fell to an extremely low level, notwithstanding continued efforts to expand public construction. The major Federal program of public works, involving an eventual expenditure of nearly $3,300,000,000, was adopted too late in the fiscal year to be reflected in actual operations during the period under review.

The extent of the decline in this industry is indicated by the fact that in the latter half of the fiscal year the seasonally adjusted index of construction dropped to 14 percent of the 1923–25 average, and for the fiscal year the index at 23 compared with 127 in 1928–29. What this means in terms of business activity may be judged from the fact that the value of construction business handled in 1929, according to the construction census, was $7,286,000,000.

Total contracts awarded in 37 States [2] amounted to $1,117,000,000, a reduction of 43 percent from the previous fiscal year. The best relative showing was in the public works and public utility group which fell 30 percent in value, compared with a decline of 52 percent for the residential group and of 49 percent for the nonresidential group. By June contracts awarded in 37 States were barely above $100,000,000 and signs of a revival in activity, other than on public works, were still lacking.

Resumption of private construction on a broader scale is dependent, in a considerable measure, on the availability of easier capital. By the end of the fiscal year no change had occurred in the long-term capital market which would tend to encourage private construction. No long-term real estate bonds were publicly offered between February and June, and the total offered during the fiscal year was insignificant. Mortgage money from almost all sources has been hard to obtain and renewals have constituted a problem.

Construction costs declined further during the first half of the fiscal year, but there was a fairly rapid rise during the latter half owing to the increase in construction material prices. The Engineering News Record's index at the end of the fiscal year had advanced to 166, compared with 153 at the beginning of the fiscal year and an average of 207 in 1929.

Although a difficult period for industry it was possibly an even more trying period for agriculture. Crops were about equal in acreage to those of other recent years and yields per acre were about average. This acreage, however, has been producing a slight surplus for a number of years and the carry-over at the end of the fiscal year, which represented surplus, was close to a record for major crops,

[2] According to the F. W. Dodge statistics.

such as wheat, cotton, and corn. Meanwhile the export markets for a number of important farm products have been considerably curtailed as a result of the growth of large-scale farming abroad, the bringing of new lands in foreign countries under cultivation, and the other factors generally tending to reduce trade.

The combination of good crops and a large livestock inventory, together with the general depression and a decreased purchasing power, caused a steady decline in agricultural prices to the lowest point in about 35 years. Prices of goods produced by farmers declined at a more rapid rate than the goods which they purchased and the farmer's ability to buy products of industry thus has been greatly lessened. This has had an important influence on industrial activity. From March to June agricultural prices advanced sharply as a result of the Government's agricultural program and an anticipation of adoption of inflationary measures.

The decline in prices seriously aggravated the very great debt and tax burden on agriculture. The Department of Agriculture estimated that in 1933 over 40 percent of the farms were mortgaged and that farmers were in debt to the extent of 12 billion dollars, about 8½ billions of which was mortgage debt. It also estimated that fixed charges paid by farmers were very high amounting to about 30 percent of the gross income last year.

Deflation in industry and agriculture had a marked effect on railroad traffic and revenues. Car loadings of originating freight declined 16 percent and ton-miles of revenue freight by 21 percent. Railway operating revenues for class "I" railroads, which handled over 98 percent of railway tonnages, amounted to about 3 billion dollars, 18 percent less than in the preceding fiscal year. Net operating income was only 6 percent below the previous fiscal year but almost 50 percent less than in 1930–31. In the closing months of the fiscal year net operating income showed an encouraging increase which was well in excess of the rate of growth in traffic volume. Although the total for the month of February was only $10,314,408, income had climbed to $60,723,013 by June. Railroad credit, impaired as a result of shrinking revenues, was maintained by additional advances from the Reconstruction Finance Corporation. During the fiscal year $193,956,702 was advanced to 51 railroads or their receivers.

The motor truck has continued to grow in importance as a vehicle of transportation for both passengers and freight. Although the most effective use of the motor truck has been found to be on comparatively short hauls, the range of its effectiveness was somewhat widened during the past fiscal year.

Air-transport operations were adversely affected by prevailing economic conditions, but despite this handicap continued expansion occurred in several directions. Passenger-miles flown increased from 120,121,467 in 1931–32 to 137,006,531 in 1932–33, an increase of 14 percent despite a reduction of 12 percent in the number of passengers carried. Express poundage carried increased 28 percent to 1,252,860 pounds. Mail poundage was reduced 24 percent to 6,741,788 pounds.

A further shrinkage in commerce prolonged the recovery of shipping, especially that engaged in foreign trade. For the final quarter of the fiscal year the advance in both domestic and foreign trade reacted favorably on marine business and on June 30, 1933, idle tonnage was 5.5 percent less than on the corresponding date of 1932.

Considerable progress was made during the fiscal year in the development of our inland waterways system.

Foreign trade of the United States was affected by the forces, both national and international, that continued to restrict the free exchange of goods and services. Notwithstanding a relatively marked expansion during the final quarter of the fiscal year, foreign trade touched the lowest level in about three decades. United States exports dropped from $1,948,000,000 for the year 1931–32 to $1,440,000,000 in 1932–33, or 25 percent. Although the decline in unit value of 11 percent was responsible for a part of this drop in value, the decrease in physical volume was about 17 percent, or relatively as great as in the preceding fiscal year. Imports fell off 33 percent from $1,730,000,000 in 1931–32 to $1,168,000,000 in 1932–33, but owing to a relatively greater drop in the level of import prices—19 percent—the decrease in quantity was only 17 percent, or about the same as in exports.

The country's "invisible" transactions also fell to new post-war low levels during the calendar year 1932, the latest period for which estimates are available. Such an important item as United States tourist expenditures abroad fell in the calendar year 1932 approximately 22 percent below the level of 1931. Immigrant remittances were only about four fifths as large as in 1931, while both shipping receipts and payments fell about 50 percent. The most important class of "invisible" receipts, namely, interest on United States investments abroad, fell about 33 percent.

In the final quarter of the fiscal year, foreign merchandise trade returns assumed a more favorable aspect, and by June the dollar value of shipments was larger than in the corresponding period of the preceding year, for the first time since 1929. Although these increases in both exports and imports were in part attributable to increasing business activity throughout the world they were influenced in large part by the trend of prices and dollar exchange. The volume, as well as the unit value, of both exports and imports for the quarter showed increases over a year earlier.

ASSISTANCE TO FOREIGN AND DOMESTIC BUSINESS

The stagnation of the movement of goods between nations is admittedly not only one of the serious results of the world depression, but, at the same time, a fundamental reason for the prolongation of this unhappy state of affairs. Apart from the importance of our export trade in manufactured products, American agriculture is also dependent, to a considerable extent, upon foreign outlets. Even last year, when the value of our exports had shrunk to the lowest point in more than a quarter of a century, foreign markets furnished the means of subsistence to several important groups of our farm population, notably those interested in producing cotton, tobacco, wheat, and hog products. During 1932, in spite of unparalleled handicaps, more than one half of the raw cotton produced in the United States was sold abroad, as was more than one fourth of our leaf tobacco, and a like percentage of our hog lard; 136,000,000 bushels of wheat—more than one seventh of that important crop last year—went to foreign markets.

During the year, the foreign service of the Department has been able to render varied services to our trade with the rest of the world. The Bureau of Foreign and Domestic Commerce has followed, and reported upon, every vital commercial aspect of changing world conditions. It has provided a wealth of useful data on such perplexing matters as tariffs, surtaxes, quotas, import licenses, foreign-exchange controls, commercial treaties, and international agreements. Important data on the monetary situation have been prepared; such subjects as credits, foreign investments, and debt payments have been studied comprehensively. With a view to possible aid to our own governmental agencies, as well as to individuals or organizations, the Bureau has investigated unemployment relief abroad, aid to the farming community, foreign social insurance, and loans abroad for public works. Foreign commercial laws have been studied, as have taxation matters and life-insurance developments abroad. Much of the basic data used by the American delegation to the London Economic and Monetary Conference was compiled in the Bureau of Foreign and Domestic Commerce.

Serving individual industries in foreign-trade matters, the Bureau has secured equitable treatment for American chemicals under certain embargo and quota systems; has inauguarated a series of studies of foreign radio markets; has acted as an intermediary in problems connected with Chinese goatskins; has issued world charts of facts on major minerals; has helped to overcome formidable obstacles to the distribution of American motion pictures abroad; and has performed similarly substantial foreign-trade services in numerous other industrial fields.

In the domestic field, because of curtailment in the budget, it has been necessary to abandon the work of making special surveys and investigations which in past years have been often beneficial only to particular industries. The Department, however, has now undertaken assistance to domestic manufacturers and merchants of a more general and long-range kind. The object of these studies will be to disclose the underlying forces which are at work in our business system—studies which no single industry is in a position to undertake, but which are essential if in the future the different parts of our industrial system are not to be permitted, through the over-development of some and the under-development of others, to fall into the dislocations from which we are now suffering.

In its endeavor to stimulate domestic business, the Bureau of Foreign and Domestic Commerce has made studies of operating costs and production capacity in various industries, ranging from jewelry to marking devices and from confectionary to drop forgings. It has completed the National Drug Store Survey. It has taken energetic steps toward the elimination of the " returned-goods " evil in retailing. It has studied the " location structure " of retail trade. Industrial marketing problems have been given careful consideration. A series of "Aids to analyzing markets " has been issued. A new type of marketing and economic-background study by " commercial districts " has been carried out in cooperation with 10 universities in the West-Mid-Continent. A study of the national income has been undertaken.

REORGANIZATION OF THE BUREAU OF FOREIGN AND DOMESTIC COMMERCE

The activities of the Bureau of Foreign and Domestic Commerce, having been the subject of considerable study by the Department, a reorganization was effected. For many years the Department has maintained a rather extensive foreign service, engaged not merely in the promotion of American export trade and in rendering service to American business men abroad but in economic reporting and in studying the general business trends in the various countries in which they are stationed.

The foreign staff of the Department has been drastically curtailed and its personnel reduced to approximately one third of the number of men in the foreign field at the close of the last fiscal year.

Relieved of the necessity for acting in a capacity somewhat analogous of that of salesmen for American products abroad, the foreign representatives of the Department of Commerce will now be able to concentrate on their primary function of providing the Bureau of Foreign and Domestic Commerce, for the benefit of American business as a whole, with complete and intelligently analyzed information concerning the significant economic, financial, and commercial developments that are constantly taking place in foreign countries. Current reporting on such changes in foreign government regulations is essential and is a legitimate activity of the Department. Equally important is the Bureau's function as a coordinating and distributing center for information, whether obtained through its own service at home or through the consuls of the State Department, bearing on basic economic, financial, and commercial trends abroad.

While looking forward to a general coordination agreement with the Department of State, the Department of Commerce announced on June 14 (effective June 30) as a part of its program for maintaining the efficiency of its service at greatly reduced cost, the closing of 21 of its 53 foreign offices, with, in some instances, a reduction of the staff at the offices retained. Most of the posts abandoned are located in the countries less important from an exporting standpoint. The territories which they have been serving will hereafter be served from the nearest Department of Commerce office located at an important capital. The separation from the service of the officials in charge of the closed offices in no way reflected on their ability or on the character of the services they have rendered, and efforts have been made, in many cases successfully, to find employment for a number of the men recalled. The offices closed on June 30 were:

EUROPE: Belgrade, Berne, Bucharest, Budapest, Helsingfors, Lisbon, Oslo, Riga.
LATIN AMERICA: Caracas, Guatemala, Montevideo, San Juan, Sao Paulo.
FAR EAST: Bangkok, Hong Kong, Mukden, Wellington.
CANADA: Montreal, Toronto, Vancouver.
AFRICA: Accra.

In the interest of economy the Department, in June, also reorganized its domestic district office service. It is believed that the saving of approximately $325,000 in the annual cost of maintaining the domestic field service system can be effected without endangering essential services to local business by substituting cooperative offices

for the 10 district offices which have been closed and by curtailing expenditures in the 24 offices retained. District offices in the following cities have been closed: Charlotte, N.C.; Denver, Colo.; Des Moines, Iowa; El Paso and Galveston, Tex.; Indianapolis, Ind.; Milwaukee, Wis.; Mobile, Ala.; Salt Lake City, Utah; and Wilmington, Del.

In each case the Department has signified its willingness to establish a cooperative office in these cities after negotiations with the local commercial organization (association of commerce; chamber of commerce; or board of trade). The Department now maintains cooperative offices in 49 important cities in the country under the arrangement with the local commercial organization. The latter pays the salary of a qualified foreign trade secretary and furnishes the necessary office equipment and space. In return, the Department supplies a wide range of foreign and domestic trade information kept always current by a steady flow of information reaching the Department from its foreign offices as well as facts and figures developed through the facilities of the Department in Washington. The Government information is supplied under a guarantee by the local commercial organization that it will be made available impartially to all interested business men in the community.

PROGRESS IN CIVIL AERONAUTICS

The Federal Airways System, as now established, comprises 18,100 miles of lighted and 900 miles of unlighted airways equipped with 262 landing fields and 68 radio communication stations, besides beacon lights, a weather reporting service, more than 13,000 miles of teletypewriter communications circuits, and the trained personnel necessary to operate and service this equipment. During the year, no new airway construction was authorized, and, for reasons of economy, the lights on three routes over which no operations were scheduled were removed.

New steps taken by the Aeronautics Branch to surround passengers on the scheduled air lines of the country with safety precautions included the practical service testing by the Department and the radio system for the blind landing of aircraft. This system makes use of radio throughout and enables aircraft to land at an airport entirely obscured by fog. It was installed at the Newark Municipal Airport, Newark, N.J., and numerous tests under conditions which would be experienced if in regular use, were made. Department of Commerce pilots effected scores of blind landings in demonstrating the practicability of the system, which has been welcomed as the most practical solution yet devised for the problem of bringing aircraft consistently to safe landings where the ground cannot be seen by the pilot.

The Aeronautics Branch flight checked and examined more than 500 pilots engaged in interstate scheduled air-passenger service during the year to ascertain their ability to fly blind, and their knowledge of the use of radio and other aids to air navigation, including meteorological data. Upon the accomplishment of the flight tests and written examinations, these pilots were issued scheduled air-transport ratings.

The transmission of weather maps over the teletypewriter circuits of the Federal Airways System was found to be practicable in tests and such a service was inaugurated on a nation-wide scale with the cooperation of the United States Weather Bureau. The United States is divided into three sections for this purpose, with a map transmitted for each section every four hours, enabling airmen to ascertain beforehand the type of weather prevailing in any part of the country, both on and off the Federal Airways System. An important improvement in the transmission of the radio range beacon signals which guide airmen along the Federal airways was accomplished by the development of a new type transmitting antenna. This antenna, designated as the T-L type, eliminates night variations found in the old loop type and which caused the radio courses to shift and become distorted. Thorough tests have demonstrated the merits of this antenna and installations are now being made.

Another distinct forward step in the Department of Commerce supervision over the design and construction of commercial aircraft was taken by a revision of the airworthiness requirements. The changes were made also for the purpose of taking full advantage of all available aerodynamic information, and to make the standards more adaptable to the individual characteristics of specific aircraft.

Some apprehension was expressed lest, in the effort to hold down expenses, the efficiency of the Department aids to air navigation might be impaired and consequently pilots and passengers placed in peril. There is no foundation for this apprehension. The safety of air travelers is, and may be counted on to remain, a paramount consideration of the Department.

BUREAU OF NAVIGATION AND STEAMBOAT INSPECTION

During the year the Bureau of Navigation and Steamboat Inspection collected more than $1,600,000 in revenue through tonnage duties, navigation fees, and fines. It recommends legislation strengthening the laws protecting our coastwise trade and excluding alien vessels from our domestic fisheries.

On June 30, 1933, the merchant marine of the United States comprised 24,868 vessels aggregating 15,060,157 gross tons. These figures include 642 vessels of 190,803 gross tons built during the year. On July 1, 1933, there were being built, or under contract to be built, in our shipyards for private shipowners, 60 vessels of 34,846 gross tons. The above total indicates a reduction of 288 vessels of 797,498 gross tons from the merchant marine of the preceding year. This reduction is accounted for by the scrapping of a large tonnage by the United States Shipping Board. There are at present laid up and out of commission 2,662 vessels aggregating 4,146,538 tons. The crews for the merchant marine, excluding masters, aggregate approximately 184,953. Of this number 41,136 were serving on the laid-up vessels.

The approval of the act of June 13, 1933, as amended, relating to the construction and inspection of boilers, "unfired pressure vessels, and the appurtenances thereof", will enable the Board of Supervising Inspectors of Steam Vessels to prescribe rules and regulations covering these subjects that are thoroughly modern in every respect.

In order to extend and improve its service in inspecting marine construction and boilers on the vessels coming under its jurisdiction, the Bureau of Navigation and Steamboat Inspection urges ratification by Congress of the International Convention on Safety of Life at Sea which would place the United States on a parity with the other principal maritime nations of the world in promoting the safety of ships, passengers, and crews at sea. It also urges the extension of existing steamboat inspection, legislation to apply to the constantly increasing number of diesel-engine-propelled ocean-going vessels, and the amendment of existing law so as to permit the local inspectors of steam vessels to make more exacting tests of operators.

LIGHTHOUSE SERVICE

In the Lighthouse Service progress is recorded in revision of the entire system of aids to navigation made necessary by the economy program. A thorough review was made of the whole system, marine interests were consulted, and a program of economies prepared. This work is still in progress. Considerable reduction of maintenance costs has been found possible through the discontinuance of some lightships and light stations, and the conversion of a number of stations to automatic operation, accelerating economy plans under way for some years. In a number of instances it was found possible to supply better service with less expensive aids, and the availability of more modern equipment, including improved lighted buoys, and of radio aids to navigation.

Although 1,718 aids to navigation were discontinued during the year, the total number on June 30 was 22,495, showing an actual net increase, mostly in the smaller types of aids marking improved waterways. Facilities for the efficient operation of the Lighthouse Service were distinctly improved by important depot construction at Portland, Maine, Chelsea, Mass., and other places, and by the completion of 4 new lighthouse tenders; in addition, the construction of 3 others was commenced. Important advances and technical improvements were made in the application of electricity for signal lights at stations and on buoys, and also with respect to fog-signal apparatus. The maintenance of aids to navigation on the entire Mississippi River system was consolidated under a superintendent at St. Louis. Important lighthouse construction was in progress. Extensive service tests were initiated of a new system of distinguishing buoys at night by the nature of the flash. The radiobeacon system maintained now includes 104 signals, well distributed along the coasts.

COAST AND GEODETIC SURVEY

By new and extensive surveys of the adjacent water areas, the Coast and Geodetic Survey has added considerably to the basic surveys of the interior of the country, and contributed much scientific knowledge helpful in warding off dangers from earthquakes by its studies of earth movements, its investigations of the densities of the earth's crusts, and in many other ways. New instruments for recording strong earth motions have been developed by the Survey and tried out during the year. These make it possible to get ac-

curate information concerning the actual motions of the earth, and such information is of great importance to engineers and architects in designing buildings that will withstand earthquake shocks. Three of the new instruments were in operation at Long Beach, Calif., during the earthquake of March 10, 1933, and very valuable records for study and investigation were obtained in learning what types of buildings are most likely to suffer the least damage.

The radio has revolutionized the methods used in charting the waters along our coasts. Through sound waves produced by bombs exploded near a sounding ship and transmitted through the water to shore stations and automatically returned to the ship as radio signals, the Coast and Geodetic Survey has discovered a large submerged mountain over a mile high, 20 miles long and 8 miles wide about 70 miles off the California coast and accurately charted it by this radio acoustic method during the past year. On the Atlantic coast a continuation of the Delaware River Valley was found 60 miles from shore and charted by this same method, which is especially valuable where the distance out is so great that shore stations cannot be made visible.

BUREAU OF FISHERIES

The Bureau of Fisheries carried forward its biological surveys of the commercial and game fisheries of the marine and interior waters for the purpose of determining changes in abundance, of assisting in the formulation of proper conservation measures, and of promoting the science of "water farming." Contributions to fish hatchery management and technique were made, which, in several cases, have resulted in more economical operation and better fish. Such technological research as the development of fish oils and fish meals of high quality for animal feeding have been worth hundreds of thousands of dollars to the American farmer and the American fisherman. During the past year the discovery and development of an electrometric method for detecting the relative freshness of fish may make revolutionary changes in distribution and marketing methods.

Economies and waste correction have resulted from the policies followed in the control of commercial fishing in Alaska. The Alaska fisheries have been built up so that an abundant yield may be obtained each season without impairment of the future supply. Activities in the fur-seal industry at the Pribilof Islands in the fiscal year 1933 resulted in the take of more than 49,000 sealskins.

BUREAU OF STANDARDS

The work of research and scientific investigation has been continued. The testing of supplies purchased by the Federal Government was one of the major activities of the Bureau of Standards during the year. Government purchasing by specification, while leading to large economies, is steadily increasing the demands on the Bureau for this work. During the past year, for example, 3,401,566 barrels of cement were tested, an increase of 10 percent over 1932. The total fee value of the testing done (the greatest

volume in the Bureau's history) for Federal and State Governments and for the public—which pays commercial prices, the fees being returned to the Treasury—amounted to about $960,000.

The Bureaus of Standards and Mines led in activities along the lines of eliminating waste. During the year the Bureau of Standards rendered noteworthy assistance to manufacturers, distributors, and consumers interested in reduction of waste through simplification, commercial standards, and the use of nationally recognized specifications, also to governmental and private organizations concerned with the promotion of building activities.

Noteworthy accomplishments in the field of fundamental measurements include the determination of the value of the ampere and the ohm by absolute methods. This was a part of an international program to establish the electrical units on an absolute basis in terms of the fundamental units of length, mass, and time, thus avoiding the necessity of relying upon material electrical standards for their maintenance. The determination, now under way, of the absolute value of gravity at the Bureau of Standards is of importance as a basis for absolute force measurements, and will be of value to the Coast and Geodetic Survey in connection with its gravity survey. Further refinements have been made in the frequency standards maintained at the Bureau, and frequency signals are now broadcast weekly with an error of not more than 1 part in 10,000,000. This service is especially valuable to broadcasting stations in checking their frequency standards in order that they may adhere closely to their assigned wave length. Special motor fuels, made up of blends of alcohol and gasoline, have been studied in the laboratory and in cars on the road, and the performance characteristics of these fuels have been established.

The American Standards Association has offered to carry on much of commercial standards work which has been discontinued at the Bureau of Standards. It is planned that the association (which is a cooperative nonprofit making national standardizing agency made up of trade associations, technical societies, and governmental departments) will hereafter continue the above-mentioned activities under the guidance of the 37 industrial groups, technical societies, and the governmental departments included in its membership.

BUREAU OF THE CENSUS

The outstanding achievement of the Bureau of the Census during the fiscal year was the completion of the Fifteenth Decennial Census, the largest task in census taking ever undertaken by the United States—at a cost of approximately $39,000,000. The census included population, agriculture, irrigation, drainage, distribution, unemployment, manufactures, and mines. An important feature was the inclusion, for the first time, of statistics on distribution, in response to a wide-spread and increasing demand for Federal statistics relating to the distribution of commodities.

The final reports consist of 32 volumes, containing 32,019 pages, as compared with 12 volumes, containing 13,323 pages, for the preceding decennial census. Twenty-four of the Fifteenth Census volumes had been published by June 30, 1933, and the eight remaining volumes were in various stages of printing.

The law provides for the collection of certain statistics once every 10 years or once every 5 years, in years not conflicting with the decennial census of population, etc. Two such censuses relating to 1932 were taken during the past year—the decennial census of financial statistics of State and local governments (formerly known as the census of wealth, public debt, and taxation) and the quinquennial census of electrical industries. Preliminary figures on both of these subjects were issued and final reports on financial statistics of State and local governments were published for a number of States.

BUREAU OF MINES

Progress in improving apparatus and practice to prevent accidents in mines is recorded by the Bureau of Mines. One hundred and forty-seven approvals of electric equipment were issued during the year and 18 explosives tested and approved as permissible for use in gaseous or dusty coal mines; 8 of these explosives tested failed to meet the Bureau's requirements. A fee is charged for this service. The Bureau also reports first-aid or mine-rescue instruction during the year to 74,500 persons in 578 communities in 36 States and Alaska. Such training, together with advocacy of rock dusting as a preventive of coal-mine explosions, studies of causes of falls of roof and coal, and the testing of explosives and electrical machinery already mentioned, no doubt deserve a large part of the credit for the low-fatality rate in coal mines. During the past year experiments by the Bureau have also proved that the pollution of streams by acid coal-mine drainage can be mitigated, if not entirely prevented, by sealing up worked out or abandoned mines so as to exclude air. Removal of this pollution in the streams reduces corrosion and water-treatment problems, increases domestic water supply, and preserves aquatic life.

A saving of more than $300,000 in investment and more than $15,000 in annual expense resulted from studies made by engineers of the Bureau of Mines to devise ways and means of effecting economies in the use of fuel at more than 100 Government-owned power and heating plants. Eight departments of the Federal Government made use of this service. Reports covering the best methods of the development of small lode-gold mines, giving unit costs, are in preparation. Studies of controlling and gaging natural-gas wells have enabled the petroleum industry to eliminate many noneconomical processes formerly based upon the rule-of-thumb methods in oil and gas fields, and have resulted in a marked conservation of these natural resources.

Research on nonmetallic minerals by the Bureau of Mines has laid the foundation for a new potash industry to produce at home an important commodity formerly imported. It has also developed domestic substitutes for foreign chalks, whitings, glass and pottery sand, and clay; and devised methods of recovery that may assist the Alabama graphite industry to meet foreign competitors. The Bureau's helium-production plant manufactured helium with an average purity of 98.20 percent and an average recovery of 90.12 percent—two new records. Educational motion-picture films, produced under the Bureau's supervision, were circulated with 34,638 showings to a total audience of 2,996,000 persons.

THE PATENT OFFICE

With nearly 2,000,000 domestic patents already granted and an almost equal number of foreign patents on record in the office, the work of examining each succeeding application becomes more and more difficult. In spite of difficulties, however, the achievements of this agency of the Department during the fiscal year just closed have been gratifying.

Although the volume of new business presented to the Patent Office was the lowest in 25 years, and the fiscal year as a whole continued the steady decline in patent applications which started several years ago, the last 3 months of the year was marked by an increase in new applications.

The fiscal year recorded a decrease of approximately 14,000 in the number of new patent applications filed and a small decrease in the number of trade-mark applications, as compared with the previous year, and an appreciable gain in design patent applications and applications on patents for plants. The number of patent applications awaiting action on the part of the office was reduced 36 percent, a result that merits comment in view of the fact that the office was operating with a smaller personnel than has been available for several preceding years. The work in the Patent Office is now more nearly current than for many years.

The revenue of the Patent Office did not suffer a loss proportionate to the decline in the volume of business, the annual receipts being only $141,000 less than those for 1932. The increase of the filing fee for patent applications from $25 to $30 was undoubtedly responsible for the relatively high receipts in the face of the decline in business. The year closed with a deficit of only $165,000 as against the huge deficit of $827,000 of the previous year. It is believed that a deficit will be avoided for the fiscal year 1934.

A special committee of representative patent experts was appointed by me to study the practice and procedure in the Patent Office and to formulate recommendations designed to expedite the work, to improve operating conditions generally, and to remove sources of dissatisfaction voiced by inventors and members of the patent profession.

FEES FOR DEPARTMENT SERVICES

The Economy Act of 1932 provided that the Department of Commerce shall charge fees to all persons desiring to obtain more than an occasional statistical and trade statement. These were formerly free to all who applied; but with the need for economy, fees have been imposed for all such data and reports, and it is the testimony of the bureaus concerned, although it is difficult to get the exact figures, that substantial sums are accruing to the Government from this source. In this connection, it should not be forgotten that several of the big units of the Department are completely or nearly self-supporting. The Bureau of Navigation and Steamboat Inspection has almost always turned in a surplus to the Treasury. Then there is the Patent Office the operations of which are almost all taken care of by the fees received.

More detailed information concerning the activities of the various agencies of the Department is contained in the attached appendix (p. 1).

BUSINESS ADVISORY AND PLANNING COUNCIL

On June 26, 1933, at our instance, a group of business men met at the Department and organized the Business Advisory and Planning Council for the Department of Commerce. The personnel of the council was selected from industry by a group of leading business men, and it is representative of American trade and industry. The purpose of the council is to assist in directing the work of the Department along the most effective and productive lines at minimum expense to the taxpayer and to cooperate in the selection and development of fundamental long-range studies considered essential to the proper advancement of business. A conception of the comprehensive program of the council may be gathered from the titles of the following committees and subcommittees it has designated to study various problems:

Decentralization of Industry
International Trade Relations
Business Ethics, Unfair Competition, Standardization, and Elimination of Wastes of Distribution
Statistical Reporting and Uniform Accounting for Industry
Equivalent Compensation in Industry
Social Legislation
General Economic Research
Departmental Problems
Foreign Service of the Department
Work of the Department in making Domestic Commerce Surveys
Fees for Departmental Services
Mineral Services and Publication Policy of the Department
Coast and Geodetic Survey

The Department anticipates invaluable constructive assistance from the study, research, and recommendations of this volunteer group of public-spirited industrialists.

Sincerely yours,

DANIEL C. ROPER,
Secretary of Commerce.

REPORT BY BUREAUS

CHIEF CLERK AND SUPERINTENDENT

Notwithstanding the curtailment of some of the activities of the Department, the problem of space became acute with the housing in the Commerce Building of the Home Loan Bank Board and the National Recovery Administration. However, the moving of the Bureau of Mines to the Interior Department Building and with some readjustments and crowding, space was found to accommodate these organizations.

A CENTURY OF PROGRESS EXPOSITION

The Secretary of Commerce being one of the three members of the United States Commission for this international celebration, which opened at Chicago on May 27, 1933, the Department provided the Commissioner General with considerable assistance in organizing his office and in the preparation of a coordinated plan for governmental participation. Scientific units furnished counsel and materials to the exposition authorities as well as to groups of private exhibitors in planning and assembling presentations of progress made during the last century in research and industry. All bureaus are represented in the 6,300 square feet of space allotted to the Department with displays depicting some features of their services and activities, and have assigned attendants to explain their major functions to visitors.

DISBURSING OFFICE

The table following shows the total amount of all appropriations for the various bureaus and services of the Department for the fiscal year ended June 30, 1933.

Bureau	Annual appropriation act	Funds reappropriated from prior years	Appropriated under Emergency Relief and Construction Act	Special act	Allotments by other departments	Total
Office of the Secretary	$553,200				[1] $86,790.20	$639,990.20
Aeronautics Branch	8,553,500		$500,000			9,053,500.00
Federal Employment Stabilization Board	75,000					75,000.00
Radio Division	[2] 490,000					490,000.00
Bureau of Foreign and Domestic Commerce	3,988,000					3,988,000.00
Bureau of the Census	862,125	$106,000.00				968,125.00

[1] Chicago World's Fair Centennial Celebration.
[2] $468,218.91 of this amount transferred to Federal Radio Commission under provisions of Economy Act (Public No. 212, 72d Cong.).

Bureau	Annual appropriation act	Funds reappropriated from prior years	Appropriated under Emergency Relief and Construction Act	Special act	Allotments by other departments	Total
Bureau of Navigation and Steamboat Inspection	$1,476,165			[3] $1,628.84		$1,477,793.84
Bureau of Standards	2,137,280				$152,700.00	2,289,980.00
Coast and Geodetic Survey	2,399,813		$1,250,000		30,000.00	3,679,813.00
Bureau of Lighthouses	9,849,280		3,810,000			13,659,280.00
Bureau of Fisheries	[4] 2,086,020	$162,595.00				2,248,615.00
Bureau of Mines	1,860,325	[5] 850,608.92			184,000.00	2,894,933.92
Patent Office	3,790,700					3,790,700.00
Printing and binding:						
All bureaus except Patent Office	600,000					
Patent Office	1,100,000					1,700,000.00
Total	39,821,408	1,119,203.92	5,560,000	1,628.84	453,490.20	46,955,730.96

[3] Refunding penalties, etc. (permanent indefinite appropriation).
[4] Includes $110,000 made immediately available in commerce act for 1934.
[5] Includes $850,608.92 fuel yards revolving fund.

Disbursements during the year ended June 30, 1933, from appropriations and from funds transferred from other departments were as follows:

Bureau	Appropriation for—			Total
	1931 and prior years	1932	1933	
Office of the Secretary	$293.08	$348,653.13	$934,597.77	$1,283,543.98
Bureau of Foreign and Domestic Commerce	147.38	83,796.07	3,657,581.08	3,741,524.53
Bureau of the Census		2,554,050.04	759,155.74	3,313,205.78
Bureau of Navigation and Steamboat Inspection		31,722.46	1,321,161.58	1,352,884.04
Radio Division		5,937.01	23,409.93	29,346.94
Patent Office		358,041.86	4,458,986.27	4,817,028.13
Coast and Geodetic Survey	1,044.80	367,923.07	2,970,421.90	3,339,389.77
Bureau of Standards	10,719.82	205,742.82	2,160,613.51	2,377,076.15
Bureau of Lighthouses	2,809.70	904,396.04	11,150,398.33	12,057,604.07
Bureau of Fisheries	749.31	222,845.86	1,793,447.37	2,017,042.54
Aeronautics Branch	211,948.00	2,492,924.18	6,419,800.10	9,124,672.28
Bureau of Mines	104.80	66,554.40	3,252,101.00	3,318,760.20
Total	227,816.89	7,642,586.94	38,901,674.58	46,772,078.41

MISCELLANEOUS RECEIPTS

Office of the Secretary:	
Copying fees	$127.00
Forfeitures, bonds of contractors	120.00
Sale of stores, condemned	550.50
Bureau of Foreign and Domestic Commerce:	
Reimbursement, Government property lost or damaged	997.41
Reimbursement for transportation	15.99
Sale of publications	32,555.16
Work done	1.16
Sale of equipment, etc	63.32
Fees under China Trade Act	2,050.00
Bureau of Census:	
Copying fees	87.00
Work done	3,638.83

Bureau of Navigation and Steamboat Inspection:	
Reimbursement, Government property lost or damaged	$7.00
Sale of publications	228.20
Sale of scrap and salvaged materials	204.50
Sale of waste paper	5.54
Tonnage tax	1,418,774.87
Navigation fines	51,498.98
Navigation fees	169,121.32
Bureau of Standards:	
Reimbursement, Government property lost or damaged	15.00
Sale of scrap and salvaged materials	10.00
Interest on deferred collections on payments	.16
Testing fees, Bureau of Standards	21,601.70
Bureau of Lighthouses:	
Commissions on telephone pay stations in Federal buildings outside Washington, D.C	23.55
Forfeitures, bonds of contractors	6.71
Unexplained balances in cash accounts	2.12
Furlough compensation deductions and vacancy savings	5.00
Refund on empty containers	218.00
Reimbursement, excess cost over contract price	343.58
Reimbursement of expenses	659.12
Reimbursement, Government property lost or damaged	4,487.56
Reimbursement for transportation	.34
Sale of scrap and salvaged materials	4,024.29
Sale of stores, condemned	159.55
Sale of stores	31.84
Telephone and telegraph service	62.30
Work done	1,222.71
All other services	91.88
Rent of public buildings and grounds	4,283.93
Rent, telegraph and telephone facilities	2.00
Business concessions	7.00
Permits, fishing and hunting	117.00
Pipe-line water rights	85.00
Sale of buildings	345.70
Sale of equipment, etc	8,858.17
Sale of land	25.00
Sale of land and buildings	3,234.13
Coast and Geodetic Survey:	
Copying fees	900.48
Refund on empty containers	33.00
Reimbursement of expenses	11.76
Sale of charts	43,351.54
Sale of maps	6,603.50
Sale of publications	5,258.11
Telephone and telegraph service	17.04
Work done	.50
Sale of equipment, etc	469.10
Bureau of Fisheries:	
Reimbursement, Government property lost or damaged	36.75
Sale of scrap and salvaged materials	248.03
Telephone and telegraph service	10.32
Sale of equipment, etc	78.50
Sale of subsistence	1,058.48
Patent Office:	
Patent fees, 1932	7,240.75
Patent fees, 1933	4,054,886.67
Bureau of Mines:	
Sale of gas from helium plants (5078)	13,833.86
Sale of gas from helium plants (5091)	35,223.05
Sale of publications	1,235.06
Work done	3.60
Rent of public buildings and grounds	55.00
Rent, land for grazing	1,837.88
Pipe-line rentals, gas	15,000.00

Bureau of Mines—Continued.	
Rentals on leases covering gas rights [1]	$850.00
Business concessions	2,500.00
Sale of equipment, etc	207.01
Testing fees, Bureau of Mines	7,035.00
Aeronautics Branch:	
Copying fees	8.08
Sale of scrap and salvaged materials	17.50
Violation Air Traffic Regulations	1,620.00
Miscellaneous: Reimbursement, gasoline State tax	56.46
Total	5,927,957.15

APPOINTMENT DIVISION

At the close of the year the personnel of the Department numbered 17,842 (15,864 permanent and 1,978 temporary). Of the total number 4,998 are employed in the District of Columbia, and 12,844 constitute the field force.

The number of employees retired on annuity during the year under the civil service retirement act was 85—48 by reason of age and 37 on account of disability. The average annuity of those retired under the act is $885. Under the Lighthouse Service retirement system 31 were retired for age and 49 on account of disability with an average annuity of $1,101.80. A total of 1,335 employees have been retired under the two systems to the close of June 30, 1933.

DIVISION OF PUBLICATIONS

The following statement gives, for the fiscal years 1932 and 1933, the amounts available to the Department for printing and binding, the amounts expended, and the unused balances.

	Fiscal year—	
	1932	1933
Services other than the Patent Office:		
Amount available	[1] [2] $757,500.00	[3] $476,000.00
Expenditures	753,370.89	[4] 347,770.32
Balance	4,129.11	128,229.68
Patent Office:		
Amount available	1,430,000.00	1,300,000.00
Expenditures	1,406,570.28	[4] 1,274,639.49
Balance	23,429.72	25,360.51

[1] Does not include the Bureau of the Census. During the period July 1, 1929, to June 30, 1932, the cost of printing and binding for that Bureau was paid from appropriations for the Fifteenth Decennial Census.
[2] Includes a contribution of $1,500 to the Bureau of Fisheries, accepted under provisions of section 8, Public Act 240, Seventy-first Congress.
[3] The appropriation for printing and binding for 1933 was $600,000. This amount was reduced by the Bureau of the Budget to $476,000.
[4] Estimated; exact figures for 1933 cannot be given until all work ordered in that year is completed and billed.

Receipts from sales of the Department's publications for the fiscal year 1932 (the latest period for which complete data are available) were $632,005.55, compared with $699,593.94 for 1931. The following table presents a comparison for the two years by selling agencies:

[1] Transfer and counter warrant issued in 1933 to correct erroneous deposit made in 1932.

Sales	Receipts	
	1931	1932
By the Superintendent of Documents: Miscellaneous sales and subscriptions	$230,099.64	$204,922.99
By Coast and Geodetic Survey: Coast pilots, inside route pilots, tide tables, current tables, charts, and airway maps	73,394.95	56,042.86
By Patent Office: Specifications of patents, reissues, etc., trade-mark section and decision leaflet of Official Gazette, and classification bulletins and definitions	396,099.35	371,039.70
Total	699,593.94	632,005.55

DIVISION OF PURCHASES AND SALES

During the year there were placed 14,412 purchase orders, covering freight, travel, rent, and miscellaneous supplies, and 455 contracts for the field services were examined and forwarded to the Department for approval.

Through the cooperation of the Chief Coordinator's Office of the Bureau of the Budget, material comprising airplanes, engines, boats, etc., to the value of approximately $74,874.69, was obtained from surplus stocks of other Government departments without the transfer of funds. Surplus material amounting to approximately $51,089.49 was transferred, without the exchange of funds, from this Department to other branches of the Government, the principal item being the motor vessel *Sequoia*, valued at $48,860, transferred to the Navy Department.

DEPARTMENT LIBRARY

At the close of the fiscal year 1933 the number of books in the library, exclusive of the fisheries collection, approximated 177,584 volumes. During the year 9,526 books were cataloged and 23,612 cards added to the card catalog. The circulation of books for the year shows an increase of 70 percent over that of the preceding year. There has also been a marked increase in the number of outside visitors using the library for research purposes.

TRAFFIC OFFICE

The traffic office has kept abreast of changes in rates and conditions, enabling the Department to take advantage of opportunities to reduce costs in the transportation of employees and property.

SOLICITOR'S OFFICE

During the fiscal year ended June 30, 1933, 527 contracts, totaling $4,140,712.25, together with 77 contracts of indeterminate amounts; 2,013 leases, amounting to $256,919.52; 9 insurance policies, amounting to $1,607,740; 37 revocable licenses, amounting to $1,644; 23 deeds, involving the sum of $72,270; 212 contracts with bonds, amounting to $1,871,097.88; 76 annual bid and performance bonds; 126 official bonds, amounting to $979,985, were examined (approved, disapproved, drafted, redrafted, or modified).

The number of legal opinions rendered, formal and informal (memorandum), totaled 173 (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 bills, reports relative thereto, etc.) numbered 90. Power of attorney cards, authorizing agents to execute official and contract bonds for surety companies, totaled 4,200. In addition, approximately 10,500 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.

AERONAUTICS BRANCH

The organization structure of the Aeronautics Branch was not changed during the past fiscal year, the activities of the Branch being met by the Air Regulation Service, the Airways Division, and the Aeronautic Development Service.

AIR REGULATION SERVICE

In carrying out the details of the regulatory powers vested in the Secretary of Commerce by the Air Commerce Act, the Air Regulation Service coordinated the work of two principal divisions, Inspection Service and Licensing Division.

INSPECTION SERVICE

The adoption of an amendment to the Air Commerce Regulations requiring that transport pilots flying airplanes engaged in scheduled operation of interstate air passenger service hold ratings issued by the Department of Commerce resulted in an increase in the duties performed by the Inspection Service during the year. A total of 557 scheduled air transport ratings were issued to pilots who successfully accomplished exhaustive tests and examinations by Department inspectors and met the requirements as to flying experience.

Airline inspectors completely reinspected all of the interstate air passenger lines as to qualifications for certificates of airworthiness to operate. This inspection included, in each case, a thorough analysis of equipment, operation and maintenance procedure, and the facilities used.

In addition, the Inspection Service inspected and examined all aircraft and airmen applying for new licenses or renewals; inspected and tested aircraft for approval by the Department; inspected aircraft repair stations, civilian flying schools, and parachutes for which approval was asked; conducted field investigations of accidents in civil aeronautics; investigated reported violations of the Air Commerce Regulations; and enforced the Air Commerce Regulations and Air Traffic Rules.

LICENSING DIVISION

The accomplishments of the five sections that comprise this division—medical, registration, enforcement, accident board, and engineering—are set forth as follows:

Medical section.—The following table shows the number of physical examinations certified during the past fiscal year and those in the preceding 4 years:

	1928–29	1929–30	1930–31	1931–32	1932–33
Original examinations, trained pilots	3,709	2,701	894	695	769
Reexaminations, all classes	8,013	18,595	23,296	25,117	26,167
Student pilots, original examinations	16,756	22,606	15,196	11,704	7,295
Total	28,478	43,902	39,386	37,516	34,231

The continuing decrease in the number of original examinations of student pilots is believed to be due primarily to economic conditions.

On June 30 there were 756 medical examiners authorized to make physical examinations for the Aeronautics Branch. There were 23 examiners at points outside the United States.

The use of the perimeter as a method of measuring the visual field was discontinued on February 1 and on February 6 the fees to be paid for original and annual physical examinations were materially reduced.

On October 1, 1932, the office which had been maintained by the assistant medical director in Kansas City was closed and the assistant medical director returned to the Washington office.

Registration section.—This section, during the fiscal year ended June 30, 1933, reviewed 26,397 applications for aircraft and airmen's certificates for compliance with the Air Commerce Regulations, and approximately 15,000 aircraft inspection reports for conformity with approved type certificates; issued 17,344 certificates for aircraft and airmen; recorded 6,239 transfers of title to aircraft; recorded 29,781 renewals of aircraft and airmen's certificates; maintained all files and records pertaining to aircraft and airmen; prepared correspondence relating to status of aircraft and airmen's licenses, and prepared all forms pertaining to the licensing of aircraft and airmen. It also issued 223 certificates of airworthiness for export covering aircraft and components exported to 29 countries.

The renewal of aircraft and pilot certificates continued to increase. The increase over last year was as follows: Aircraft, 22 percent; pilots, 6 percent. The total volume of accountable work during the year decreased 5 percent from that of the previous year.

Enforcement section.—During the year this section has handled the technical phases of enforcing the provisions of the Air Commerce Act of 1926 and the preparation of amendments in the enforcement of the Air Commerce Regulations and the Air Traffic Rules. It has taken care of the assessment and settlement of penalties, and has acted in a general advisory capacity to the Aeronautics Branch in all matters pertaining to air law.

The section has coordinated with the State authorities in the interpretation and enforcement of Federal and State aeronautic regulation, and a great deal of research has been conducted into the subjects under consideration by the International Committee of Technical Aerial Legal Experts. The work of this committee culminates

in the preparation of international conventions on subjects dealing with private air law, and these conventions will in the future have a great deal of effect on United States air commerce.

The section has handled in conjunction with the Department of State all arrangements for foreign flight in United States aircraft.

Accident board.—This board analyzed 1,965 accidents, 304 ground accidents, and 159 mishaps, which occurred in civil aeronautics during the fiscal year. The membership of the board consists of two pilots, a flight surgeon, an aeronautical engineer, a lawyer versed in air law, and a statistician.

The board analyzed all accidents, regardless of statistical grouping, as nearly as practicable in accordance with the method outlined by the special committee on aircraft-accident analysis of the National Advisory Committee for Aeronautics. This method has been adopted as a standard for the analysis, classification, and comparison of aircraft accidents, so that both civil and military aircraft accidents may be made comparable.

Engineering section.—During the past fiscal year the number of technical data entries decreased slightly, but owing to the number of large transport airplanes and the greatly increased speeds of all types of airplanes which were investigated and the special problems which are constantly arising because of the advanced structural and aerodynamic features which are incorporated in most of the new airplanes, the work of the section has increased materially. The establishment of closer contact with the industry has aided greatly in reducing the volume of necessary correspondence.

The result of the rationalization of the airworthiness requirements for aircraft, which has been in the process of preparation for the past two years, was forwarded to the aircraft manufacturers for their consideration. These changes in the requirements were made for the purpose of making the design standards more adaptable to the individual characteristics of specific aircraft with the least possible change for conventional types. The comments received from the manufacturers indicate that this first attempt to rationalize the current requirements will be highly satisfactory.

Further study was made on the requirements for autogiros on the basis of test reports of actual flight conditions.

The requirements for aircraft components and accessories were formulated and placed in effect on March 1, 1933. These specifications apply to all important components and accessories which are manufactured as complete units, except engines and propellers, and purchased by aircraft manufacturers and/or operators for use on licensed aircraft.

Aeronautics Bulletin No. 7-G pertaining to the requirements for engines and propellers was revised to include certain changes deemed necessary. In an effort to cooperate with the engine manufacturers the policy of permitting the manufacturers to conduct the required type test of new engines at their own factory was adopted.

For the fiscal year, 21 approved type certificates were granted for airplanes, 1 for an autogiro, 1 for a glider, 42 for propellers, 19 for engines, 12 for parachutes, and 17 for components and accessories. In addition 36 types of airplanes, 43 propellers, and 10 components and accessories were examined and approved without being granted

approved type certificates. There were also 929 cases of airplane repairs and 386 alterations to licensed aircraft. The total number of technical data entries for the year was 4,569.

AIRWAYS DIVISION

Three outstanding achievements are of record for the Airways Division during the fiscal year: (1) the inauguration of weather-map service every four hours by teletypewriter circuits to 78 air terminals in the United States; (2) the substitution of the new T-L antenna for the old loop type for the transmission of radio range beacon signals to guide airmen flying through conditions of poor visibility; (3) and the installation of distant control of radio aids to air navigation.

The teletypewriter transmission of weather maps, conducted in cooperation with the United States Weather Bureau, provides a complete weather map of the United States, divided into three sections, six times a day. This service enables airmen and airline operators to plan their flights many hours ahead with a reasonable knowledge of the weather conditions to be encountered thereon. Heretofore, weather maps were available only twice a day.

The new T-L antenna has satisfactorily disposed of the problem of night errors that was formerly encountered with the old loop antenna. Six of the new type now are in operation, 38 are about to be placed in service, and the equipment is available for installation at 6 additional sites.

Centralization of the operation of radio range beacons and airways radio communication stations is provided by the distant-control system. Heretofore, the operators of these aids to air navigation were located on the premises of each radio facility, and as these were far removed from the air terminal owing to the hazards of the radio towers, the operators seldom came in personal contact with the people whom they served. Now they are located at the airport in the teletypewriter station and they operate their airways radio broadcasting stations and the radio range beacon transmitters by means of a dial switch and leased telephone lines. This centralization of control and close contact with the flying public will promote efficiency and reduce the cost of operation and maintenance of these air navigation facilities. Three distant-control installations have been completed and the equipment for 62 additional stations has been purchased and delivered for installation during the first few months of the next fiscal year.

Owing to the need for economy in the operation of the Federally lighted and radio-equipped airways, the lights on three routes over which there was no scheduled operation were removed. These were: Norfolk-Washington, Phoenix-San Diego, and Kingsville-Houston. There was no new airways construction authorized for the fiscal year. Part-time operation of lights to conform with scheduled air mail and passenger operations was ordered in keeping with the program of economy.

The work of constructing and maintaining the lighted and radio equipped airways was transferred from the Bureau of Lighthouses to the Aeronautics Branch, effective July 1, 1933.

The Federal airways system as now established comprises 18,100 miles of lighted and 900 miles of unlighted airways on which are installed 262 intermediate landing fields, 1,550 rotating and 281 flashing beacon lights, 68 radio communication stations, 99 radio range beacons, 95 radio marker beacons, and 13,000 miles of teletypewriter communications circuits with 232 teletypewriter stations.

AERONAUTIC DEVELOPMENT SERVICE

The activities of the aeronautic development service centered around the collection and dissemination of aeronautic information, promotion, and correlation of aeronautic research, assistance to communities in the selection and development of airports and rating of airports, publication of airway maps and bulletins, and the general promotion work of the Department looking toward the development of civil aeronautics.

Five units functioned throughout the year in carrying out these duties: Aeronautic information division, research division, airport section, airway mapping section, and a section devoted to special research committees.

INFORMATION DIVISION

Composed of four sections—editorial, statistics and distribution, airway bulletin, and aeronautics reference library—the information division served as the contact office between the Aeronautics Branch, the aeronautic industry, and the general public.

The editorial section edited and prepared for publication the 24 issues comprising volume 4 of the semimonthly Air Commerce Bulletin through which official contact is made by the Aeronautics Branch with the public. It also edited 6 aeronautics bulletins and 4 other publications, and in addition assisted in preparing articles and addresses and statements for the press concerning various phases of aeronautics in response to requests. In keeping with the administration's economy plan, revisions of 10 aeronautics bulletins, nonperiodical publications on technical and nontechnical subjects were discontinued.

Various economic studies were conducted by the statistics and distribution section to assist the industry and many special tables and summaries were prepared in compliance with requests for aeronautical information. Following are some of the most important subjects on which studies were prepared during the fiscal year:

Census and value of aeronautic manufacture for the calendar year 1932, which included aircraft, engine, propeller, parachute, pontoon, and accessory production, as well as quarterly figures based on registrations and reports; study of licensed and unlicensed aircraft by year of manufacture, segregated as to gross weight and horsepower of single- and multi-engine craft; quarterly reports showing status of aircraft, gliders, pilots, glider pilots by States; scheduled air transport operations statistics, both foreign and domestic, compiled monthly, semiannually, and annually; miscellaneous aircraft operations statistics; scheduled air transport and miscellaneous aircraft accident statistics; annual and total accumulated flying time of all

pilots by grades; and special material on civil and commercial aeronautics for actuarial groups and insurance companies to be used as a basis for analyzing aeronautical risks and in fixing premiums.

The Airway Bulletin Section inaugurated the publication of a special weekly bulletin entitled "Weekly Notices to Airmen," which serves as a supplement to Airway Bulletin No. 2. It carries current information regarding airport establishments, changes and warnings, information relative to the Federal aids to air navigation in operation along the airways, aeronautic light establishments and discontinuances, and special warnings that might affect the safety of flight. It is made available to all established airports and landing fields. The section also prepared special material for publication in the Air Commerce Bulletin, published a weekly bulletin showing the status of all proposed airports, this material being of particular use to manufacturers of airport equipment; maintained airport records in a current condition at all times through means of correspondence and from reports of Aeronautics Branch field personnel, and served as the clearing house for all information relative to airports and landing fields and the Federal airways system.

The growing interest and increased activities in commercial aeronautics were shown by a greater use of the aeronautics reference library during the past year, requests for information and service having increased each month.

Publications received numbered 6,000; 620 magazines and reports were indexed and 230 books and documents were cataloged. The circulation was 5,315, and 4,200 requests for information were answered.

RESEARCH DIVISION

Radio aids to air navigation.—The research work on the use of radio in aeronautics was devoted principally to improvement of the radio system of blind landing aids, the radio range beacon system, and an airplane direction finder.

The system of radio aids for blind landing was perfected and many completely blind landings were made, both at College Park, Md., where the experimental work was carried on, and at Newark Airport, N.J., where an installation was made for practical service tests. A completely blind flight in dense fog was made from College Park to Newark and was climaxed by a blind landing, showing the practicability of the system.

The radio range beacons were made still more reliable through improvements in the T-L antenna system which was developed to eliminate the difficulty of course fluctuations of the radio range beacon. The T-L antenna was also adapted for use with the simultaneous radio telephone and range beacon system previously developed. In cooperation with the airways division, means were devised to secure simultaneous visual and aural operation in an airways radio range beacon. The Department installed a combined radio telephone and range beacon, with simultaneous aural and visual operation, and with T-L antenna, at Elizabeth, N.J. A simple means for positive identification of location of airplanes using the range beacons was worked out.

An improved airplane direction finder with visual indicator was developed and flight tested.

Patent applications were filed on 20 of the radio developments.

Lighting research and testing.—An exhaustive study of the use of the newly developed bipost lamp in 24- and 36-inch beacons showed that the use of the new lamp would be advantageous. Nine sets of airplane position lights were tested for approved type certificates, and a reflector for position lights was developed which makes possible the regular production of position lights of greatly increased effectiveness. Tests on several types of landing lights were made. Neon boundary lights were tested, and illuminated wind indicators were studied by an exposure test.

A complete test on an automatic light-sensitive device was made under temperature conditions ranging from 40° F. to approximately 200° F.

Specifications for the colors of aviation red and green glasses have been prepared and standard color glasses furnished.

The candlepowers of a number of parachute flares were measured and a code-flasher mechanism was tested.

Aircraft engines.—For the first time since the construction of the Arlington laboratory in 1929 the demand for type tests of commercial aircraft engines has shown a marked decrease. In the course of the year only two engines were submitted for test. One of these engines failed twice during July 1932 and the other passed in October. Facilities now are available at the Bureau of Standards for the dynamometer calibration of all types of aircraft engines under sea level and under approximate altitude conditions.

Many fuels, propellers, and engine parts have been tested in connection with the investigation of service difficulties. Four out of six crank shafts from approved engines examined for fatigue cracks were found to be unsafe for further use. An electrical method of testing has been devised for applying repeated stresses to metal propellers to determine their resistance to failure under service conditions.

The octane number ratings of aviation fuels are determined according to A.S.T.M. method D357-33T, pending the development of a standard method for rating aviation gasolines.

AIRPORT SECTION

The field staff of the airport section rendered advice in connection with the selection of airport sites and the general requirements for safe airport development; inspected airports preliminary to the assignment of Federal ratings; and appeared before civic groups and meetings of various kinds in the interest of the development of aviation and airports in particular. Eight hundred and fifty-four airports were visited and 32 talks given.

During the past year 244 airport ratings and 73 designations as marked auxiliary fields were issued. These bring the total of rated airports on June 30, 1933, to 287 and the number of marked auxiliary fields on the same date to 73.

The section and its airport specialists worked with State authorities in coordinating their activities with the Department of Commerce and in field inspections of State-developed landing facilities. At the request of the State officials in each case, airport section repre-

sentatives have operated during the past year in the following States: Arkansas, Colorado, Connecticut, Florida, Idaho, Illinois, Michigan, New Hampshire, New Jersey, New York, Ohio, Oregon, Pennsylvania, Tennessee, Vermont, Virginia, Washington, and Wyoming.

AIRWAY MAPPING SECTION

The publication of airway maps for the Aeronautics Branch has been carried on by the airway mapping section of the Coast and Geodetic Survey using the printing facilities of that bureau.

The work completed during the fiscal year brought the total sectional airway maps published up to 18 with 16 additional ones in progress, some of which were near completion at the end of the year. The many changes in aids to air navigation requiring frequent new editions necessitated an increasing proportion of time spent on maintenance.

Sectional airway maps now adequately cover continuous passage on many of the more heavily traveled routes. The sales of these maps and comments on their value by airmen have been most gratifying. The number of new maps published was greater than in any previous year. The completion of several maps to fill in gaps has formed a continuity in these maps from Boston to Los Angeles and San Francisco and from Chicago to Washington that brings out for the first time their potential value not only for flying but also for general administrative purposes of the air transportation companies.

During the fiscal year, 17,647 copies of sectional airway maps, and 11,722 copies of strip maps were issued.

SPECIAL RESEARCH COMMITTEES

Two special research committees met and reported during the year. One was the liaison committee on aeronautic radio research which is a continuing body. It rendered its third annual report on May 15, 1933. The other was the committee on airport traffic control which reported on February 15, 1933. Both these reports are available at the Aeronautics Branch.

ADMINISTRATIVE DIVISION

During the year this division maintained all accounting and bookkeeping records of expenditures from the appropriation "Aircraft in commerce" as well as budget, personnel, and other records relating thereto. Arrangements were made at the close of the year for the transfer to the division of the work relating to accounting, contracts, and personnel paid from the appropriation "Air navigation facilities." This work has heretofore been performed by the Bureau of Lighthouses.

Following is a tabulation of the amounts that have been appropriated under the two titles since the Aeronautics Branch began to function:

Fiscal year—	Aircraft in commerce	Air navigation facilities	Total	Fiscal year—	Aircraft in commerce	Air navigation facilities	Total
1927 [1]	$250,000	$300,000	$550,000	1931	$1,260,830	$7,944,000	$9,204,830
1928	700,000	3,091,500	3,791,500	1932	1,369,660	8,992,640	10,362,300
1929 [2]	859,500	4,659,850	5,519,350	1933	1,000,000	7,553,500	8,553,500
1930	958,000	5,458,620	6,416,620	1934	1,070,570	6,590,210	7,660,780

[1] Second deficiency act, fiscal year 1926, approved July 3, 1926.
[2] Includes under "Aircraft in commerce," $72,500 appropriated by the second deficiency act of 1928 and $85,000 appropriated by the second deficiency act of 1929, and under "Air navigation facilities" $1,000,000 appropriated by the second deficiency act of 1928.

The personnel paid from the appropriation "Aircraft in commerce" for the past six years is as follows:

Date	District of Columbia	Field	Total	Date	District of Columbia	Field	Total
June 30, 1928	104	68	172	June 30, 1931	175	136	311
June 30, 1929	146	127	273	June 30, 1932	159	146	305
June 30, 1930	166	150	316	June 30, 1933	135	133	268

BUREAU OF THE CENSUS

INTRODUCTION

The Fifteenth Decennial Census was completed and the reports had been published or were in process of printing on December 31, 1932, the close of the decennial census period. By January 1, 1933, the last of the large force of temporary employees had been dropped from the roll, and the Bureau went back to its permanent basis on that date.

The magnitude of the Fifteenth Census, the most extensive ever undertaken, is evidenced by the size of the final report—32 volumes containing 32,019 pages. The report of the Fourteenth Decennial Census consisted of only 12 volumes containing 13,323 pages. The Fifteenth Census volumes, bulletins, and special studies contain a total of approximately 66,000 printed pages.

During the fiscal year just closed, the Bureau conducted its regular annual, quarterly, and monthly inquiries, as well as the following investigations: Census of Financial Statistics of State and Local Governments (decennial); Census of Electrical Industries (quinquennial); and Census of Manufactures (biennial). The preliminary or final reports were issued.

FIFTEENTH DECENNIAL CENSUS

The Fifteenth Decennial Census work during the fiscal year 1933 consisted principally in preparing copy for the remaining volumes of the final report and the special reports and studies which had not already been sent to the printer, and in reading proof.

Of the 32 volumes comprising the final report of the Fifteenth Decennial Census, 7 volumes had been published prior to July 1, 1932, 17 volumes were published during the year, and the 8 remaining volumes were in process of printing at the close of the year. Two of the 8 had been printed but not bound, 1 was partly printed, and 5 were ready for the press. The Abstract of the Fifteenth Census, containing 976 pages and presenting in convenient form the most significant data on each of the subjects covered by the census, was published in May 1933. Owing to the increasing demand for graphic presentation of statistics, approximately 500 charts and maps were included in the reports of the Fifteenth Census.

The principal data had been published in the form of bulletins, one for each State, as rapidly as the results for the State were ready, followed by a summary for the United States. Sixteen series of such bulletins were issued. About two-thirds of these bulletins had been issued prior to July 1, 1932, and copy for the remaining third had been sent to the printer by that date. The remainder of the bulletins were published during the past year. These bulletins were bound together to form a number of the 32 volumes of the final report and parts of other volumes.

The general report on each of the main subjects covered by the census is composed of a number of chapters, each covering a subject

or group of subjects, and containing historical and analytical tables. Previously the chapters had been reprinted separately for convenience after the publication of the volume, but at the Fifteenth Census the chapters for population and agriculture were published in advance, as rapidly as they were completed. While copy for a considerable number of chapters had been sent to the printer, and a few published, prior to July 1, 1932, the majority of them were published during the past year.

A list of the volumes and special reports follows.

FINAL REPORTS

Population:
- Vol. I, Number and Distribution of Inhabitants
- Vol. II, General Report—Statistics by Subjects
- Vol. III, Reports by States—Composition and Characteristics of the Population for Counties, Cities, and Townships:
  - Part 1, Alabama-Missouri
  - Part 2, Montana-Wyoming
- Vol. IV, Occupations—Reports by States
- Vol. V, Occupations—General Report
- Vol. VI, Families—Reports by States
- Metropolitan Districts

Unemployment:
- Vol. I, Unemployment—Returns by Classes
- Vol. II, Unemployment—General Report

Agriculture:
- Vol. I, Farms by Minor Civil Divisions
- Vol. II, Reports by States—Statistics for Counties:
  - Part 1, Northern States
  - Part 2, Southern States
  - Part 3, Western States
- Vol. III, Type of Farm—Reports by States with Statistics for Counties:
  - Part 1, Northern States
  - Part 2, Southern States
  - Part 3, Western States
- Vol. IV, General Report—Statistics by Subjects
  - Horticulture
  - Irrigation
  - Drainage

Manufactures:
- Vol. I, General Report—Statistics by Subjects
- Vol. II, Reports by Industries
- Vol. III, Reports by States—Statistics for Industrial Areas, Counties, and Cities

Mines and quarries

Distribution:
- Vol. I, Retail Distribution:
  - Part 1, Summary by States, Counties, and Incorporated Places
  - Part 2, Reports by States, Alabama-Montana
  - Part 3, Reports by States, Nevada-Wyoming
- Vol. II, Wholesale Distribution—Reports by States—Statistics for Counties and Cities
- Construction—Reports by States—Statistics for Counties and Cities

Outlying Territories and Possessions—Population, Occupations, Unemployment, and Agriculture

Abstract of the Fifteenth Census

SPECIAL REPORTS

Chickens and Chicken Eggs, and Turkeys, Ducks, and Geese Raised on Farms
Distribution of Sales of Manufacturing Plants
Foreign-born White Families by Country of Birth of Head
Hotels
Products of Manufacturing Industries
Retail Chains

SPECIAL STUDIES

A number of special studies were made, based on the results of the Fifteenth Decennial Census. These also include detail not contained in the regular reports, and in some cases the results of special tabulations for limited areas. In addition, many of the studies involved considerable research. These studies covered the main subjects of the census as follows:

Population	2
Agriculture	6
Manufactures	2
Wholesale distribution	7
Retail distribution	6
Distribution of agricultural commodities and rural trade	7

FINANCIAL STATISTICS OF STATE AND LOCAL GOVERNMENTS

The Bureau was engaged during the year in collecting statistics of revenues, expenditures, indebtedness, assessed valuation, and tax rates and levies for 1932 for States, counties, cities, towns, and all other civil divisions having power to levy taxes and incur debt. These statistics are collected once every 10 years, and have heretofore been published under the title of "Wealth, Public Debt, and Taxation." Upon investigation it was found that in 46 of the 48 States either a part or all of the information required for the various taxing units of the States could be obtained from records on file at the State capitals. Accordingly, with the cooperation of the State officials, 123 local agents were appointed at the State capitals to prepare census schedules presenting all of the required data available there. The data not available at the capital were secured by mail from the county or other local officials. The canvass was practically completed by June 30, 1933, and preliminary press announcements for 26 States have been issued. The final reports for 26 States were prepared, and 3 of them have been published.

Through the cooperation of State and local officials, and the appointment of local agents wherever possible, the field work for this census was done more promptly and economically than at preceding censuses. One valuable feature of this census is the digest of State laws relating to taxation and revenue. Digests have been published for 3 States and completed for 22 other States.

The estimated national wealth has been included in the Census of Wealth, Public Debt, and Taxation since 1850. Upon the recommendation of the Census Advisory Committee, however, no attempt is being made to estimate the national wealth at this census.

FINANCIAL STATISTICS OF STATES AND CITIES

The annual reports covering Financial Statistics of States and Cities (detailed statistics not included in the decennial census mentioned above) provide information relative to receipts and payments, indebtedness, assessed valuation, and tax levies of the States and of the cities having a population of over 30,000.

During the fiscal year just ended, the final report on Financial Statistics of Cities, 1930, and the preliminary bulletins on Financial

Statistics of States and Cities, 1931, were published. The final reports for 1931 were completed and the report for States was sent to the printer, but the report for cities will not be published at this time because of lack of printing funds.

By Executive order of June 10, 1933, the compilation of financial statistics of cities is limited to cities of 100,000 or more population for the period ending June 30, 1935. This limitation begins with the report for 1932.

QUINQUENNIAL CENSUS OF ELECTRICAL INDUSTRIES

Preliminary work on the Census of Electrical Industries for the year 1932 was started immediately after the beginning of the fiscal year. In accordance with the provision of law, this census covers street railways, electric light and power, telephone, and telegraph business. Motor-bus operations by street railway companies and by companies succeeding to the operation of former street railway companies are also included in the report on electric railways.

For the first time the canvass was made entirely by mail, no funds being available for field work. Approximately 99 percent of the schedules have been received and they are now being edited and tabulated. Press announcements giving preliminary figures on central electric light and power stations have been issued for all States and the United States; also preliminary summaries on electric railways and telegraphs in the United States.

BIENNIAL CENSUS OF MANUFACTURES

The Census of Manufactures, which is taken in connection with the decennial census, is considerably more comprehensive than those taken between decennial censuses. The schedules for 1931 were reduced so far as general inquiries were concerned, no inquiry having been made for number and compensation of proprietors, officials, and salaried employees, for power equipment, or for coal consumed. No curtailment was made, however, in the detailed production inquiries. The production inquiries have been formulated and revised from census to census in accordance with recommendations made by manufacturers' associations and representative manufacturers. By no means can all the suggestions made by these associations and individuals be adopted, and the inquiries represent only the information which is in general demand by the industries.

The preliminary reports were all issued within the year in which the canvass was made (1932) and the final reports, covering 310 industries, were completed and sent to the printer before June 30, 1933, which is relatively earlier than at any previous census. Thirty of the reports, covering 78 industries, have been published.

In addition to the Biennial Census of Manufactures, the Bureau collects and compiles statistics for the years intervening between the biennial censuses of manufactures for the following industries: Clay products; Paper and paperboard and paper-making machines in use; Pulpwood consumption and wood-pulp production; Lumber, lath, and shingles.

The preparation of a card index for use at the 1933 census was begun. This index will carry the figures for a few important items, and its use will facilitate the preparation of the preliminary reports.

VITAL STATISTICS

For the first time the birth and death registration areas of the United States are complete. This is an accomplishment for which the Bureau has been working for many years. The last State, Texas, was recently admitted to the area, the tests made by the Bureau showing that the birth and death registration meets the Bureau's requirement for admission to the registration area. Hawaii and the Virgin Islands furnish transcripts of birth and death certificates, and Puerto Rico furnishes transcripts of death certificates, the statistics being shown separately in the Bureau's reports.

Copy for the 1930 reports on Birth and Mortality Statistics was sent to the printer before July 1, 1932. The preparation of the reports for 1931 is well advanced.

Preliminary announcements have been made of the birth and death rates for 1932 in the birth- and death-registration areas (except Utah, for which transcripts of certificates have not yet been received). These were the lowest recorded by the Bureau, the birth rate being 17.4 and the death rate 10.9 per 1,000 population.

The Weekly Health Index, showing total and infant deaths and death rates, and the Four-Week Summaries of Deaths from Automobile Accidents were published regularly during the year.

The Manual of Joint Causes of Death was published during the year. This is a companion volume to the Manual of International List of Causes of Death, published in 1931, and it will be of material assistance in establishing a uniform method of classifying certificates on which two or more causes of death are given.

A special study entitled "Introduction to the Vital Statistics of the United States, 1900 to 1930" was published.

Owing to the reduction in the Bureau's appropriation, it was necessary to reduce the rate of pay for transcripts of birth and death certificates furnished by State officials from 3 cents to 2 cents each. This reduction has been accepted by all of the States in view of the circumstances, but as the States find it difficult to do the work at this price the Bureau authorized the transcribers to discontinue for the time being the copying of the date relating to birthplace and occupation on the death certificates and the data relating to occupation of parents on the birth certificates.

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INSTITUTIONAL POPULATION

ANNUAL REPORTS

Reports on prisoners in State and Federal prisons and mental patients in State hospitals for the years 1929 and 1930 were published during the year. Similar reports for 1931, also reports on mental defectives and epileptics in State institutions for 1929 and 1930 and for 1931, were prepared but have not been published because of lack of printing funds. Schedules for 1932 are now being collected from these institutions.

Plans were worked out for including judicial criminal statistics in the annual census. Returns for 1932 have been received from 3 States, 14 States are collecting the data, and 1 State is being urged to collect such data. Information for 1932 will not be collected from the 31 remaining States, but the data collected will be compiled for use in determining the value of the statistics.

DECENNIAL REPORTS

The decennial inquiries relating to county and municipal penal institutions and institutions for juvenile delinquents are under way. As an economy measure, it was decided to limit the statistics for county and municipal penal institutions to the first six months of the year.

The Bureau has under consideration the inclusion in the decennial census of institutions of four other classes, namely, institutions for dependent children, child-placing organizations, almshouses, and other institutions for adults.

MARRIAGE AND DIVORCE

Statistics on marriage and divorce have been collected and published annually by the Bureau since 1922 and for various periods prior to that year. A preliminary press announcement for 1932 has been issued, showing a decrease of 7.5 percent in marriages and a decrease of 12.7 percent in divorces as compared with 1931. The final report has been nearly completed.

REPORT ON NEGROES IN THE UNITED STATES

There has been considerable demand for a volume bringing together all of the Fifteenth Census data relating to Negroes, similar to the compilation made after the census of 1910. The work has been begun and it is expected that the report will be ready sometime next year.

COTTON AND COTTONSEED

In accordance with the provisions of law, there were collected and published during the year 12 reports of Cotton Ginned to Specified Dates; monthly reports of Cotton Consumed and Held by Consuming Establishments; monthly reports of Cotton Spindles, of Cotton Held in Compresses, Warehouses, etc., and of Cottonseed and Cottonseed Products.

In addition, two bulletins were published, one at the close of the ginning season, showing the quantity of cotton ginned from the crop of 1932, by States and by counties, and the other giving statistics of cotton production and distribution for the season of 1931–32. The statistics are collected from individual ginneries and from consuming and storage establishments, by a force of 776 agents employed on a part-time basis.

MONTHLY AND QUARTERLY INDUSTRIAL STATISTICS

The Bureau collects and publishes current statistics for 57 industries or commodities (in addition to cotton and cottonseed), 50 on a monthly basis and 7 on a quarterly basis. This represents a reduction of 13 reports as compared with the previous year. The 8 monthly reports on hides, skins, and leather were discontinued because of the repeal of the act authorizing these statistics. Four other monthly inquiries and one weekly inquiry were discontinued during the year, having been taken over by the trade associations. Requests have been made for the resumption of the statistics for two of these industries and for the collection of current statistics for other industries, but on account of the reduction in its appropriations the Bureau has not thus far found it practicable to take up the additional inquiries. The statistics for the monthly and quarterly reports issued during the year for these 57 industries or commodities were compiled from returns from 12,026 manufacturers and other concerns. The Bureau is now publishing current statistics for the following:

MONTHLY

Air-conditioning equipment
Automobiles
Automobile financing
Babbitt metal
Bathroom accessories
Boots, shoes, and slippers
Boxboard
Cellulose plastic products
Commercial steel castings
Convection-type radiators
Distillate oil burners
Domestic pumps and water systems
Domestic water-softening apparatus
Electric industrial trucks and tractors
Fabricated steel plate
Fire-extinguishing equipment
Floor and wall tile
Hosiery
Knit underwear and cut and sewn underwear
Leather gloves and mittens cut
Malleable castings
Measuring and dispensing pumps (gasoline and other pumps)
Mechanical stokers
Men's and boys' clothing cut
Methanol and acetate of lime (wood chemicals)
Oil burners
Paints, varnish, and lacquer products
Plastic, cold-water paints, calcimines
Plumbing brass
Plumbers' woodwork
Porcelain enameled flat ware
Porcelain plumbing fixtures
Prepared roofing
Public-merchandise warehousing
Pulverizers
Pyroxylin-coated textiles
Railroad locomotives
Range boilers
Steel barrels
Steel boilers
Steel furniture and fireproof safes
Structural-clay products
Sulphuric acid
Superphosphates
Terra cotta
Vitreous-china plumbing fixtures
Wheat ground and wheat-milling products
Wool consumption
Wool manufactures, activity of machinery
Work clothing

QUARTERLY

Animal and vegetable fats and oils
Edible gelatin
Electric (mining and industrial) locomotives
Electrical goods (orders)
Lacquers (sales)
Glues of animal origin
Wheat and wheat-flour stocks

ESTIMATES OF POPULATION

Estimates of the population between decennial censuses have been made for many years. The estimates for the United States and the States are based on births, deaths, immigration, and emigration. As this method is not applicable to counties and cities, the Bureau has been experimenting during the past year with various other methods in an endeavor to make more nearly accurate estimates for the counties and cities.

The estimates are used in vital statistics and public-health work throughout the country, and by various branches of the Government, by industrial and commercial concerns, and many others. The accuracy, and consequently the value, of the estimates decline in proportion to the time which has elapsed since the decennial census. This is one reason why a census of population should be taken every 5 years instead of once every 10 years.

SEARCHING OLD POPULATION RECORDS

One branch of permanent census work which brings a very direct and practical benefit to the people is the furnishing of individual records of age, nationality, etc., from the census returns. This work is constantly increasing as a result of the enactment of old-age penson laws in more and more States, and of the increasing requirements to establish age for annuities, citizenship, pensions, passports, working papers, etc., as well as for genealogical purposes and for settling estates. During the year 17,163 searches of population schedules were made, and in addition 5,109 persons consulted the census records, those for the censuses of 1790 to 1880 being available to the public. The later returns are confidential and can be examined only by sworn employees of the Bureau.

The early census schedules are deteriorating rapidly and it will soon be necessary to take steps to preserve these original records. Reconditioning of the records would be but temporary and they will eventually have to be printed or reproduced in some manner if the information is to be available for all time.

OFFICIAL REGISTER

By Executive order of June 10, 1933, the function of preparing the Official Register was transferred to the Civil Service Commission. This publication had been compiled by the Census Bureau annually since 1925.

MACHINE TABULATION

The regular inquiries of the Bureau, together with the special tabulations made for other agencies, required the punching of 8,139,640 cards and the sorting and tabulating of the cards which was equivalent to the passing of 326,921,485 cards through a machine once.

By order of the Secretary of Commerce, there has been established in the Bureau a central tabulation unit to handle the machine-

tabulation work for all bureaus of the Department. This unit has been placed in the Machine Tabulation Division of the Bureau, and the tabulating equipment turned over by other bureaus has been consolidated with the Bureau's equipment.

WORK DONE FOR OTHER FEDERAL OFFICES AND OUTSIDE AGENCIES

The demand for detailed census data not shown in the regular tabulations continued during the year. Special tabulations on various subjects were made for other branches of the Federal Government, for States, and for outside organizations and individuals. A charge is made to cover the cost of the work, total payments of $12,566.61 having been received during the year.

A considerable number of special tabulations were made for the National Recovery Administration, for the Department of Agriculture for use in carrying out the provisions of the Agricultural Adjustment Act, and for industrial organizations for use in formulating codes under the National Industrial Recovery Act.

The Bureau has collaborated with the National Recovery Administration in the preparation of schedules for canvassing business concerns to secure information for the formulation of codes and for checking on employment and pay-roll results of the recovery program. The tabulations of these returns are being made by the Census Bureau, the cost of the work to be paid, of course, by the National Recovery Administration. A test canvass was made by the Bureau, following two different methods—one by mail in Philadelphia and the other by personal visit of agents in Baltimore.

The provision carried in the Legislative Appropriation Act of 1933, approved June 30, 1932, whereby one Government bureau or office can place orders for work with another bureau or office and can pay by check either in advance or upon completion of the work, has greatly facilitated the work for other Federal agencies.

PERSONNEL

OFFICE FORCE

On January 1, 1933, following the close of the decennial census period, the force was reduced to the permanent personnel, numbering 721, and by June 30, it had been further reduced to 673. This is considerably below the permanent force regularly maintained by the Bureau, 72 positions with annual salaries totaling $132,320 having been temporarily abolished because of reduction in the Bureau's appropriations. These positions were made vacant by resignation, transfer, and retirement.

FIELD FORCE

On June 30, 1933, the field force, practically all local agents, numbered 991. This included 746 special agents collecting cotton

statistics, 48 agents on vital statistics work, 54 enumerators on financial statistics of State and local governments, 6 consulting experts, 119 special agents without compensation who were employees of the Forest Service, and 18 others on various kinds of work.

By Executive order of May 23, 1933, the positions to collect cotton statistics were placed in the competitive classified service. As a result of examinations held in the cotton belt by the Civil Service Commission, lists of eligibles were furnished the Bureau and practically all of the 776 appointments have now been made.

APPROPRIATIONS

The Bureau operated during the first half of the fiscal year under the appropriation for the Fifteenth Decennial Census, which was limited to December 31, 1932, and during the second half of the year under an appropriation of $862,125, together with the unexpended balance of the Fifteenth Census appropriation which was made available by law. The expenditures from the two appropriations amounted to $2,459,685 during the year. The total expenditure from the appropriation for the Fifteenth Decennial Census was $39,447,922.

LEGISLATION

The Bureau contemplates recommending at the appropriate time the enactment of legislation to provide for the following:

(1) Complete census of manufactures to be taken every fifth year and a limited census to be taken annually, with certain quarterly and monthly statistics.

In May 1933, the Federal Statistical Board of the Federal Coordinating Service adopted resolutions recommending substantially the above changes in the census of manufactures.

(2) Mid-decennial census of population, to be taken in 1935 (or late in 1934), in connection with the census of agriculture which is provided for by the act of July 18, 1929.

The Bureau has received numerous letters advocating such a population census for reasons which may be briefly summarized as follows:

(*a*) That such a census is needed to reveal and measure the unusual population shifts and changes that are now taking place.

(*b*) That such a census is needed as a basis for intelligent action and planning in business and public affairs.

(*c*) That such a census is needed to make possible reliable population estimates which are necessary for computing death rates, birth rates, and per capita figures, and for other purposes in the years intervening between censuses.

The American Statistical Association and the American Sociological Society at their annual meetings in December 1932, adopted resolutions that a mid-decennial census of population should be taken. In March 1933, the Census Advisory Committee adopted a resolution that such a census be taken late in 1934 or early in 1935 and that it be limited to a few basic items.

The law authorizing a census of agriculture in 1935 provides that it shall be taken as of January 1. This is not a satisfactory date for a census of population, and, if a census of population is to be taken, the Bureau may recommend that the date be changed to November 15, 1934, which is also believed to be a more satisfactory date for agriculture. The cost of enumeration would, of course, be considerably less for the two censuses if taken together. Additional funds for the fiscal year ending June 30, 1935, would be required.

BUREAU OF FOREIGN AND DOMESTIC COMMERCE

The past fiscal year has been a momentous one in the economic history of the United States, and indeed of the entire world. The summer of 1932 marked the apparent turning point in many lands of one of the severest depressions the world has ever known. Improvement has been slow, however, especially in the United States, where recovery was retarded first by the political uncertainty engendered by a national election and later by the collapse of our credit structure. Faced with the necessity for drastic action, a new administration declared a banking holiday at the outset. Congress was called into special session, and, in quick succession, powerful emergency measures were passed. As the fiscal year comes to a close, these new laws are being put to the test. Their success or failure will be written in the annals of succeeding years.

Throughout this interesting but difficult period, the Bureau of Foreign and Domestic Commerce has been functioning in its capacity as the service arm of the Federal Government for American business. The trend in modern thinking is unmistakably toward a more scientific approach to business and economic problems. The scientific approach is a factual approach and requires abundant, dependable data. The Bureau of Foreign and Domestic Commerce has long since anticipated this trend and has gradually developed as the agency of the Federal Government for the collection, analysis, and dissemination of commercial facts, both domestic and foreign. The past year has seen a continuation of this fact-finding function. The necessary curtailment of funds resulting from the economy act has necessitated a careful reexamination and valuation of the functions of the Bureau, and a constructive reorganization. The Bureau now looks forward to an even larger sphere of usefulness in the years ahead.

THE YEAR IN FOREIGN COMMERCE

THE FURTHER ERECTION OF TRADE BARRIERS

The decline in commodity prices, the complete cessation of international capital investment and the timidity and caution surrounding short-term loans, the necessity of meeting interest or amortization by many countries on a heavy volume of indebtedness, and the absence of any international monetary standard for most of the world, all contributed to complicate international economic relations. The continued recession in general business activity throughout the world during the first half of the fiscal year was directly reflected in a reduced volume of exports and imports. But national policies, endeavoring to defend financial stability, to preserve employment, or to exert pressure for political purposes, led to the

erection of increasingly complex and baffling restrictions, barriers, and regulations, calculated to impede the flow of merchandise across frontiers. This tangle has resulted in intensified perplexity—and often stark frustration—on the part of the export community in most of the major countries.

Tariff measures have exerted an exceedingly potent influence. Other elements have proved obstructive or disturbing. The world has witnessed an increased chafing under the obligations of the strict most-favored-nation principle, and a general impulse to evade it. Surtaxes have been imposed on imports originating in countries with depreciated currencies. The system of quantitative limitation of imports by "quotas" spread rapidly during the fiscal year, and import-license requirements were established in many cases. The inauguration or development of foreign-exchange controls is a device that has proved particularly disconcerting and hampering to export and import interests everywhere. In numerous instances such controls have been operated in a preferential, and essentially prejudicial, manner. In fairness it should be noted, however, that the rigors of this condition have been mitigated, in a number of cases, by exchange-clearing and trade-compensation agreements between nations.

In the broad matter of commercial treaties and international agreements, the outstanding developments have included England's abandonment of its traditional position and its adoption of a general tariff; the subsequent Imperial Economic Conference at Ottawa, which resulted in considerable extension of the system of tariff and other trade preferences among the areas constituting the British Empire; and the various efforts or projects for regional tariff arrangements or multilateral agreements, particularly in Europe but also in Latin America.

RECORD OF AMERICAN TRADE

The international economic relations of the United States are extremely complex. The estimate of American balance of payments prepared by the Bureau of Foreign and Domestic Commerce each year makes a bulletin of considerable thickness and weight.

The last decade has seen marked changes in the character of this balance. In 1922, 1923, and 1924 the excess of exports in merchandise was financed through net gold imports. During the period 1925–29 the export balance continued, being offset by net long-term capital exports. With the collapse of the capital market, the "favorable" balance in the depression years was financed, up until recently, through the net reduction in foreign-owned dollar balances in the United States. The year under consideration has seen a still further variation in the increase in American short-term accounts abroad. Although there are no statistics available showing the extent of the "flight of capital," there is no doubt that fear of dollar inflation has materially increased the country's creditor position on short-term account.

By far the largest item in the balance of payments is the movement of merchandise. United States foreign trade during the fiscal year ended June 30, 1933, moved steadily downward until, at the end of the third quarter, it reached the lowest level in three decades. A relatively marked expansion occurred during the final quarter and

by June the export and import indexes, adjusted for normal seasonal variation, reached the highest level in the year. For the first time since 1929 the value of shipments in both directions during June was greater than in the corresponding period of the preceding year. This upward trend is continuing into the new fiscal year. The expansion since the third quarter has been especially marked in crude materials and semimanufactures, although many classes of both export and import commodities have shown increases.

Exports in the fiscal year 1932–33 amounted to $1,440,000,000, a decline of 26 percent from the preceding year. Although the reduction in the price level during the first three quarters of the year was responsible for a part of the drop in value, the decline in physical volume was about 17 percent, or relatively as great as in the year immediately preceding. Crude materials constituted 34 percent of the total exports, in comparison with 28 percent in 1931–32 and 22 percent in 1929–30. Foodstuff exports dropped from 17 percent of the total in 1931–32 to 14 percent, while finished manufactures fell from 42 percent to 39 percent.

The decline in value of imports, which totaled $1,168,000,000 during the fiscal year, was 33 percent, but, owing to a relatively greater drop in the level of import prices, the decrease in quantity was only 17 percent, about the same as for exports. Foodstuffs aggregated 33 percent of the total imports, in comparison with 27 percent in 1931–32, and semimanufactures approximately the same proportion as in the preceding year. Crude material imports fell off from 29 percent of the 1931–32 total to 26 percent in 1932–33, while finished manufactures dropped from 27 to 24 percent.

A detailed analysis of the record for 1932 is given in a recent publication of the Bureau, "Foreign Trade of the United States."

The excess of merchandise exports over merchandise imports increased $54,000,000 over the favorable balance in 1931–32 to $272,000,000 in 1932–33. Gold imports aggregated $399,000,000 in comparison with $520,000,000, while gold exports dropped from $1,234,000,000 in the preceding year to $135,000,000.

BUREAU'S SERVICES RELATED TO CHANGING WORLD CONDITIONS

Although the volume of foreign trade declined, the services of the Bureau of Foreign and Domestic Commerce were in constant demand. Through its foreign offices, in cooperation with the Consular Service, and through its facilities in Washington and in the district offices, the Bureau continued its assistance to those engaged in foreign trade. Our foreign observers reported fully the kaleidoscopic changes in policy born of the trend toward economic nationalism. These reports from the field were analyzed in the Washington offices and distributed to interested business men and students of world affairs through the channels of correspondence, special and regular publications, and the district offices. Frequent changes in foreign-exchange control presented the Bureau with ample opportunity to serve American business. Numerous calls for the latest facts about exchange procedure were handled by the Bureau. Restrictions by foreign governments on the transfer of funds brought additional requests for advice and assistance.

The currency situation came in for an unusual amount of attention with the revival of bimetallism as a practical world political and economic problem. The Bureau prepared two monographs on the silver question, The Silver Market and The Monetary Use of Silver in 1933. A study of the use of silver in war-debtor countries was prepared at the request of a member of the Senate. Data were also collected on the effect of depreciated currency on imports of a number of specific commodities.

SIGNIFICANT SERVICES RENDERED IN FOREIGN TARIFF MATTERS

The unprecedented number of changes in foreign tariffs and tariff policies and the wide-spread extensison of other types of trade control measures, was noted above. The Bureau's Division of Foreign Tariffs is the only organization in the United States equipped to furnish information and advice on the tariffs, trade controls, and commercial policy of all foreign countries. The work of this Division was correspondingly increased and to a certain degree altered to cope with these changing conditions. More than ever has constant vigilance been necessary to anticipate, analyze, and interpret, for the benefit of American trade, the increasingly frequent and often sudden developments abroad in the field of trade controls and restrictions. An outstanding service of the Bureau in this direction has been its steady effort, in cooperation with the Department of State and the Foreign Service of both Departments, to prevent, by every available legitimate means, the establishment of discriminations against American trade and to assure for American exporters an equitable share in markets subject to any form of restriction.

A new phase of the Bureau's activities, particularly in the latter part of the year, was the beginning of a series of preliminary studies of United States trade with a number of individual foreign countries, at the request of the Department of State, in connection with the anticipated negotiation of reciprocal trade agreements. Preparatory work for these proposed agreements was begun and considerable progress was made with the preliminary studies.

Regional trade agreements and compensatory trade agreements between individual countries were an important development of the year. An outstanding event in this field was the Imperial Economic Conference at Ottawa. A further extension of the system of preferences within the British Empire, inaugurated by the conference, together with the change in the general tariff policy of Great Britain which had been put into effect during the period immediately preceding the conference, made necessary a close study of the bearing of this important event, as well as of similar developments elsewhere, upon American trade.

The Bureau has always cooperated closely with the Department of State and other departments and establishments of the Government concerned with foreign tariffs and trade controls, but during the past year this cooperation was on an even broader scale because of the character and extent of the changes in foreign tariffs. In addition to the cooperation with the Department of State which has already been indicated, the Bureau worked closely with and furnished a considerable amount of material to the Department of Agri-

culture in connection with its comprehensive study of foreign restrictions on international trade in farm products in response to a Senate resolution. Assistance was also rendered to the Tariff Commission advisory committee on import valuations and the Bureau has worked with the Commission on other matters from time to time. Similar association has been maintained with the Treasury Department and other Government organizations.

Cooperation with various trade organizations has also been increasingly close during the past year in this general field. In connection with the imposition of foreign quotas on American products, the Bureau assists the Department of State to obtain equitable allocations for American trade. Further allocations to individual shippers are left to the trade itself through the appropriate associations, where such exist. The changes and possible future of American foreign trade generally have engaged the serious attention of both general and individual trade organizations and increasingly frequent calls have been made upon the Bureau by such organizations for information and advice in formulating their own policies and activities.

A number of special studies were made and publications issued in addition to the ordinary current publication of tariff changes through the usual channels. The special publication covering the Shipment of Samples and Advertising Matter Abroad was republished in revised form. This covers in detail the making of such shipments to over 150 foreign countries or colonies. The pamphlet on Preparing Shipments to Canada was also completed and published, the demand for it being so great that two reprints were necessary within a period of a few months. The timely publication reviewing Foreign Tariffs and Commercial Policies During 1932 was also in such demand as to necessitate a reprint.

VITAL FACTS PROVIDED FOR LONDON ECONOMIC CONFERENCE

The usefulness of the expert staff of the Bureau of Foreign and Domestic Commerce was well illustrated by the service it was able to provide to the American delegation to the World Economic Conference in London. Much of the basic data used by the American representation was compiled by the Bureau. In addition to the outstanding contributions made by the Foreign Tariffs Division the services of the Economic Research Division were also utilized. Aiding the American delegation in still another way, the Bureau supplied a summary of the maritime policies of all the major countries of the world, together with other basic shipping data. And, finally, the Chief of the Bureau's Foreign Tariff Division served as a technical adviser on the staff of the American delegation.

FOREIGN COMMERCIAL LAWS AND PUBLIC-FINANCE MEASURES STUDIED

The Bureau continued to gather, compile, and disseminate information on foreign commercial laws restricting or otherwise affecting American business interests. In this field, special assistance was rendered to American governmental agencies—particularly on the subject of taxation abroad. Life-insurance developments throughout the world were studied by the Bureau, in conjunction with various private organizations. Vigorous efforts have been made to minimize

and offset the foreign misappropriation and misuse of American-owned trade marks. A new service has been instituted by which the Bureau furnishes notification of foreign legislative changes to interested persons.

The Bureau handled a rapidly mounting number of requests for information on European public finance, with reference to exchange movements, credits, foreign investments, debt payments, etc. The abandonment of the gold standard accentuated the demand for data of this character. The Bureau kept closely in touch with the measures adopted abroad in such fields as unemployment relief, aid to agriculture, debt moratoria, social insurance, and internal and external loans for public-works construction. The information thus obtained has proved useful, on numerous occasions, to American Government bodies concerned with comparable measures for the United States.

At the request of the State Department, the Bureau analyzed the trade of 16 foreign countries, to facilitate future commercial agreements. In connection with debt negotiations, analyses of foreign countries' "capacity to pay" were carried out. An elaborate report was prepared on the subject of American branch factories abroad, and intensive study was given to the international cartel movement.

THE FOREIGN COMMERCE SERVICE

During the fiscal year just ended there was a reduction of only about 15 percent in the number of requests for assistance made by American manufacturers and exporters upon the Foreign Commerce Service of this Bureau—a service which comprises commercial attachés, trade commissioners, and assistants in the major foreign centers. Throughout the year these foreign representatives of the Department mailed or cabled to Washington thousands of reports dealing with every phase of economic conditions abroad; and the pertinent data in these reports were disseminated quickly to interested persons.

The commercial attachés have been called upon to render increased assistance, in economic and commercial matters, to the diplomatic missions to which they were attached. But in addition to these vital functions the members of the Foreign Service were able to send 35,191 letters of information and advice to American firms (practically all of them in answer to specific requests from those firms) during the 12 months under review.

FOREIGN-TRADE ACTIVITIES OF COMMODITY DIVISIONS

The Bureau's commodity divisions at Washington have continued their activity during the past year (often in direct cooperation with the Foreign Service representatives) in furthering the export interests of their respective industries. A number of selected examples will suffice to illustrate the character of this work.

Because of prevailing conditions, various American automobile companies were forced to withdraw from the foreign field many direct factory representatives, and therefore leaned more heavily upon the Bureau's Automotive Division, which has advised very frequently

with exporters developing programs for oversea sales. The Division has endeavored to interpret international developments and major trends in its field; one of the striking trends to which it has recently called attention is the increasing manufacture and use of Diesel-engined commercial vehicles abroad.

In chemicals the foreign situation has been particularly acute, and uneasiness was manifest in all branches of the American chemical industry relative to production developments, the maintenance of exports, and the menace of unfair competition from imports. The Chemical Division pictured the situation in a trade-information bulletin on the European chemical industry. Facts bearing upon the problem of Japanese and Dutch competition were made available to the industry. The Bureau's cooperation resulted in equitable treatment for American chemicals under certain of the embargo and quota systems abroad. Periodic reports on cartel developments proved of particular value to our synthetic organic chemical industry. A statistical study was made of American chemical imports from countries with depreciated currencies. Bimonthly reviews of world trade in medicinal and toilet preparations were instituted. There has been a special effort to develop basic and current commercial data on "exotic" raw materials—botanicals, gums, resins, waxes, balsams, and essential oils. Foreign industrial consumption of chemicals has been studied more intensively.

Last December the Electrical Equipment Division inaugurated a service that had long been planned—issuing a circular a week, one country at a time, covering the foreign radio markets. This service has been accorded high praise by the industry. The manuscript of an exhaustive study on world power development from an economic standpoint is now nearing completion.

The Bureau's Hide and Leather Division took an active part in formulating the plans and procedure whereby the Tanners' Council of America, with the authority of the French Government and the American State Department, was designated to control the allocation of import permits for patent leather under the French import quota. The Division acted as an intermediary between the Chinese goatskin importers and the Chinese Hide and Skin Inspection Bureau whereby modifications of the regulations as to grading and trim of Chinese goatskins (of great importance to American tanners of these skins) were secured.

The Minerals Division prepared and published for general distribution Charts of World Production, Imports, and Exports of Major Minerals of Industry. At the request of an association representing the entire domestic copper industry, the Bureau, through its foreign and domestic agencies, prepared complete lists of foreign copper and brass manufacturers and dealers; these were published by the association. Statistical research and compilation of world-wide international trade figures covering petroleum and its products were continued as in past years; similar research covering copper, lead, zinc, and coal was also conducted at the specific request of trade organizations.

The Motion-Picture Division has been cooperating very closely with the trade on problems of foreign business. American distributors of motion pictures have intensified their efforts in foreign

fields in view of the increased competition of foreign producers, new quota and contingent laws abroad, language barriers, and exchange controls. Despite these obstacles, American distributors still control the bulk of film distribution abroad, and they have depended largely on the Bureau for accurate data on foreign conditions. New Government restrictions, or old ones made more drastic, were instituted in France, Germany, Austria, Czechoslovakia, and Jugoslavia, necessitating important services to the trade by the Bureau. American distributors were forced to withdraw from the Czechoslovakian market for nearly 8 months. At the expense of the trade, our special motion-picture trade commissioner made numerous trips to Czechoslovakia, and played an important part in negotiating the return of American distributors to that central European market.

The trend of exports of rubber products from each important exporting country was discussed in a series of special circulars by the Bureau's Rubber Division.

In order that the large American office-equipment industry might have a dependable measure of current trends in foreign trade, the Bureau's Specialties Division obtained official statistics from a score of foreign countries for a 6-month period in 1932, showing the flow, by countries of origin and destination, of this class of goods. More than half of the typewriters produced in this country in recent years have been shipped abroad, but the gains made by our competitors in the world's trade in typewriters and other office machines during the past year are significant.

The Textile Division supplied data and held conferences on subjects relating to Russian purchases of raw cotton and cotton goods, as well as Chinese purchases of raw cotton.

The Transportation Division published, in convenient form, a manual containing information on all foreign railroads, for the purpose of assisting in the extension of sales of specialized railway equipment abroad.

DATA ON INDIVIDUAL DISTRIBUTORS OF MERCHANDISE ABROAD

Despite the decrease in export business, there has been no abatement in the demands of American foreign traders upon this Bureau for up-to-date and accurate information respecting distributors of merchandise in all foreign markets. The Commercial Intelligence Division supplied, during the year, 29,000 reports in detail on individual foreign business organizations, and added 88,000 new and revised reports to its master file, which now contains reports on approximately 600,000 business organizations abroad. The Division satisfied requests for 82,000 "lists of foreign buyers." These two services are on a fee basis, payment being required on the part of all users other than Government departments. During the fiscal year the Commercial Intelligence Division handled 6,086 trade opportunities submitted by the foreign field officers of the Departments of Commerce and State, checking each prior to publication and distribution to American traders. This Division made available, to credit associations in this country, much research material useful in following foreign credit and collection conditions, and it coor-

dinated its activities with credit groups in order to analyze trends. In cooperation with the Finance Division, it aided in estimating frozen credits abroad, with respect to shipments of merchandise, and the effect on credit terms of foreign-exchange conditions. Much study was also given to the subject of credit insurance.

BUREAU ACTIVITIES IN PROMOTION OF DOMESTIC TRADE

In the field of domestic commerce the Bureau rendered very substantial assistance to the N.R.A. and the other governmental bodies concerned with recovery activities. The achievements in this phase of the work will be considered in a subsequent section of this report. Other services by the domestic-commerce divisions were of varied character.

IMPORTANT STUDIES IN FIELD OF MERCHANDISING RESEARCH

During the past fiscal year the Merchandising Research Division completed the field work and most of the subsequent statistical work on the national drug-store survey. Three publications on various phases of the study appeared, bringing the total number of reports from this survey to six. Work proceeded on other studies of operating costs and of production capacity, and reports were published on the drop-forging industry, the blueprint industry, the marking-devices industry, and the wholesale jewelry trade. Studies were also under way on confectionery jobbing, manufacture of women's garments, and die casting. "Retail-management practices" and "Retail delivery" were the subjects of special analyses and reports.

An unusual approach to a combined research and educational effort was presented by work on the problem of returned goods, data for which were gathered through the Federation of Women's Clubs. After study of the material obtained, the cooperating organizations took definite steps in their respective communities to eliminate the returned-goods evil. A new departure in the analysis of the retail market was initiated by the publication of a study entitled "The Location Structure of Retail Trade in Baltimore." This study presented for the first time the organized character of retail trade in a metropolitan city, portraying the respective functions of the central shopping district, the subcenter, the string-street, and the neighborhood business development. The idea was considered to be one of fundamental importance, particularly in the marketing field, and this lead has been followed by various agencies in preparing similar break-downs of the retail-marketing structure in other cities.

The industrial-marketing section issued a bibliography of all sources of information of direct use to industrial-marketing specialists, and several reports on detailed phases of the industrial-marketing problem.

The periodic credit surveys and the special bankruptcy studies were continued, several reports being published during the year.

"DISCUSSION AND ACTION" PROGRAMS—BUSINESS-INFORMATION SERVICE

In the Marketing Service Division, the trade-association section gave an increased volume of service to all persons interested in the

activities and organization of trade associations. The group discussion and action programs were continued at the request of organizations desiring a carefully planned procedure in overcoming the merchandising problems of their particular trades and industries. Through scheduled meetings arranged for these discussion purposes, trades or functional groups of manufacturers, wholesalers, or retailers were acquainted with the tested experience of business throughout the United States. One hundred and twenty-six programs of this kind were requested by 41 cities in 23 States.

The business-information section continued its work of replying to inquiries from individuals and organizations on practically all phases of business not immediately under the jurisdiction of commodity or technical divisions. The merchandising-information service was expanded, and is now being received regularly by more than 300 chambers of commerce and trade associations.

An evidence of the keen national interest in business research was the continued popularity of the Bureau's processed publication, Domestic Commerce, issued three times a month—for which 3,500 firms, in a wide range of activities, paid $1 a year.

ALTERED EMPHASIS IN DOMESTIC REGIONAL WORK

As regards the Domestic Regional Division, the fiscal year just closed was a period of transition caused by the necessity for economy and by basic changes in Bureau policy relating to research work. The purpose originally proposed for this Division in 1927—the maintenance of information on regional economic conditions—had been thrust aside by the pressure for studies of immediate and specific application to the problems of individual trades. This phase of the Division's work was closed during the year with parallel publication of three regional studies of furniture distribution—covering, respectively, the West-Mid-Continent, the Mid-West, and the Gulf Southwest, in order of issue.

One study prepared during the year involved a new venture by the Bureau in active cooperation with 10 universities in the West-Mid-Continent in a general marketing and economic background study. It involved a study of business activities, sources of income, and economic trends by "commercial districts" (a phrase used to describe groups of counties homogeneous in their character of business activities). The experience was so favorable, and the interest in the general plan so wide, that considerable hope is held for expansion of the Bureau's cooperative activities in this field.

The Bureau issued a series of Aids to Analyzing Markets, which might be described as a conversion of the obsolete dollar totals of 1929 retail trade into percentage ratios by States, counties, and cities—of long-range value to marketing organizations.

At the suggestion of the advisory committee on marketing, an experiment was made in cross-sectioning census figures for specific commodity lines. Furniture was selected because of the intimate knowledge of the trade acquired through the regional studies. The manuscript, completed July 1, drew together all census material relating to the manufacture and distribution of furniture, and

pointed out the possibilities and dangers of interrelating the available data.

A study of carload rail commodity movements was practically complete at the end of the year, in such form as available data permitted.

The apparent and growing need for better current knowledge of regional conditions led the Bureau to begin a tally and appraisal of city and regional business indexes. Parallel to this, a breakdown of the gainfully employed population of the larger cities in percentage terms was made as a basis for appraising the representative character of employment and other index samples. This material was found to be of considerable interest to the N.R.A., and plans were made for continuing it into the new year, in such a way as to lead to greater completeness and coordination of local business indexes.

DOMESTIC BUSINESS FURTHERED BY COMMODITY DIVISIONS

A great variety of valuable services calculated to promote business within the United States have been performed by the several commodity divisions of the Bureau. For example, the Industrial Machinery Division endeavored to analyze markets with particular regard to the technique covering the sale of machinery. More than half of the service of the Chemical Division was concerned with domestic trade problems. Producers of equipment and other capital goods sought data as to the requirements of branches of the chemical industry. Investors desired a perspective of creative chemistry. Prospective as well as established producers requested territorial information as to supply, location, distribution, and consumption. Governmental bodies required counsel on chemical matters.

The Hide and Leather Division gave very substantial assistance to the Bureau of Agricultural Economics in their establishment of domestic grades for calfskins and country hides. Shoe-repair dealers requested the Bureau's assistance in organizing a national body, and were supplied with the names and addresses of officers of local organizations in various sections of the country. Saddlery and harness producers "contacted" the Bureau frequently for data as to the growing popularity of horseback riding in the United States and the increased market for their products resulting therefrom.

The Rubber Division's semiannual surveys of dealers' stocks of automobile tires and inner tubes were broadened to include stocks held by mail-order houses, and chain stores operated by tire manufacturers and by automotive supply companies. This enabled the industry to measure accurately the retail movement of tires through distributors. This was particularly helpful because of an unusual wholesale distribution during midsummer, in advance of the application of the tire-production tax.

The Bureau's Transportation Division completed a study on the Calumet River project (Chicago), which was submitted to the Board of Rivers and Harbors, War Department. Two important additional studies of proposed waterways—namely, a study of the Trinity River area in Texas and the proposed trans-Florida Ship Canal—were undertaken for the Rivers and Harbors Board; these reports will be submitted during the coming fiscal year.

ECONOMIC RESEARCH

The Division of Economic Research carried forward during the year its continuing research into developments affecting the economic welfare of the country, expanded and improved its statistical services, cooperated with other bureaus and independent organizations in a study of many of the more pressing current economic problems, and inaugurated several special research projects, the most important of which was a comprehensive survey of the national income.

The study of the national income for the period 1929 to 1932, inclusive, was undertaken in response to Senate Resolution No. 220 of the Seventy-second Congress, which directed the Bureau to make total income estimates for these years, including income originating from agriculture, manufacturing, mining, transportation, and other gainful occupations, as well as the distribution of the income in the form of wages, rents, royalties, profits, etc. This study is being made with the assistance of the National Bureau of Economic Research, and will be completed in December 1933.

Minor research projects completed during the year included a comprehensive statistical report on conditions in the United States as of March 1933; a study of industrial overcapacity; a study of the trend of the major statistical indicators 1929–32; and a review of the economic importance of the alcohol beverage industry. A series of charts showing production and wholesale prices in the leading foreign countries, world stock of raw materials, and United States exports, by countries, economic classes, and commodities was also prepared.

Depreciated foreign exchanges and their effect on our foreign trade was one of the problems of major interest during the year to which the Bureau devoted considerable study. Statistics and testimony on this subject were submitted, by request, to a subcommittee of the Committee on Ways and Means of the House of Representatives. An analysis of United States foreign trade statistics, with particular reference to the effects of exchange movements, was made for the Tariff Commission for use in their report in response to the Costigan resolution. The Bureau also prepared for this same purpose an estimate of the employment afforded by export trade and the extent of unemployment resulting from the drop in exports from 1929 to 1932. An outstanding contribution to our foreign trade records was the completion of the indexes of export volume, by economic classes, for the period of 1913 to date; also, the completion of quarterly indexes, by economic classes, for 1932 and 1933, and the initiation of a similar compilation for imports. A comprehensive review of our foreign trade was published in bulletin form.

The publication of the Survey of Current Business was speeded up so that both weekly and monthly issues went forward more promptly to subscribers. The presentation of the material was improved, including the revamping of the weekly supplement to include a weekly summary of business trends. Improvement was made in the statistical data, both from the standpoint of coverage and refinement of existing material. New indexes were presented on the trend of world stocks and prices of raw materials, and a revision of the indexes of agricultural marketings was completed.

PUBLICATIONS OF THE BUREAU

The output of the Editorial Division during the fiscal year ended June 30, 1933, was considerably curtailed by reason of a decrease of over 50 percent in the allotment for printing. For reasons of economy, the size of some of the periodical publications was also reduced, especially that of the weekly Commerce Reports. In addition to the periodical publications prepared for the printer, considerable time was given to special reports in the domestic commerce field, such as a series of reports on analyzing markets in various States, another on furniture distribution, an analysis of the causes of commercial bankruptcies, and a drug-store survey. Among other publications handled in the Division during the year were The Silver Market, Monetary Uses of Silver in 1933, Company Law and Business Taxes in Great Britain, and Shipment of Samples and Advertising Matter Abroad.

ASSISTANCE RENDERED TO DOMESTIC RECOVERY ORGANIZATIONS

SUBSTANTIAL HELP ACCORDED TO THE N.R.A.

The Bureau of Foreign and Domestic Commerce, with its distinctive facilities and contacts and its readiness to offer assistance in any program affecting trade and industry, was offered a further opportunity by the enactment of the National Industrial Recovery Act. Its chief service during the fiscal year was to support the Recovery Administration in visualizing to the entire population of the country the scope, purposes, and benefits of the National Industrial Recovery Act.

Appreciating immediately the importance of this measure, this Bureau in the very beginning set up a coordinating unit and sent representatives to attend hearings before the congressional committee. These representatives followed closely the passage of the act through Congress, and by special bulletin kept the Bureau's district offices advised as to the progress of this legislation. With additional observations by the district office managers taking account of local conditions, the business community was thus apprised from the first (through periodic district office news letters and other channels) of the character and significance of the new measures.

In anticipation of the formulation of codes, a number of surveys were made and conferences held, so that this organization would be fully prepared to cooperate, if and when needed. As an example of this preparatory work, the Textile Division of the Bureau, through its advisory council, had done much preliminary work on a code for the textile industry.

After the National Recovery Administration began to function actively, it called on the Bureau of Foreign and Domestic Commerce for a variety of services. The contacts of the commodity divisions were often utilized. A few of the more striking instances of this cooperation will be cited. During the last quarter of the fiscal year the Minerals Division of the Bureau cooperated with no fewer than 55 trade associations or groups in furnishing essential data for the preparation of codes under the N.R.A. The Bureau assisted the National Lumber Manufacturers Association and the American

Paper and Pulp Association by providing statistical data on production, imports, and exports of forest products, mill labor values, unit production man-hours, etc., so as to develop basic facts for N.R.A. codes. The Bureau furnished to the N.R.A., also, much information regarding the set-up of the tanning industry, the leadership in the industry, and the functions of the tanners' council, and assistance was rendered in bringing the industry into touch with N.R.A. at an early date.

Bureau files of material relating to the iron and steel industries were compiled, and were undoubtedly useful during the formative period of the N.R.A. policies. Again, the Bureau furnished to the N.R.A. charts showing the structure of the automotive industry, and Bureau officials held many conferences with leaders of that industry on N.R.A. matters. A presentation was made as to the existing and the logical organization of the chemical industry. Comparable services have been rendered by all the other commodity divisions of the Bureau.

BUREAU'S FACTUAL MATERIAL EXTENSIVELY UTILIZED BY N.R.A.

The close of the fiscal year found the Bureau's Marketing Service Division performing varied services in connection with the recovery act—disseminating bulletins on N.R.A. matters to a list of about 1,000 national trade associations; handling thousands of letters directed to the N.R.A. requesting information, documents, and mailing-list services; providing the N.R.A. daily with detailed information as to trade and commercial groups from the Division's Index of Commercial and Industrial Organizations; advising representatives of trade associations in personal conference and by correspondence as to N.R.A. requirements and procedure; providing speakers (on N.R.A.) for radio addresses and before local groups.

Much of the factual material that had been gathered by the Bureau's Merchandising Research Division was placed at the disposal of the N.R.A. as soon as it began to operate. Special tabulations and charts were prepared—usually based on this material and on the Bureau's contacts—on such subjects as the organization structure of basic trades, the extent to which uniform cost accounting has been adopted in industry, estimates of retail costs and volume in the years following the retail census of distribution, and operating data concerning various trades under examination. Several of the Bureau's cost specialists were drawn upon, both by the N.R.A. and trades and industries engaged in drafting codes, for special consultation.

DISTRICT OFFICES BECOME NUCLEI FOR NATION-WIDE CAMPAIGN

The foregoing were the principal measures of collaboration with the N.R.A. adopted by the Bureau of Foreign and Domestic Commerce at its Washington headquarters. In the Bureau's field service throughout the United States, the participation was equally vital, and productive of even more tangible results. In establishing an organization to administer the recovery act, due recognition was given to the high importance of commanding immediately and inexpensively a nation-wide organization, through which a vigorous, in-

structive campaign for enlistment of membership in the N.R.A. could be launched. The district offices of the Bureau, holding the respect of the business community, provided such a set-up. Heavy demands have been made on all the Bureau's district managers to address trade groups and large assemblages and to make radio talks.

It is the confident expectation of Bureau officials that this organization will continue to be, in the future, a highly important factor in the carrying on of the activities undertaken by the N.R.A. The Bureau's many facilities and advantages for such work are obvious, being the result of long experience, cordial and helpful contacts, and an exceptional accumulation of data.

AID AFFORDED TO OTHER GOVERNMENTAL RECOVERY BODIES

The cooperation of this Bureau has by no means been confined to the National Recovery Administration. The Bureau has been generally recognized as a repository of pertinent, comprehensive, and timely data on virtually every aspect of world industry, trade, and finance. It is only natural, therefore, that applications for the Bureau's aid should have come from a variety of governmental bodies concerned with the diverse measures designed to stimulate business and conserve commercial interests. The Bureau has been useful, also, to relief agencies.

The Bureau supplied to the Reconstruction Finance Corporation essential data in connection with that agency's study on forestry—including prices of sulphite pulp over a period of years, the operating capacity of sulphite wood-pulp and writing-paper mills, and the possibility of enlarged production of pulp in the South.

The Bureau's specialists on petroleum and metals served as members of a committee appointed by the Secretaries of Interior and of War in matters pertaining to the forecasting of domestic consumption and the rationalization of world production and exports.

The Bureau's Textile Division cooperated most usefully with the American Red Cross. Congress appropriated 844,000 bales of raw cotton to be distributed by the Red Cross in the form of cotton cloth and clothing. The Bureau helped substantially in the organization of this project. The raw cotton had to be exchanged for appropriate consumer textile commodities, and the Bureau assisted in setting up exchange and buying methods. In consequence of the cooperative effort, the Red Cross was enabled to distribute throughout the country more than 100,000,000 yards of cloth, 2,600,000 blankets and comforts, and 66,000,000 garments of all sorts.

CONCLUSION

As the year closes, the Bureau of Foreign and Domestic Commerce finds itself facing a critical point in its history. The budget for the next fiscal year represents a reduction of 62.3 percent from the high reached in 1932, and of 49.5 percent from the funds available in the year covered by this report. Inasmuch as the Bureau's expenditures consist primarily of pay-roll disbursements, it is inevitable that this reduction should result in a drastic curtailment of staff.

At the same time, the policy and functions of the Bureau are in process of revaluation, to the end that its activities shall represent the highest form of service to the business community and to the other branches of the Government. That it will play an important part in the economic developments of the next year cannot be questioned. It must provide a factual basis for the wise determination of economic policy looking toward the return of stability and security to our economic system.

BUREAU OF STANDARDS

GENERAL ACTIVITIES

Finances.—The congressional appropriation for the Bureau for the fiscal year just closed amounted to $2,137,280. This represented a reduction of $612,290 below the appropriation for 1932, exclusive of nonrecurring items. The appropriation was later supplemented by an allotment of $120,000 from other sources. The reduction was met by means of drastic economies in operation and an 8-day furlough for all employees; without resorting to a forced reduction of the staff. Funds received from other governmental agencies for supporting work of special importance to these agencies amounted to $444,563. A general statement of the Bureau's finances will be found in table 2, on page 70, of this report.

Personnel.—The regular staff at the close of the fiscal year numbered 946 employees. With miscellaneous assignments the grand total was 1,033 persons, a decrease of 76 as compared with last year. The turnover was 1.8 percent as compared with 2.7 percent for 1932. There were 49 research associates stationed at the Bureau on June 30, engaged in technical problems of mutual interest to the Government and to industry and supported by 20 national engineering societies and trade associations. The number of research associates for the previous year was 66.

Testing.—The testing of supplies for the Federal and State Governments and the calibration of apparatus in terms of the national standards constitute the largest activity of the Bureau of Standards. The policy of the Government to purchase supplies on the basis of Federal specifications, while resulting in great economies, at the same time imposes a steadily increasing burden on the Bureau in carrying out the necessary tests. A summary of the Bureau's testing work during the past year is given in table 1 on page 68. The total number of tests completed was 263,679, and the fee value commensurate with the cost of the work had it been carried out in commercial testing laboratories was $959,719.04. The corresponding figures for 1932 are 253,823 and $944,302.83.

Visiting committee.—The present members of this committee are: Gano Dunn, chairman; Charles F. Kettering; Dr. Charles L. Reese; Morris E. Leeds; and Dr. Karl T. Compton. Their advice and counsel have been most helpful.

International relations.—The advisory committee on electricity and photometry, established by the International Committee on Weights and Measures, held its third biennial meeting at Paris, January 31 to February 3, 1933. This advisory committee consists of representatives of France, Germany, Great Britain, Italy, Japan, the United States, and the Union of Socialist Soviet Republics. The

committee recommended that the general conference approve the principle of establishing values for the electrical units based upon absolute measurements, and that it empower the International Committee on Weights and Measures to carry out the detailed work necessary for putting the plan into effect. This would include fixing the ratios of the new units to the present international units and the date for general adoption of the units.

The advisory committee also recommended that the general conference give to the international committee power to fix specifications for a black-body standard of light and to adopt a standard value for the brightness of the black-body radiator operated at the freezing point of platinum. These proposals were based in part on experimental work done at the Bureau of Standards.

The adoption of certain factors of visibility for calculating the photometric values of lights of different colors were also recommended. These factors were determined largely by measurements made at the Bureau of Standards.

Conference of State utility commission engineers.—The eleventh annual conference of State utility commission engineers was held at the Bureau in June. Committee reports and papers were presented on grounding of electrical circuits, limitations of voltage in joint use of poles, lighting of airways and airports, grade-crossing protection, billing demand, promotional rates, rules and regulations for bus transportation, truck regulations, taxicab regulations, line extension policies, underground corrosion, and on commission engineering activities.

Federal fire council.—A fire protection manual was prepared at the request of Government agencies charged with the design, construction, equipment, or management of buildings.

American Standards Association.—Under the procedure of this association, the Bureau is sponsor for 15 standardization projects and is represented on 80 sectional and special committees.

National Screw Thread Commission.—The 1928 report was revised and will soon be published. The commission was abolished by Executive order signed by the President on June 10, 1933.

American gage design committee.—The original report of this committee is being revised and extended to include plain and thread plug and ring gage blanks up to about 12 inches. Several other types of gage blanks have been added.

Federal Specifications Board.—This board, of which the Director of the Bureau of Standards is ex-officio chairman, has promulgated 826 standard purchase specifications, the use of which is mandatory upon all Federal departments, establishments, bureaus, offices, and agencies.

ELECTRICITY

New basis for electrical units.—Determinations of values for the ampere and the ohm by absolute measurements were continued. In the case of the ampere, the average value from results to date is 1 B.S. international ampere=0.999941 absolute ampere.

Values for the ohm are derived from calculated inductances of carefully constructed coils, several of which have been built at the

Bureau in recent years. The value (subject to slight corrections) of 1 B.S. international ohm as determined by various coils is:

From the porcelain coil: 1.000463 absolute ohms.
From the quartz coil: 1.000442 absolute ohms.
From the pyrex glass coil: 1.000455 absolute ohms.

Standards of electrical resistance.—Eighteen 1-ohm resistance standards of the type recently developed at the Bureau were constructed, and appear to be of exceptional quality. They will probably be used in future international comparisons, as well as in the maintenance of the unit in this country.

Standards of electromotive force.—Improvements in the constancy of the Weston normal cell as a standard of electromotive force have been made possible by the use of materials for the containers which are more inert chemically than those previously employed. A new high precision potentiometer for the comparison of standard cells was constructed and placed in service. Comparisons were made of the Bureau's standards of electromotive force with those of England, France, and Germany.

Large absolute electrometer and equipment for testing of current transformers.—A number of mechanical improvements have been incorporated in the Bureau's absolute electrometer, and results are now attainable with a precision of a few hundredths of 1 percent. The equipment for testing current transformers has been put into commission and has been found satisfactory for tests up to 12,000 amperes.

Magnetic testing and research.—An apparatus for magnetic testing at high magnetizing forces was developed and has been added to the list of approved methods of the American Society for Testing Materials. A magnetic balance was developed for the inspection of austenitic steel. Apparatus was constructed for the application of the "Magnaflux" method to the inspection of hollow steel airplane propellers and proved very effective in the location of hidden defects.

International standards of candlepower for commercial types of electric lamps.—The national laboratories of France, Germany, Great Britain, and the United States have now agreed to bring their standards of light for the commercial types of lamps into accord through the use of visibility factors established by measurements at the Bureau and accepted by the International Commission on Illumination. Values of the colored filters to serve this purpose have been adopted and each participating laboratory has received one of the filters.

Primary radio-frequency standard.—The Bureau's primary standard of radio frequency was improved and is now automatically protected against power failures.

Secondary standards of radio frequency.—A semiportable piezoelectric standard was developed to maintain a frequency constant within 1 part in 10,000,000 for several hours without adjustment. A new type of toroidal quartz plate was developed with marked advantages in respect to temperature coefficient and constancy.

Dissemination of standard radio frequency.—The accuracy of the 5,000-kilocycle radio transmissions was increased to 1 part in 10,000,000. Greater reliability was brought about by a change from 1 to 30 kilowatts in the power of the transmitter and by the develop-

ment of highly accurate automatic monitoring procedure. The standard frequency signals were made available to the public over wire line connections.

Measurements of radio wave variations.—Equipment for the automatic recording of received wave intensities was installed and applied to a study of the relative values of different frequencies for broadcasting. The data aided directly the work of two international radio conferences (Madrid, 1932, and Mexico City, 1933). Radio transmissions at the lower and the higher frequencies were correlated with solar data and terrestrial magnetic changes. Equipment was developed for a fundamental study of direction and polarization phenomena.

Height of ionized layers.—Automatic recorders were developed and used for determining the varying heights and ionization of the layers in the upper atmosphere which make possible long-distance radio transmission. Part of this work was in connection with the world-wide Polar Year program of scientific measurements.

Storage batteries.—It was found that gradual corrosion of the positive grids of storage batteries under ordinary conditions may liberate enough antimony to increase materially the rate of sulphation of the negative plates. Determinations have been made of viscosity and resistivity of sulphuric acid solutions at low temperatures, which will aid in predicting the operating characteristics of storage batteries under severe climatic conditions. Mechanical, electrical, and chemical properties of storage-battery separators have been measured for the Navy Department, to determine the suitability of different kinds of wood, both treated and untreated, and the variation of these properties in commercial practice.

Insulating properties of rubber.—A complete study of the dielectric constant, power factor, and resistivity of rubber-sulphur compounds at temperatures from −75° to +150° C., and under various pressures, has been completed.

Telephone engineering service.—Three Government departments and other establishments were advised as to the most economical and efficient methods for supplying telephone and related services in their buildings.

Electrical and other safety codes.—Bureau representatives have assisted in revision of the National Electrical Code. Handbook no. 17, containing a revision of the code for protection against lightning, was issued, and a model ordinance for electrical inspection was prepared. Two documents on construction of power lines were prepared for the International Electrotechnical Commission. Members of the staff participated in the Annual Safety Congress and in the work of the safety code correlating committee, and assisted State officials and various committees formulating and revising safety codes.

Prevention of underground corrosion.—The successful use of bituminous coatings on pipe lines requires the setting up of recognized methods for identifying the materials used, and for determining their properties and performance. Two methods for determining the condition of bituminous coatings after service have been developed in cooperation with the American Gas Association and American Petroleum Institute. A laboratory method for determining the resistance of coatings to soil stress, the principal cause of coating failures, is being developed.

WEIGHTS AND MEASURES

Invar tapes.—Studies of invar as used in Coast and Geodetic Survey tapes, have shown that the newer melts of invar are not as stable as the old ones. An endeavor should be made to reproduce the older compositions and heat treatments.

Ethyl alcohol tables.—The Bureau cooperated with the Bureau of Industrial Alcohol of the Treasury Department in the preparation of tables to be published in the new edition of the United States Gauging Manual. A complete alcoholometric table was prepared for publication in the United States Pharmacopoeia.

Cooperative orifice meter tests.—The Bureau has assisted the joint orifice-coefficient committee of the American Gas Association and the American Society of Mechanical Engineers by advising on the tests to be made and by analyzing the results. The object of the work is to set up a table of coefficients which may be used in the commercial metering of such fluids as water, steam, and fuel gases.

Precision circles.—In order to determine the factors which cause instability in theodolite circles, a series of circles made of various metals has been cast, machined, and heat treated. Three circles, made and graduated in Europe, showed very definite evidence of non-uniform dimensional changes.

Testing of timepieces.—The year's record shows the largest number of tested pieces since 1923–24 and the largest fee value for over 10 years. Material tested included chronometers, pocket watches, bracelet watches, stop watches, stop clocks, time switches, electric clocks, and fire-alarm boxes.

Nickel-chromium alloys for weights.—Studies of the effect of hydrochloric acid fumes on sample weights constructed of an 80 percent nickel, 20 percent chromium alloy, finally caused the rejection of this material for standards of extreme precision. For standards such as analytical weights or commercial test weights, the material is approved.

Scales.—Each of the 19 master track scales owned by the railroads or State governments was calibrated. Adjustments were necessary on 11 of these. Eight maintained their accuracy within the required limit (approximately 0.01 percent).

A total of 864 railway track scales was tested on 87 railways in 39 States, involving 23,000 miles of testing equipment travel. Of these 80.6 percent were correct within the prescribed tolerance of 0.20 percent. The average error was 0.17 percent. Corrective adjustments were made on 54 scales.

Fifty-eight track scales used for weighing grain, subject to the special tolerance of 0.10 percent fixed by the Interstate Commerce Commission, were tested. For the group 58.6 percent were within the prescribed tolerance and the average error was 0.13 percent.

Forty-three test-weight car calibrations were made at the Bureau's master scale depot at Clearing, Ill., of which two were for regular use on Canadian railways. Thirty-three cars, to which standardization service is not otherwise practically obtainable, were calibrated in the field.

The mine scale testing equipment made 163 tests at coal mines in Maryland, West Virginia, and Kentucky. Of these 57.1 percent were

not correct within the prescribed tolerance of 8 pounds per ton. Inadequate equipment and faulty installation and maintenance methods were the general causes of discrepancy.

Dental materials.—In cooperation with the American Dental Association standards and specifications have been established for amalgam alloys, dental mercury, dental investments, four types of dental golds and technics, and for the most efficient use of these materials. The Bureau has developed a method for the analysis of cements and cement liquids, which makes possible an accurate analysis of combinations of zinc, aluminum, and phosphoric acid.

Certification of gages.—The usual number of plain gages were measured and there was an increase in the number of micrometers, penetration needles, and miscellaneous articles submitted. There was a decrease of about 35 percent over the previous year in the number of thread gages and precision blocks certified. This decrease is partly the result of the waiving for one year of the American Petroleum Institute's requirement for annual inspection of manufacturers' master cable and rotary tool joint gages.

Screw-thread survey.—The screw-thread survey, in cooperation with the American Society of Mechanical Engineers, was completed. Some of the conclusions are: (1) About 60 percent of threaded product is made to American National specifications; (2) a little less than one half of the product is within the specifications of the class of fit intended; (3) about 55 percent of screws and bolts are smaller at the minor diameter than the minimum 1/8-inch flat, thus causing an unnecessary reduction in tensile strength; and (4) about 75 percent of nuts have a half-angle of the thread larger than that which will consume one half of the pitch diameter tolerance.

Gaging mesh size of gill nets.—At the request of the Bureau of Fisheries an investigation was made of methods of gaging or measuring the mesh size of gill nets. The problem has a direct bearing on the conservation of fish, particularly in the Great Lakes where fishing is controlled by the States bordering on the Lakes and by the Dominion of Canada. A flexible steel gage was recommended for field use because of its convenience and simplicity, and when properly standardized was found to give the accuracy required.

Precision dividing engine.—The engine has been completed, and gratings ruled which were exceptionally free from periodic errors. The most serious difficulty at this time is securing satisfactory diamond points. The chipped or natural cleavage diamond points first used sometimes give excellent results for several thousand lines, but often fail before a ruling is completed. A lapping machine is being designed and built which it is hoped will produce satisfactory points.

Thermal expansion.—Information regarding the Bureau's fused-quartz thermal-expansion apparatus has been supplied to a number of commercial laboratories. Samples of known expansion have been sent to eight laboratories for use in calibrating thermal-expansion apparatus, and comparisons have been made with the Bureau's data.

Identification of questioned documents and other objects.—The 77 tests on identification included work for practically all departments of the Government. On 58 of these, definite reports were given which enabled the Government to proceed with or discontinue the

investigation. On the others definite decisions by the Bureau were impossible because of insufficient material or difficulty in discovering satisfactory characteristics.

HEAT AND POWER

Establishment of a color-temperature scale.—An absolute scale of color temperatures, based on the freezing points of platinum, rhodium, and iridium, is being established. The work at the platinum point has been completed, and a group of three electric lamps, to be used as working standards, have been calibrated at this point.

Thermal conductivity of metals.—Measurements on some 30 alloys, chiefly alloy steels, at temperatures from 100° to 500° C. were completed. The test method has been standardized.

Viscosity of liquids.—A new means of computing changes of viscosity produced by changes of temperature, pressure or composition, has been developed which greatly simplifies the analytical treatment and permits accurate practical viscosity calculations.

Properties of steam.—Experimental work in cooperation with the American Society of Mechanical Engineers, on saturated steam in the range of temperatures between 100° and 374° C. (1 to 218 atmospheres) has been continued and the results published.

Phenomena of combustion.—A study of the effect of water vapor on the reaction of carbon monoxide and oxygen at constant volume shows a marked effect of water-vapor concentration on flame speed and luminous intensity, which increases with pressure.

Heats of combustion of pure compounds.—Measurements were made of the heats of combustion of the normal paraffin hydrocarbons from heptane to dodecane. When the mean values of these heats of combustion are plotted against the number of carbon atoms in the molecule of the compound the points lie on a smooth curve within about 0.01 percent.

Combustion in an engine cylinder.—Measurements have been made of the radiant energy emitted from different regions in the combustion chamber of an engine, during normal explosions and when fuel-knock occurs. Absorption in the ultraviolet, as a means of detecting preflame oxidation, is being studied.

Blended fuels.—In view of current proposals for the blending of alcohol with motor gasoline, comparative road tests have been made, using the same gasolines with and without the addition of absolute alcohol. The influence of water on the miscibility of alcohol and gasoline, with and without the use of blending agents, and the effect of added alcohol on the knock rating of gasolines have been determined.

Vapor lock investigation.—An investigation of vapor lock in 55 representative cars, operated under various conditions, shows that cars differ considerably in their capacity for handling vapor in the fuel system. The results indicate the permissible gasoline vapor pressures for freedom from vapor lock in the majority of cars on the road.

Extreme pressure lubricants.—In cooperation with the automotive and petroleum industries, the properties of lubricants necessary for lubricating gears under heavy load are being determined. The ma-

chine developed for testing the load-carrying capacity of lubricants has been found to give results in accord with service performance.

Fire tests of welded-steel floors.—This series of tests, conducted in cooperation with the American Institute of Steel Construction, included 5 fire tests and 1 loading test. The work resulted in a number of improvements in design and details of construction, which are applicable to other similar types of floors, as well as to the one tested.

Domestic heating installations.—The fire hazard of typical domestic heating installations has been determined, so that information is now available on which building-code requirements can be based.

OPTICS

Standardization of railway signal and other colored glasses.—In cooperation with the American Railway Association, the Bureau is standardizing the colors of United States railway signal glasses. Thirty-four of the official A.R.A. standard glasses have been permanently deposited with the Bureau. Over 2,000 Lovibond glasses, used in the color grading of vegetable oils and other commodities, have now been standardized. To check the reliability of spectrophotometric equipment in industrial and college laboratories, colored glass filters have been prepared and their transmission determined throughout the visible spectrum. Several of these filters have now been issued to various laboratories.

Photographic emulsion investigations.—Investigations of the mechanism of photographic hypersensitizing and of reversal by desensitizers have been completed and the results published. Special "grainless" emulsions of minimum gelatin content were prepared for practical use in other problems.

Lens design and production.—A new and more convenient form for third order equations has been derived for application to lens systems where the thickness may not be neglected, and has been utilized in the study of a telephoto optical system for astronomical purposes. A method of producing a polished aspherical surface has been developed. A new type of polishing tool permits work to be done on any desired zone of a lens and facilitates the figuring of a surface for the elimination of spherical aberrations. The method has been applied successfully in the production of a 12-inch single component lens with a focal length of 84 inches.

Refractometry methods.—In making refractive index measurements with a spectrometer it has been found possible to liberalize the tolerance for permissible curvature of prism surfaces and to eliminate customary and troublesome collimation adjustments. The procedure is applicable even when all wave lengths of the visible spectrum are employed and the spectrometer objectives are corrected for only two colors.

Tiltmeters.—Interference tiltmeters were perfected and built to measure the tilting of any surface upon which they are supported, with an accuracy of 0.1 second of angle. Several instruments have been installed and are now being operated at locations in California.

Evaluation of sources of ultraviolet radiation.—In cooperation with the Council on Physical Therapy of the American Medical Association, specifications were prepared on the minimum intensities of

typical sources of ultraviolet radiation which will insure effective therapeutic results. The interlaboratory comparison of standard sources of ultraviolet radiation was successfully completed.

Standards of thermal radiation.—Intercomparison of the Bureau's standards of thermal radiation, maintained for calibrating radiometers in absolute units, showed them to be in good agreement with the original standards. Life tests showed but little depreciation after 300 hours' use.

The stability of levulose.—Measurements have been made of the velocity constants of the decomposition of levulose in aqueous solutions of various acidities and temperatures. Regardless of temperature, levulose showed a maximum stability at pH 3.3. Data were tabulated showing the time required for 1 percent decomposition at integral pH's and 10° temperature intervals.

Semifactory production of levulose.—New and improved equipment was installed in the Bureau's semicommercial plant, and about 50 short tons of Jerusalem artichoke tubers were worked in the new diffusion battery. Several hundred pounds of thick sirup of varying degrees of purity were produced.

Purity of levulose sirups.—An improved process has resulted in sirups of 99 percent purity, and it is possible to recover by crystallization more than 75 percent of the sugar before reducing the purity of the sirup to what was heretofore the starting point.

Lactones of the monobasic sugar acids.—Improvements in the methods for the preparation of the lactones of the sugar acids were developed. The lactones of the principal sugar acids were prepared, purified, and their optical rotations determined.

Oxidation of sugars.—Crystalline magnesium xylonate, a new substance, was prepared by electrolytic oxidation of xylose in the presence of magnesium carbonate. Crystalline calcium lactobionate was prepared by electrolytic oxidation of lactose. Gluconic acid solutions were prepared by electrolytic oxidation of dextrose in the presence of a bromide, the bromide being removed by replacement with chlorine. This affords a cheap means for preparing crude gluconic acid solutions. Crystalline gluconic acid was separated in good yield from aqueous solutions containing about 65 percent total solids. This affords a means for preparing gluconic acid in any desired quantity.

International sugar scale.—The eighth session of the International Commission for Uniform Methods of Sugar Analysis at Amsterdam in September 1932 officially adopted the Bureau's proposed scale for the buying and selling of sugar throughout the world.

Standard wave lengths.—Intercomparisons of the wave lengths of all strong lines of neon, argon, krypton, and xenon have been made and defined on the cadmium scale with an average accuracy of about 1 part in 50 millions. Descriptions of these spectra were extended into the infrared, and wave length values calculated from precisely established spectral terms have been recommended as additional standards.

Spectral analysis.—The arc spectra of pure metals, to which graded amounts of impurities have been added, were examined to determine the sensitivity of the spectral method and to find a physical basis for methods of chemical analysis by means of partial spectra. To make such chemical analyses, the program of standardizing the emission spectra of the elements was carried forward by the measure-

ment and classification of the first spectrum of xenon, second spectrum of krypton, the first 2 spectra of chlorine, and the first 3 spectra of lanthanum. Analyses of the first spectra of vanadium and chromium and of the second spectrum of hafnium were extended, and standardization of columbium, tantalum, and silicon spectra was improved.

Interaction constants.—Measurements have been made on the brightness of the green continuous spectrum of a cesium discharge as a function of the number of electrons and ions per cubic centimeter. Results are expressed in terms of the collision area for recombination which at low vapor pressure was found to have a value, independent of pressure, of 1.7×10^{-21} cm^2. Above 5 microns pressure, the area increased rapidly to about 50 times this value at 300 microns.

X-rays.—Studies of commercial X-ray machines have revealed that the effective voltage applied to an X-ray tube and the effective current through it are far better indicators of the quality and quantity of the X-rays emitted than are the peak voltage and average current commonly specified. New equipment has been developed and a service established for the standardization of X-rays used in treating skin diseases. Under the Bureau's direction, three secondary X-ray standard ionization chambers have been set up outside of Washington. In cooperation with the representatives of the radiologists, X-ray protection recommendations have been promulgated. These will promote greater safety to hospital workers and probably lead in turn to lower insurance rates.

Radium and radioactive materials.—The number of preparations tested was 1,550, with a radium content of nearly 8 grams and a market value of about $550,000. Twenty samples of luminous materials were tested. A more rapid method of measuring radioactive samples, without sacrifice of accuracy, has been developed.

CHEMISTRY

Isotopic fractionation of water.—By fractional electrolysis, water of less density and water of greater density than normal water have been prepared. The heavier water has a higher freezing point, a higher boiling point, and a lower refractive index than normal water. The heaviest water thus far prepared has a specific gravity of 1.015. Isotopic fractionation has also been produced by distillation and by adsorption. The preparation of heavy hydrogen in a pure state opens up a new field of chemistry.

Hydrocarbons from petroleum.—A new type of packed-column still of high efficiency was developed. Five additional hydrocarbons have been isolated from petroleum and their properties determined.

Standard states for bomb calorimetry.—As a result of a thermodynamic analysis of the process taking place in the combustion bomb, corrections have been computed which make it possible to reduce all bomb-calorimetry results to a uniform basis, thus leading to greater accuracy and reliability.

Heat of formation of hydrochloric acid.—By direct union of hydrogen and chlorine in a flame calorimeter an accurate value for the heat of formation of hydrochloric acid from its elements has been obtained.

Heat content of phosphorus pentoxide.—The heat capacity, heat of sublimation, and heat of solution of phosphorus pentoxide between room temperatures and 1,100° C. has been determined. These data are of importance in connection with the production of fertilizers from phosphate rock.

Analytical reagent chemicals.—The critical study of methods for the examination of reagent chemicals, in cooperation with the American Chemical Society, resulted in the completion of 11 new specifications, and progress on a number of others.

Methods of analysis.—New or improved methods have been developed for the determination of aluminum in nitriding steels and magnesium in cements and similar materials. Experimental work has shown that palladium, rhodium, and iridium may be separated, individually or collectively, from platinum by hydrolytic precipitation. Several series of standards were prepared as a groundwork for quantitative spectrochemical analysis in this group of metals. Methods for the purification of rhodium and iridium, particularly methods for the rapid preliminary separation of these two metals from each other, were studied. Improvements have been made in existing methods for the analysis of alkaline tin-plating solutions. These will be useful in the control of commercial plating solutions. The minor products of decomposition of cyanide solutions such as formate, cyanide, and urea have been investigated and methods for detecting them in such solutions have been developed.

Standard samples.—There are now available 97 different standard samples, used by commercial testing laboratories in checking the accuracy of their analytical methods. During the past year 3,904 standard samples were distributed. The fees received offset the cost of preparing and distributing these samples.

Chromium plating.—A study, in cooperation with the Bureau of Engraving and Printing, of the possibility of depositing chromium from solutions of the trivalent or divalent chromium salts showed that it is not possible to obtain as satisfactory deposits or as good efficiencies as from the chromic acid solutions now used.

Protective value of electroplated coatings.—Last year exposure tests of electroplated steel specimens were started in six locations in cooperation with the American Electroplaters' Society and the American Society for Testing Materials. Inspections at regular intervals have shown that the thickness of the coatings is the most important factor in their protective value. Accelerated tests were found useful for roughly predicting the behavior of coatings under severe conditions of exposure, but they did not detect minor differences.

Gas analysis.—The limit of accuracy of general gas analysis has been extended by the design and construction of two sets of apparatus for gas-volumetric measurement of unusual precision, one for very small and one for large samples of gas.

Gas service and standards.—A review of the literature relating to the heating values of gases has been made and a table of the probable "best values" has been prepared. The Bureau's circular on standards for gas service has been rewritten. The circular discusses fully the heating value, composition, and pressure of gas supplied by gas

companies; meters; the extension of mains; and the relationships of company and customers. It includes summaries of existing regulations, existing company practices, and methods for producing gases.

A number of attachments for general installation on gas appliances, usually by house-to-house salesmen, have been tested. None of them has been found to have merit, and some introduce serious hazard into the household. The effects of barometric pressure on the operation of gas appliances were determined. Differences in design or adjustment necessary to make the appliances safe and satisfactory at different altitudes were worked out. Difficulty has been experienced in the use of the burners commercially available by laboratories and glass-blowing shops supplied with natural gas, propane, butane, or other slow-burning gases. To meet this need burners of three types were designed and constructed at the Bureau. Tests with several gases at the Bureau and elsewhere show them to be superior to burners now on the market.

MECHANICS AND SOUND

Absolute determination of gravity at Washington.—Final results of this investigation are now being obtained. A precise determination of this basic constant is of importance in the work of the Coast and Geodetic Survey and in making absolute force measurements at the Bureau of Standards.

Temperature coefficient of elasticity.—The temperature coefficient of the modulus of rigidity and Young's modulus of elasticity of 34 samples of various metals and alloys, useful as elastic elements for instruments, was determined in cooperation with the National Advisory Committee for Aeronautics.

Fatigue tests.—High-frequency fatigue testing of a number of light aluminum and magnesium alloys has been completed and a report, describing the results of the work, is being prepared.

Calibrating of proving rings.—A study of 17 proving rings commercially built according to the designs developed at the Bureau and meeting its specifications, showed them to possess satisfactory constancy.

Testing of engineering instruments and appliances.—During the year in excess of 1,000 engineering instruments were calibrated. Work has been started on a more complete standardization of the water current-meter equipment largely employed by the engineering branches of the Government. Type tests have been made of additional elevator safety interlocking devices for compliance with the performance standards included in the American Standard Safety Code for Elevators. The performance of automatic mail-metering devices, submitted for the approval of the postal authorities, has been investigated. The increasing use of automatic devices of this nature has made this work of considerable importance.

Fire extinguishing appliances and equipment.—A large number of items of fire-extinguishing equipment have been investigated and tested for the Government departments, principally for the Bureau of Navigation and Steamboat Inspection, to determine their suitability for use on vessels under the jurisdiction of that Bureau.

Acoustic properties of building materials.—Public interest in the reduction of noise continues. Over 50 different samples of sound-

absorbing materials have been submitted by the public for measurement, and numerous samples of material for use in Government buildings have been tested for the Supervising Architect of the Treasury. Apparatus has been constructed for the study and measurement of transmitted vibrations arising from machinery.

Wind pressure on structures.—The results of wind tunnel measurements on a model of the Empire State Building were published. The facilities of the Bureau were placed at the disposal of Prof. C. L. Harris, of Pennsylvania State College, for a study of the influence of neighboring structures on the wind pressure on tall buildings.

Robinson cup anemometers.—An investigation has been made of the rate of rotation of the standard 3- and 4-cup Robinson anemometers, as a function of wind speed, fine-grained turbulence of the wind, and roughness of the surface of the cups. Anemometers with conical cups have also been studied. Tests have been made on a whirling arm as well as in wind tunnels.

Cast-iron pipe.—As the available data on cast-iron water pipe cast horizontally by the multiple-gate process were insufficient, the Federal Specifications Board requested the Bureau to test a series of these pipes. Chemical and metallographic examinations, and mechanical tests were made on pipes 4, 6, 8, and 12 inches in diameter. The results indicated that satisfactory cast-iron pipe is made by the multiple-gate process.

Specification for wire rope.—The Bureau has cooperated with the manufacturers in a proposed revision of Federal Specification no. 297 for wire rope. The number of types of rope covered has been increased from 19 to 44, and the specification is now believed to include practically all types needed.

Strength of welded joints in tubular members for aircraft.—Continuing the work with the National Advisory Committee for Aeronautics, this investigation has been extended to cover tests on heat-treated welds and on welds of thin-walled tubing. Special attention is being paid to methods of preventing heat cracks, including a study of welds made by a new process, using a carbonizing flame and a special low melting point rod. Tests so far have indicated that this new process gives somewhat stronger welds.

End fixation of struts.—An investigation for the Navy Department on round tubular struts with elastically restrained ends showed that their strength could be predicted by calculation from tests on round end struts of the same material and shape, by the use of a theoretical factor to take account of the restraint. Methods have been worked out for determining, in certain types of trusses, a safe upper limit to this factor.

Airplane wing beams.—A number of experimental designs of metal wing beams built for the Navy have been tested under different loading conditions, thus supplying data upon which to base the design of improved types of military aircraft.

Wire loops.—At the request of the Navy Department, the Bureau has investigated failures of terminal wire loops in aircraft. They were all found to be fatigue failures caused by relatively high bending stresses where the loop passes through the terminal fitting. Careful preforming of the loops to fit the terminal greatly lessens but does not completely eliminate the trouble.

Vibrations of aircraft propellers.—In cooperation with the Aeronautics Branch of the Department of Commerce, an investigation is in progress on the stress distribution in vibrating propellers. A simple method of exciting resonant vibrations in nonrotating propellers, of sufficient intensity to cause fatigue failures, has been devised. The stress distribution has been measured with a Tuckerman optical strain gage.

Aircraft instrument developments.—A resistance type superheat meter for metal clad airships, three air-speed recorders for flight test use and one for the airship Akron, a strut type commutator-condenser air-speed meter, a suspended head pitot-static tube, a sensitive benzol manometer, and a pressure plate anemometer were designed and constructed for the Bureau of Aeronautics of the Navy Department. Experimental developments included electrically heated goggles, a venturi fuel flow meter with a new method of distant indicating, an improved carbon monoxide alarm, and a navigational computer. Test data on magnetic compasses are being obtained as part of a program to secure further improvement in performance. A monograph on aircraft power-plant instruments was completed for the National Advisory Committee for Aeronautics.

National Hydraulic Laboratory.—In addition to the equipment listed in last year's report, two 9-ton weighing tanks, several bulkheads, a supply main, and various safety screens and motor panels have been installed. Four research projects are now under way, 3 of them for other Government bureaus and 1 as general research. These are: Flow in the plumbing systems of high buildings; a study of deep-well current meters, for United States Geological Survey; loss of head at pipe bends, for Bureau of Reclamation; and effect of silt-laden water in scouring a sandy river bed, for Bureau of Reclamation.

ORGANIC AND FIBROUS MATERIALS

Properties of floor coverings.—The work of the research associate of the Asphalt and Mastic Tile Association has resulted in a specification for asphalt tile which has been adopted by the association, and will also form the basis of a forthcoming Federal specification. Specifications for wood-block flooring have been prepared in cooperation with the Supervising Architect's Office and the Post Office Department. Also, a specification has been developed for asphalt cement for use in laying flooring.

Thermodynamics of rubber.—The heat capacity-temperature relation of rubber has been found to follow a smooth curve from 14° to 195° K., but shows an anomaly between 195° and 202° K. which is probably associated with the hardening of rubber on cooling. The heat of combustion of rubber hydrocarbon in the "sol" modification was found to be 45,231 ±14 joules per gram at 25° C.

Photo-elastic properties of rubber.—The double-refraction of rubber under stress has been studied in relation to composition. The stress-optical properties of rubber, vulcanized with sulphur alone, differ markedly from those of rubber vulcanized with sulphur and organic accelerators. Photo-elastic methods have been applied to the study of stress distribution around inclusions in transparent

rubber sheets under tension, and have yielded results in agreement with theory. A new type of gage was developed in order to make dimensional measurements with an accuracy comparable to that of the optical observations.

Test methods for textiles.—Improved methods for analyzing cotton-wool mixtures have been developed and incorporated in the Federal specifications for these materials and in the American Society for Testing Materials methods of test for textiles. A method for the analysis of weighted silk was also developed, and a key to the identification of textile fibers, including those used in brushes and cordage, was prepared for the American Society for Testing Materials. The general methods used for testing Government purchases of textiles were completely revised and the revision approved for promulgation by the Federal Specifications Board.

Cotton textiles.—To aid in the selection of the best construction of cotton yarn or fabric to meet specified requirements, special yarns were spun and cloths woven from them, after which the relation between construction and properties of the fabrics was determined. The results are being summarized and collated.

"Handle" and "feel" of textiles.—Two new instruments for evaluating the "handle" and "feel" of textiles have been developed by the Bureau. The first, known as the flexometer, measures the flexural attributes of cloth, including flexural work, flexural resilience, and flexural hysteresis; quantities related to the stiffness and creasability of the fabric. The second, the compressometer, measures the compressional attributes, including thickness under different known pressures, compressibility, and compressional resilience, attributes related to softness or hardness and springiness as appreciated by squeezing the cloth between the fingers.

Accelerated aging test for waterproofed fabrics.—An accelerated aging test, designed to produce changes in the waterproofness of cloth similar to those which may occur in service, has been developed. The results obtained are comparable to those on fabrics exposed out of doors.

Dope for airplane wing fabric.—In cooperation with the National Advisory Committee for Aeronautics, a study was made of synthetic resins and cellulose derivatives in dopes. Cellulose acetate dopes were most satisfactory as regards tautness and fire resistance; the addition of boric acid-borax mixture to the under side of wing fabric markedly increased the fire resistance of the doped fabric.

Isoelectric point of silk.—In cooperation with the American Association of Textile Chemists and Colorists, the isoelectric point of silk, a fundamental characteristic of practical importance in all wet treatments including degumming, dyeing, and laundering has been definitely located at pH 2.5.

Manila rope.—The quantitative method for evaluating the color of rope fiber has been successfully applied by the manufacturers and has been incorporated in the revision of the Federal specification for manila rope. Spectral reflection measurements of the latest Philippine Island Government standards for abaca were made as a basis for the quantitative evaluation of the fiber.

Currency paper.—Cooperative work with the Bureau of Engraving and Printing and the Bureau of Efficiency on economies and

improvements in the paper currency indicate that the linen fibers used at present may be replaced with less expensive cotton fibers. Service trials of such paper are in progress.

Properties of lithographic papers.—Experimental printings of offset lithographic papers have shown that considerable waste results from dimension changes of the papers caused by variations in atmospheric humidity. In cooperation with the Lithographic Technical Foundation, precise laboratory measurements were made of these changes and other reactions.

Preservation of records.—Conclusive evidence was obtained that acid fumes in the air of cities is a deteriorant of books and other records stored in libraries. The feasibility of cleansing library air of acidic gases by an alkaline wash has been demonstrated. Further evidence was obtained that the stability of record papers is closely related to the purity of their fibers and the care exercised in the paper-making operations.

Domestic caseins.—Paper-coating tests of representative caseins, in cooperation with the Bureau of Dairy Industry, have shown that the domestic coating caseins compare favorably with foreign products. The foaming, which occasionally occurs with certain caseins, can be overcome by blending with nonfoaming products.

Paper standards.—Quality standards for specification purposes were developed for binders board in cooperation with the Binders Board Manufacturers Association, for Braille paper to be used by the Library of Congress in books for the blind, and for paper towels and mimeograph papers in cooperation with Government specification committees. Assistance to the Technical Association of the Pulp and Paper Industry and the American Society for Testing Materials included development of testing procedures for air and water permeability and folding endurance.

Acid in leather.—Research on 13 different leathers developed a more reliable method for determining the harmful acidity present in leather. Determinations of pH were made on leathers containing various amounts of sulphuric acid, and these were correlated with the deterioration or loss in strength of the leather after aging for 2 years. It appears that the deterioration of leather by acid is fundamentally due to the breaking down of the protein or hide substance when the activity of the acid in the leather is that indicated by a pH of near 3.

Sole leather.—Service tests of chrome-retanned sole leather and flexible vegetable-tanned leather showed that the retanned leathers wore from 5 to 70 percent longer than the vegetable leathers. The longer wear was, in most cases, related to the degree of vegetable tanning. Leathers having the greatest degree of retannage showed the least increased wear. In general, the flexible vegetable leathers showed no greater wear than the ordinary vegetable-tanned sole leathers.

Structure of collagen.—New information has been obtained on the nitrogen content of collagen, the basic raw material of leather. This work has shown that there are 38, or a multiple of 38, nitrogen groups in a unit of collagen structure; and that $\frac{1}{38}$ of the total nitrogen is present as free amino nitrogen.

High-grade cellulose from farm wastes.—Cellulose of 95–98 percent alpha content has been obtained in 35 percent yields from cornstalks, oat hulls, and straw by a new process which also permits the separation of the gums, pentoses, and lignins, with a total recovery of over 80 percent of the farm waste. Commercial uses for all these products are being sought.

Xylose from cottonseed hull bran and cornstalks.—Reports from hospitals indicate that xylose sugar can be used in comparatively large quantities by humans, and is valuable as a kidney diagnostic. A large demand has developed for samples of pure xylose which are being furnished as rapidly as possible.

Textile sizing from sweetpotato starch.—The viscosity of starch sizing for textiles unfortunately decreases rapidly with prolonged cooking in the mill. It has been found that the addition of small amounts of lecithin and lanum (commercial cholesterol) materially increases the stability of sweetpotato starch size.

Paper from cornstalks and straw.—The optimum cooking conditions for the production of kraft pulp from cereal straws have been determined. Large-scale experiments in the application of this and other pulping processes have been started, and a practical papermaking test has been run on a kraft pulp from cornstalks for a wrapping paper.

Development of machinery for making pressed boards from cornstalks.—It was found last year that by making cornstalks into a mat and pressing them a board having very high strength could be produced. In cooperation with the Iowa State College, machinery has been developed for the production of this board on a semicommercial scale. An automatic press has been designed to produce several boards simultaneously.

METALLURGY

Solubility of gases in metals.—Confirmation has been obtained of the tentative value of 0.0025 for the product of the concentrations of carbon and oxygen coexisting in liquid iron at 1,600° C. and in equilibrium with carbon oxides at 1 atmosphere pressure, a basic reaction in steel manufacture.

Crystal structure of metals.—The presence of a small amount of magnesium has been found to be advantageous in alloys of the zinc-aluminum system which form the basic zinc-base die-casting alloy. This confirms the results obtained in industry.

Machinability of metals.—A report was published on the work-hardening of the machined surface of steel forgings which results from cutting with lathe tools. The effects of size, form, and composition of tools; speed, feed, and depth of cut; and composition and heat treatment of the steels being cut were studied.

Wear resistance of metals.—The rate of metal-to-metal wear of eutectoid carbon steel, hardened and tempered at a relatively low temperature, was found to be slightly lower in an atmosphere of hydrogen or of nitrogen than in air. If the same steel was tempered at a somewhat higher temperature, the rate of wear in hydrogen or nitrogen was relatively enormous as compared with the rate of

wear in air. Under these latter conditions, oxide films on the wearing surfaces of the specimens markedly reduced the rate of wear.

Mechanism of creep in metals.—The phenomenon of creep in metals at elevated temperatures has been studied by using single-crystal specimens of extremely pure silver. Pure metal single-crystal specimens have been employed in order to determine creep rates for material in which grain size, grain boundaries, and precipitated phases play no part.

Heat-resistant alloys.—A report was published on the resistance to creep and the structural stability of iron-nickel-chromium alloys at 871° C. The strongest alloys were those containing approximately equal parts of nickel and chromium and not more than 30 to 40 percent iron. A condition of structural stability was approached more rapidly in alloys subjected to elevated temperature and stress combined than in alloys exposed to elevated temperature alone.

Stability of sheet aluminum alloys exposed to the weather.—Exposure tests of these materials extending over a period of 5 years, in cooperation with the National Advisory Committee for Aeronautics, the Army Air Corps, and the Bureau of Aeronautics have been completed, and are of decided value in establishing the reliability of these materials for structural purposes.

Protection of aluminum alloys by anodic oxidation.—In cooperation with the Bureau of Aeronautics, Navy Department, the factors which determine the useful life of the electrolytic baths used in the anodic oxidation process have been studied. Several new methods have been developed which are being tried on a commercial scale by the Navy.

Atmospheric corrosion of nonferrous metals.—This is a cooperative project with a committee of the American Society for Testing Materials. Specimens exposed to the weather for a year at nine widely separated locations were assembled at the Bureau for detailed inspection and determination of changes by corrosion, and then reinstalled in the corrosion racks. Observations have been continued on soldered joints in sheet roofing copper and on screen wire cloth representative of seven nonferrous materials exposed to the weather.

Bridge wire.—Although numerous mechanical tests of various types have shown that a heat-treated galvanized bridge wire is somewhat more sensitive to certain kinds of stresses than a cold-drawn galvanized wire, the results of this study have also indicated that the failure of the bridge cables composed of the heat-treated wire was the result of combined stresses rather than simple tensile stresses. A method was developed for testing wire under pulsating tensile stresses, and tests were conducted with the mean stress between 50,000 and 156,000 pounds per square inch.

Rail steel.—Tensile tests at elevated temperatures, with the load applied very slowly, show that, for medium manganese rail steel, the temperature at which "secondary brittleness" occurs is somewhat lower than when the load is applied more rapidly.

Quenching of steels.—The decomposition of austenite during the hardening of a steel has been studied by measuring the changes in electric resistance that take place during the rapid cooling. Quenching rates at the temperatures of the transformations have been determined and a temperature—quenching rate—constitution diagram has

been constructed representing the behavior of the steel during uninterrupted quenching. An automatic thermal analysis apparatus was developed for use in this work.

High-strength cast iron.—A report was issued showing the degree of improvement which can be made in cast iron by carefully regulated preheating prior to casting in the ordinary manner. This varies with the composition; a common iron can easily be increased 25 percent in strength in transverse bending, hardness, and density by preheating to 1,650 to 1,700° C. (approximately).

Effect of phosphorus and sulphur on steel.—Data have been obtained on two materials; a medium carbon forging steel with sulphur varying from 0.02 to 0.10 percent in forged rounds 1, 2, and 8 inches diameter, and a low-carbon steel suitable for pipe manufacture with phosphorus varying from 0.007 to 0.08 percent. No marked detrimental effects of sulphur or phosphorus were noted in either.

Utility of spark test for steels.—The general usefulness and limitation of the spark test for carbon and alloy steels was studied by applying the test to 280 materials differing in composition. For sorting mixtures of steels of known composition, it is unexcelled.

Casting of aluminum alloys.—A study of the casting of aluminum-copper alloys has shown that preheating above 750° C. (approximately) before casting is detrimental in many respects. Treatment with zinc chloride does not remedy this condition which holds for casting of high-grade aluminum as well as commercial grade.

Information circular on molding sands.—Information on the properties of foundry molding sands and the methods by which such properties can be determined has been compiled, summarizing much of the Bureau's research work in cooperation with the American Foundrymen's Association.

CLAY AND SILICATE PRODUCTS

Effects of particle size in ceramic whiteware.—A feldspar and a potter's flint, separated into small fractions by air elutriation, were used in preparing specimens of ceramic whiteware comparable to commercial products. Shrinkage and porosity of specimens heated at the same temperature could be changed as much as 5 and 18 percent, respectively, by using the initial material and the finest fractions.

Measurement of moisture expansion.—Measurements of moisture expansion of ceramic whiteware were made directly with a comparator and indirectly with an interferometer. The latter method was found sufficiently accurate for the purpose.

Composition and physical properties of glass.—Using as a basis linear relations previously determined, it has been found that the refractivity of commercially stable glasses, made by substituting for part of the soda certain glass-forming oxides, is the sum of the products obtained by multiplying the percentage of silica, soda, lime, alumina, magnesia, and potash by 0.00474, 0.00566, 0.00767, 0.0064, and 0.0055, respectively. The relations between the refractivity for any frequency in the visible spectrum and the specific volume of each type of these glasses is strictly linear in the range studied, and

consequently the dispersion of the glasses of any of the types considered is directly proportional to the specific volume of the glasses.

Production of optical glass.—Thirty-three pots of optical glass, embracing five different kinds, were melted. From a part of these melts 25,750 molded and annealed blanks for optical elements weighing 3,525 pounds were made for the Navy Department. The substitution of powdered flint for glass sand in the batches for light barium crown and medium flint glasses makes it possible to reduce the time required for melting from about 36 to 24 hours (33 percent) and, at the same time, to improve the quality of the glass.

Cement.—Studies of the fundamental properties of the cement systems have been continued. The effect of calcium chloride on the strength and other properties of cements is being determined. Isothermal calorimeters for the determination of the heat of solution of anhydrous and hydrated cement have been constructed for use in testing cement for Boulder Dam and for general research work in the hydration of cement.

Length change in alternate wetted (70° F.) and dried (150° F.) mortar specimens of masonry cements so weakens the specimens having the highest volume change that they break of their own weight. A duplicate set of specimens has been made and is undergoing 1 year's damp closet storage at 70° F. In this set, specimens that showed large length change in the alternate wet and dry storage are exhibiting a rapid increase in length. A study of the causes of staining of limestone by masonry cements has been started.

Compressive strength tests of concrete at the age of 1 year have been completed on 12 high early-strength cements; 6 by 12-inch cylinders were but slightly affected by 300 cycles of freezing and thawing; 3- by 6-inch cylinders subjected to alternate freezing, thawing, and drying gave strengths considerably below normally-cured specimens, with spalling taking place in some cements after about 30 cycles of drying and freezing.

The investigations of the Portland Cement Association Fellowship have been continued along two fundamental lines: (1) the establishment of the constitution of cement clinker and the effect of constitution on cement properties, and (2) the control of the reactions of cement during setting and hardening. These studies provide information upon which may be based the design of concrete, either to meet special requirements or to meet more rigid criteria for durability or architectural versatility.

A branch laboratory has been established at Riverside, Calif., to test cement for the Boulder Dam. This laboratory, with the branch laboratories in Northampton, Pa., Denver, and San Francisco, together with the cement-testing laboratory in Washington, have tested 3,401,566 barrels of cement for the Government, an increase of 10 percent over the previous year.

The Cement Reference Laboratory, a cooperative project of the Bureau of Standards and the American Society for Testing Materials, began and largely completed a third tour of inspection among the cement laboratories throughout the country. A ruling of the Bureau of Public Roads requires reference laboratory inspection at all laboratories which make acceptance tests of cement for Federal-aid projects. A turbidimeter has been developed for making rapid and economical determinations of subsieve fineness of portland cement.

An investigation of the durability of elastic calking cements is in progress. Tests of 382 samples for use in Government buildings show a marked improvement in the quality of the product. The bureau's test procedure is being used by some manufacturers.

Vibrated concrete.—A machine has been designed and built for making a study of vibrated concrete specimens. By vibration, concrete with a selected low-water content has twice the strength and a greater density than hand-placed concrete using approximately the same quantities of material.

Physical properties of common brick.—A survey has been completed listing the compressive strength, modulus of rupture, water absorption, and other properties, in connection with the geographical distribution of brick samples from 255 plants distributed throughout the United States.

Brick masonry.—The bond between brick and mortar was found to be dependent upon the absorptive properties of the brick and the water retaining capacity of the mortar. Mortars having a relatively high compressive strength stand up best under repeated freezing and thawing.

Problems relating to the design of hollow tile and brick extrusion machines.—Tests to determine the effect, on power consumption and output, of changes in taper of hollow-ware dies, showed that a die of 3° taper was productive of the highest extrusion rate per unit of power consumed by the assembly.

Study of refractories.—The quantity of silica which may be present as tridymite, cristobalite, or quartz, greatly affects the percentage increase in modulus of elasticity in flexure between 20° and 600° C. Ten brands of brick, ranging from 0 to 55 percent in uncombined quartz, show increases in modulus of elasticity ranging from 5 to 75 percent, respectively. Two pieces of equipment were constructed for measuring the elastic, plastic, and creep properties of refractories in tension or compression at temperatures ranging to over 1,000° C. A study of the properties of Olivine from six different sources indicates that some of them have potentialities as basic refractories.

Vitreous enamels.—The stresses developed in enamel coatings, as they cool subsequent to fusion upon the metal base, are being studied. Tests of 800 specimens of 11 typical first-coat enamels indicate that the tensile strength varies by about 25 percent, while the modulus of elasticity varies by about 5 percent. The computed maximum elongation before tensile failure is slightly over 0.25 percent.

Lime.—Electrometric measurements have been made of the activity coefficients of hydroxyl ion in solutions of calcium hydroxide. Comparison of a sedimentation method with microscopic methods for determining particle size indicated that the diameters of particles ranging between 1 and 10 microns could be determined by sedimentation to within a half micron. The product of the reactions between lime, silica, and water at elevated temperatures and pressures has been determined.

Gypsum.—From the measurements of the heat of solution of stable and unstable forms of calcium sulphate and its hydrates the energy changes involved in passing from one form to another have been determined. The use of ammonium acetate as a solvent has now

been extended to determine the purity of gypsum, calcined gypsum, and gypsum plasters, and the sand content of set gypsum plaster.

Building stone.—Ninety-four samples of stone, including granite, marble, limestone, sandstone, and slate, have been tested for Government construction projects. Seventy samples have been tested for the public in connection with the Bureau's research programs. One of the major research projects, the study of granite, has included tests on 36 samples from various States, and 29 new samples have been collected during the year.

Slate.—Data on the physical properties and weathering characteristics of slate have been published, and tests for the permanence of the color of slate are being developed.

SIMPLIFIED PRACTICE

Simplified Practice Recommendations.—Eight new Simplified Practice Recommendations were developed, increasing the total to 169. Of these, 150 have been formally approved and 143 have been issued in printed form. Twenty-one proposals for new Simplified Practice Recommendations were brought before the Bureau during the year.

Revision and reaffirmation conferences.—Twenty-three existing Simplified Practice Recommendations were reviewed by their respective standing committees. Of these, 19 were reaffirmed without change and 4 were revised.

Identification of simplified lines in trade literature.—In response to the urgent request of organized consumer groups, a very considerable number of manufacturers are now identifying the Simplified Practice Recommendations, by number and title, in their handbooks, catalogs, and other trade literature. One recommendation (R36, Milling Cutters) is being reproduced, serially, in the American Machinist magazine as Reference Book Sheets. A number of industries have made it known that they propose to identify—and in some cases actually reproduce—their own particular simplified practice recommendations in their codes of fair competition under the National Industrial Recovery Act.

BUILDING AND HOUSING

Building and plumbing codes.—A new edition of Recommended Minimum Requirements for Small Dwelling Construction was printed. Contacts with local committees and officials engaged in code revisions were maintained, and showed further local use of the building code committee's recommendations throughout the country.

Mechanics' lien act.—The standard State mechanics' lien act prepared by the Department of Commerce committee, in cooperation with the National Conference of Commissioners on Uniform State Laws, was approved and published.

Home financing.—Data were prepared to aid the Federal Home Loan Bank Board in commencing its activities. A statement describing methods of reducing foreclosures on homes brought this problem to the attention of responsible groups in many cities.

City planning and zoning.—The advisory committee started work on the problem of replanning of blighted areas and the assembly of

large plots for rehabilitation. Periodical reports on city and regional planning and zoning progress were continued.

Cooperation on building and housing problems.—Assistance was rendered to the National Conference on Construction held in October 1932, especially in preparing reports on real estate appraisal practices, a directory of sources of construction statistics, and construction inventories. A staff member aided in a demonstration real property inventory in Cleveland, Ohio. Further assistance was rendered the President's Conference on Home Building and Home Ownership in preparing reports for final publication. Studies included a cyclical analysis of building activities and the accumulating housing shortage. The staff assisted the Department of Commerce Advisory Committee on Reconditioning, Remodeling, and Modernization, which encouraged local campaigns held in more than 60 cities.

SPECIFICATIONS

Encyclopedia of specification.—The third volume of the encyclopedia series, Standards and Specifications for Metals and Metal Products, was issued in June. Manuscripts for two additional volumes are in preparation.

Surveys of standardization activities.—Surveys were made of commodity standardization activities of American technical societies, trade associations, State, county, and municipal purchasing agencies, and other consumer groups. The results have been published.

Facilitating the use of specifications.—Lists of sources of supply of commodities guaranteed to comply with the requirements of 398 Federal specifications and 32 commercial standards were compiled for the purpose of distributing them to agencies making purchases out of tax moneys—Federal, State, county, and municipal. These lists represent 18,621 requests from 8,340 firms.

At the request of the New York City Committee on Purchasing more than 1,800 commodity specifications used by the city of New York were compared with those of the Federal Specifications Board and the other national agencies. Similar, but less detailed surveys have been made for the board of education of the city of Philadelphia and the New York Advisory Committee on Prison Industries.

TRADE STANDARDS

Commercial standards.—At the close of the year there were 86 active projects for the establishment of commercial standards. Cooperation with the respective industries at their request resulted in the acceptance of commercial standards for sulphonated oils, fiber insulating board, Douglas fir plywood, apple wraps, builders' template hardware, fuel oils, Fourdrinier wire cloth, and hosiery lengths. Thirteen preliminary and two general conferences were held to pave the way for the establishment of standards of quality for curled hair, binders' board, pressed felt, gold-covered articles, rug cleaning, sweaters, bathing suits, hospital and institutional mattresses, domestic stokers for Pennsylvania anthracite, Douglas fir plywood, and walnut veneers. Eleven printed editions of established commercial standards were made available.

TABLE 1.—*Number of test items, determinations, and fee value for tests completed during the fiscal year ended June 30, 1933*

Kind of instrument, class of test, nature of service	Public		Government departments and State institutions		Bureau of Standards		Total		
	Number of test items	Fee receipts	Number of test items	Fee value (no charge)	Number of test items	Fee value (no charge)	Number of test items	Number of determinations	Fee receipts and fee value
Electrical standards, instruments and materials	412	$4,232.65	623	$5,876.50	313	$2,201.00	1,348	1,750	$12,310.15
Electric batteries			2,490	14,644.50	6	17.00	2,496	4,831	14,661.50
Electric lamps and lighting equipment	265	809.00	4,747	[1] 39,081.00	262	1,357.00	5,274	5,359	[1] 41,247.00
Length measuring devices	594	974.00	183	2,007.00	20	476.50	797	1,323	3,457.50
Gage and gage steels	212	608.50	1,117	1,542.60	99	228.00	1,428	7,425	2,378.65
Haemacytometers, sieves, thermal expansion, etc	851	982.55	405	3,437.90	70	2,772.50	1,326	15,835	7,192.95
Weights and balances	205	848.85	5,969	3,296.35	1,654	1,529.55	7,828	16,407	5,674.75
Scales	64	358.50	1,071	51,749.00	1	5.00	1,136	31,241	52,112.50
Timepieces	94	233.50	385	1,732.00	42	125.00	521	5,891	2,090.50
Volumetric apparatus	5,996	3,830.80	7,018	6,126.50	165	56.85	13,179	25,356	10,014.15
Hydrometers	262	548.95	645	1,008.70	2	3.00	909	24,075	1,560.65
Denisity determinations	2	2.50	4	6.00	98	306.50	104	185	315.00
Laboratory thermometers	1,163	3,169.70	850	2,912.85	336	845.20	2,349	9,314	6,927.75
Clinical thermometers	20,902	2,165.80	120,383	17,964.15			141,285	618,860	20,129.95
Pyrometers, calorimeters, etc	163	1,420.04	53	1,082.50	76	937.00	292	3,203	3,439.54
Insulating materials	77	801.00	19	305.00	5	100.00	101	106	1,206.00
Fire-resisting materials	26	330.00	67	2,835.00	5	110.00	98	91	3,275.00
Fuels and lubricants	87	988.75	1,316	17,841.34	224	2,212.25	1,627	7,565	21,042.34
Automotive equipment, etc			58	6,115.00			58	240	6,115.00
Airplane engines			5	7,100.00			5	26	7,100.00
Optical instruments and materials	325	2,565.20	171	1,183.50	231	3,488.00	727	3,512	7,236.70
Carbohydrates	15	226.00	2,575	6,858.50			2,590	3,647	7,084.50
Radioactive materials	1,453	4,057.47	144	495.00	18	20.00	1,615	744	4,572.47
Engineering instruments and appliances	114	4,035.00	978	23,921.00	39	559.00	1,131	1,354	28,515.00
Aeronautic instruments	23	405.95	1,050	10,201.00	9	141.50	1,082	4,450	10,748.70
Aerodynamic tests of models	5	64.50	8	170.00			13	120	234.50
Physical properties of engineering materials	1	100.00	4,599	21,199.50	184	1,051.00	4,784	8,501	22,350.50
Sound producing and measuring instruments	15	288.50	14	295.00			29	22	583.50
Making of special castings	2	67.50	23	1,140.00	68	955.00	93	382	2,162.50
Fusible boiler plugs			293	5,274.00			293	586	5,274.00
Metallographic examinations	1	8.00	500	5,887.50	593	1,175.80	1,094	3,389	7,071.30
Miscellaneous metallurgical tests	2	2.00	298	10,134.00	195	1,418.25	495	1,194	11,554.25
Pottery and chinaware			18	24.00			18	78	240.00

Glass	65	371.00	7	97.00	21	34.00	93	53	502.00
Refractories and heavy clay products	1	15.00	2,671	16,225.50	5	68.00	2,677	5,961	16,308.50
Cement, concrete materials, lime, etc	12	50.00	27,032	[2] 311,444.50	23	374.00	27,067	116,572	[2] 311,868.50
Stone and sand lime brick	5	54.00	71	1,747.00	66	2,387.00	142	467	4,188.00
Miscellaneous ceramic materials	7	40.00	8,416	39,270.60	5,751	8,309.95	14,174	30,852	47,620.55
Rubber	1	25.00	2,149	44,780.00	203	2,111.50	2,353	13,006	46,916.50
Textiles	2	25.00	6,742	33,267.00	126	1,267.00	6,870	16,942	34,559.00
Paper	59	204.50	2,353	19,901.00	34	224.50	2,446	7,977	20,330.00
Leather			689	3,215.00			689	2,496	3,215.00
Paint, varnish, and bituminous materials	2	17.00	4,902	99,620.50	37	570.00	4,941	35,255	100,207.50
Chemical analysis of metals	1	15.00	373	6,043.00	425	6,521.00	799	3,472	12,579.00
Chemical tests of miscellaneous materials	4	85.00	1,410	21,588.00	50	840.00	1,464	4,928	22,513.00
Distribution of standard samples	3,546	7,568.19	283	1,291.50	10	173.00	3,839	135	9,032.69
Total	37,036	42,594.45	215,177	872,153.49	11,466	[3] 44,971.10	263,679	[4] 1,023,582	959,719.04

[1] Includes fee value of $4,424.34 for inspecting 2,070,700 incandescent lamps at various factories for other branches of the Government.

[2] Includes fee value of $52,800 for sampling 1,836,124 barrels portland and 17,100 barrels masonry cement and 24,000 barrels of low-heat cement; testing 3,315,946 barrels portland and 85,620 barrels masonry cement; and shipping 1,474,576 barrels portland and 10,235 barrels masonry cement.

[3] Tests necessary in connection with the Bureau's own work on research and standardization are not included in these totals.

[4] Determinations for the public 177,670; for Government departments and State institutions 820,060; for the Bureau 25,852.

GENERAL FINANCIAL STATEMENT

During the fiscal year 1933 the Bureau expended and accounted for funds aggregating $2,701,843.14, including $444,563.14 received by transfer and reimbursement from other departments for special researches. The amounts and objects of each appropriation for the past fiscal year, together with disbursements, liabilities, and balance for each appropriation, are shown in the following table:

TABLE 2.—*Disbursements, liabilities, etc., 1933, 1932, and 1931 appropriations*

Appropriation	Total appropriation [1]	Disbursements	Liabilities	Balance
Salaries	$685,000.00	$591,440.90	$16,326.04	$77,233.06
Equipment	80,000.00	73,881.48	5,322.55	795.97
General expenses	[2] 60,972.21	52,960.71	1,867.86	6,143.64
Improvement and care of grounds	12,900.00	11,195.01	352.02	1,352.97
Testing structural materials	[3] 317,110.53	270,671.29	12,820.61	33,618.63
Testing machines	[4] 46,276.86	38,736.62	2,001.24	5,539.00
Metallurgical research	[5] 51,941.80	45,281.77	633.23	6,026.80
Investigation of optical glass	22,980.00	19,946.01	594.49	2,439.50
Standard materials	9,200.00	7,943.68	236.66	1,019.66
Investigation of textiles	53,100.00	46,465.59	537.97	6,096.44
Sugar standardization	[6] 81,820.00	70,740.15	2,052.90	9,026.95
Gauge standardization	43,000.00	37,025.35	1,095.03	4,879.62
High temperature investigation	6,900.00	5,650.38	262.08	987.54
Testing railroad-track, mine, and other scales	52,980.00	46,663.43	1,431.60	4,884.97
Investigation of fire-resisting properties	28,030.00	24,155.70	815.94	3,058.36
Testing miscellaneous materials	42,620.00	36,526.25	1,260.75	4,833.00
Investigation of public-utility standards	[7] 97,313.69	83,648.79	3,184.86	10,480.04
Radio research	76,800.00	66,451.86	2,780.82	7,567.32
Industrial research	[8] 115,211.05	96,085.25	3,950.19	15,175.61
Sound investigation	9,200.00	7,474.36	510.71	1,214.93
Investigation of clay products	42,240.00	35,618.99	1,282.27	5,338.74
Color standardization	13,630.00	10,878.06	1,247.54	1,504.40
Investigation of radioactive substances and X rays	23,000.00	19,334.84	1,020.93	2,644.23
Standardizing mechanical appliances	43,830.00	37,188.58	1,516.66	5,124.76
Standardization of equipment	[9] 160,045.00	136,591.25	4,761.45	18,692.30
Investigation of automotive engines	42,850.00	36,975.05	784.07	5,090.88
Utilization of waste products from the land	43,080.00	37,047.68	916.93	5,115.39
Investigation of dental materials	5,750.00	4,488.75	246.19	1,015.06
Hydraulic laboratory research	44,270.00	38,379.12	2,421.20	3,469.68
Appropriations transferred from other departments which are available for the current year:				
Aircraft in commerce	50,000.00	42,008.11	2,546.04	5,445.85
Air navigation facilities	95,000.00	82,278.00	3,981.92	8,740.08
Incidental expenses of Army	10,000.00	8,634.31	684.48	681.21
National Advisory Committee for Aeronautics	42,400.00	34,918.32	2,209.66	5,272.02
Salaries and expenses, Bureau of Engraving and Printing	12,000.00	10,755.82	394.53	849.65
Aviation, Navy	88,300.00	74,527.75	3,376.25	10,396.00
Chicago World Fair Centennial Celebration, 1933–34	12,350.00	4,228.23	3,222.30	4,899.47
General expenses, Bureau of Mines	85.56	72.71	----------	12.85
Mineral mining investigation	79.44	67.52	----------	11.92
Appropriations transferred from other departments under the provisions of the legislative act approved June 30, 1932: Working fund	79,577.00	60,767.49	9,843.97	8,965.54
Total, 1933	[10] 2,701,843.14	2,307,705.16	98,493.94	[11] 295,644.04
Total, 1932	3,298,522.83	3,123,379.31	1,457.97	173,685.55
Total, 1931	4,123,487.39	4,005,601.90	----------	117,885.49

[1] Includes reimbursements and transfers received from other departments as shown under the following footnotes:

[2] $972.21. [3] $47,110.53. [4] $226.86. [5] $191.80. [6] $5,000.00. [7] $1,013.69. [8] $211.05. [9] $45.00.

[10] Includes, in addition to reimbursements, $120,000 transferred to the Bureau from the Department under authority contained in sec. 317, legislative act, 1933.

[11] Includes, in addition to unobligated balances, impounded amounts.

BUREAU OF FISHERIES

The fishing industry in all its branches has suffered severely in common with other producers of foodstuffs. The extensive decline in prices, especially of those products with which fish normally compete in the retail markets, has faced the industry with actual disaster. The complexity of the system of fish distribution, seasonal character of supply, remoteness of centers of production from population centers, and the limitation of the consumption of fish combine to make it most difficult for fishery operators to compete at present price levels. The temporary scarcity of some staples has tended to keep up the cost of production and added to the difficulties of the producers. On the other hand, advances in quick freezing, the packaging of fresh and frozen fish, and the value of marine products in the diet in combating faulty nutrition are tending to popularize fishery products with the consuming public. With the development of improvements in fish manufacture and merchandising, especially with respect to adequate display and refrigerating equipment suitable for handling quick-frozen foods satisfactorily and their more general installation in retail stores, and the education of the public to a realization that frozen foods can be fully as sound, palatable, and nutritious as the fresh products, we may expect this branch of the fishery trade to become more stabilized.

Commercial fishing by United States craft is far-reaching in its scope, being prosecuted on the high seas and in the territorial waters of the Atlantic Ocean, Pacific Ocean, and the Gulf of Mexico, as well as in the Great Lakes and in interior waters. These fisheries during the calendar year 1931 furnished employment to about 123,000 persons as fishermen; and there were 82,000 persons engaged in transporting, manufacturing, and the wholesale trade—making a total of about 200,000 persons, who depended directly upon the fisheries for a livelihood. This was about 4,000 less than were employed during the previous year. The catch in 1931 amounted to 2,657,317,000 pounds, valued at $77,344,000, a decrease of 19 percent in quantity and 29 percent in value as compared with the previous year.

The fisheries in 1931 were marked by decreases in the production of all the major groups of products; thus, the output of canned fishery products which amounted to 506,702,000 pounds, valued at $62,940,000, represented a decrease of 12 percent in quantity and 24 percent in value as compared with the previous year; byproducts, valued at $18,538,000, decreased sharply; packaged products amounting to 139,283,000 pounds, valued at $23,076,000, decreased about 11 percent in quantity and 20 percent in value; cured fishery products amounting to 98,969,000 pounds, valued at $12,364,000, decreased about 21 percent in quantity and 27 percent in value; frozen prod-

ucts amounting to 112,257,000 pounds, with an estimated value of $11,000,000, decreased 19 percent in quantity and about 33 percent in value; and fresh products (not packaged) estimated at 600,000,000 pounds, valued at $47,000,000, decreased about 25 percent in quantity and 41 percent in value.

Imports of fishery products for consumption in 1931 were valued at $43,033,000, which is 15 percent less than in the previous year, while exports of domestic fishery products were valued at $11,574,000, which is 33 percent less than in the previous year.

INTERNATIONAL RELATIONS

INTERNATIONAL PASSAMAQUODDY FISHERIES COMMISSION

The International Passamaquoddy Fisheries Commission, appointed by the joint resolution of Congress approved June 9, 1930, completed its investigation of the probable damage to the food fishes of the region which would result from the proposed construction of power dams at the mouths of the Passamaquoddy and Cobscook Bays. The investigators employed by the Commission, with the counsel of the advisory board, reported that they anticipated that the construction of the proposed dams would reduce the herring fishery inside the bays to negligible proportions, that the fishery in the adjacent area outside the bays would be affected to an unknown degree, and that there appears little probability of the dams affecting the fishery along the coast of Maine or even seriously of Grand Manan.

Owing primarily to the limitation of time, which would not permit completion of two full seasons of fieldwork, the investigations do not explain the unusual richness of the sardine herring fishery both inside and outside the proposed dams; and without an elucidation of the unique character of the area, the Commission was unable to state categorically that the projected dams might not so alter the environment as to affect seriously the results of the fishery. The investigation contributed results that greatly increase our understanding of the present water circulation, the production of plankton and the nature of the herring concentration in the region. The investigation of forces beyond these, that determine the existence of the fishery, requiring the development of new methods, has not been possible within the limits of the Commission's work.

The administrative report of the commission has been prepared and the technical reports of the investigators will be submitted during the coming year.

NORTH AMERICAN COUNCIL ON FISHERY INVESTIGATIONS

The nineteenth meeting of the council was held at Washington, D.C., on October 20 and 21, 1932, with representatives from Canada, Newfoundland, and the United States present. Views were exchanged and the progress of investigations conducted by the various countries on important North Atlantic fishing banks, including fishery statistics, bait investigations, hydrographical investigations, including a study of currents by means of drift bottles, plankton, mackerel, herring, cod, and haddock investigations, was presented for consideration and criticism.

Much attention was given to the success of biological research in predicting the abundance of the various species of fish many months in advance of the season, thus tending to remove the element of "fisherman's luck" and increasing the value of the catch by reducing unnecessary expense.

One of the most important undertakings of the council is that of coordinating the collection and dissemination of fishery statistics regarding the locality of capture and the quantities taken of the important species of fish in the North Atlantic in which the nationals of each country are interested. Revised charts were adopted by the council defining statistical areas of the North Atlantic region, to be used as a basis of a uniform statistical system among the several countries.

The council approved the following resolution:

Whereas much of the value of fishery investigations depends upon continuity of records over a period of years; and

Whereas the present program of fishery investigations is proving to be invaluable in determining governmental policies with respect to our highly important sea fisheries: Therefore be it

Resolved, That the council extend a vote of appreciation to the Woods Hole Oceanographic Institution for loaning the use of its vessel to the United States Bureau of Fisheries for continuing high-sea investigations for the current year, and that it urge the importance of provisions being made by the United States Congress to supply the funds necessary for the continuance of that work during the next fiscal year by the United States Bureau of Fisheries.

CONSERVATION OF WHALES

The Multilateral Convention for the Regulation of Whaling agreed to by the economic committee of the council of the League of Nations on September 24, 1931, has now been ratified by the following nations: United States, July 7, 1932; Norway, July 18, 1932; Union of South Africa, January 11, 1933; Switzerland, February 16, 1933; and Mexico, March 13, 1933. In addition to these ratifications the following have signified adherence to the convention: Nicaragua on April 30, 1932; Sudan, April 13, 1932; Monaco, June 17, 1932; Brazil, November 21, 1932; and Egypt, January 25, 1933. There remains only the signature of the United Kingdom of Great Britain and Northern Ireland to make the convention effective.

The more recent intensive prosecution of the whale fishery and consequent need of adequate regulation is indicated by a world catch of 42,874 whales in 1930–31 as compared with 11,369 in 1920; and a total production of whale oil in 1931 amounting to 184,348,800 gallons as compared with 20,366,350 gallons in 1920.

HALIBUT INVESTIGATIONS

The investigations of the International Fisheries Commission provided for under the convention between the United States and Great Britain concluded May 9, 1930, have been continued in accord with the duties prescribed by articles I and III of the treaty.

A practical demonstration has been successfully concluded during the past year as to the feasibility and effectiveness of international regulation of a deep-sea fishery when based upon adequate biological and statistical knowledge. Regulations of the commission in con-

junction with certain economic conditions have already had a most salutary effect on the stock of halibut. The long continued decline in abundance to the low level of 1930 has been halted, and on the more severely depleted southern grounds the recovery in 1933 has been to 50 percent above that of 1930. It is essential that the ground gained so far be maintained and the spawning reserve rehabilitated to the end that the fishery may become a stable resource with permanent yield.

Collection of comprehensive statistical and biological data by the commission for the past 8 years has been continued, and its analysis has revealed certain fundamental short-time reactions of the supply to the demands put upon it by the fishery. These reactions appear adequate to explain what has happened during the last 8 years. Hence it may now be possible to predict with a degree of accuracy what the immediate effect of regulation may be upon the stock.

The biological work has consisted chiefly in the analysis of data previously collected, as field work was of necessity curtailed on account of reduced appropriations. The preparation of reports upon studies of the rate of growth, maturity, fecundity, migrations, and biological statistics has engaged the scientific staff.

The limited field work conducted resulted in definite progress being made in the development of methods of determining the success of spawning by means of quantitative net hauls during 2½ months of charter of the United States halibut vessel *Eagle* in the Gulf of Alaska. The study of the migration and rate of decimation by the fishery of the few remaining spawning schools on the southern grounds was begun by conducting a tagging experiment off Cape St. James on the chartered Canadian halibut boat *Capella I* for 3 weeks, along the lines of the experiments of 1925 and 1926, already reported upon. A system of market measurements has been inaugurated to supplement size composition data secured from trade sizes.

The practicability of the commission's regulations involving division of the convention waters into areas, limiting the catch from each area, licensing of vessels for the halibut fishery, collection of statistics of abundance and locality of capture, modification of the closed season, and closing of nursery grounds has been satisfactorily proved during the past year. After public hearings during November 1932 several changes resulting from suggestions by the industry and findings of the scientific staff were made for the 1933 season, including changes in the dates of the closed season and in the boundary lines between regulatory areas. The well-known spawning grounds off Yakutat Bay were closed to fishing from November 1 to the end of February and provision was made for the prohibition of the use of dory gear in southern areas. The catches in the two principal areas were fixed at the same amounts as in the previous year, taking into consideration the change in boundary lines. These regulations were approved by the President of the United States and the Governor General of Canada and became effective on January 9, 1933.

JAPANESE VESSELS IN BERING SEA

The canning of spider crabs in Bering Sea was carried on in 1932 by Japanese interests as in the preceding 2 years. The floating

cannery *Nagato Maru* operated in the region between Amak Island and Port Moller, well outside the territorial waters of Alaska, for a period of about 4 months, during which a reported total pack of 33,000 standard cases of canned crab meat was prepared. Two auxiliary motor vessels, the *Kasuga Maru* and the *Ise Maru*, accompanied the cannery ship, and fishing was carried on from 10 small boats. The *Nagato Maru* carried a crew of about 45 men, and approximately 400 persons were employed in fishing and canning operations. The supply ship *Seiten Maru* visited the vessel once during the season to deliver supplies and take aboard a cargo of canned crab for transportation to Japan.

Early in the spring of 1933 the Japanese cannery vessels *Taihoku Maru* and *Shoheo Maru* arrived in Bering Sea t engage in crab fishing in offshore waters. A third cannery ship, the *Kasada Maru*, arrived later and was reported to be engaged in crab canning near the other vessels.

DOMESTIC RELATIONS

COOPERATION WITH STATES AND OTHER AGENCIES

Dwindling revenues for fisheries work in the States, together with curtailment of the Bureau's appropriation, rendered even more valuable and essential a broad program of cooperation and mutual aid between agencies concerned with the same activities.

In connection with the propagation and distribution of fish, mutually reciprocal relations have been established with 21 different States, enabling the State waters to be stocked more effectively and economically. These measures of cooperation have extended into practically all fields of fish-cultural work, including the exchange of eggs, joint use of hatchery facilities, distribution by the States of fish produced in Federal hatcheries, loan of experienced personnel to help the States, financial assistance on the part of the States in some instances, and loan of equipment. In addition the Bureau has directly aided 6 other States by supplying eggs, fish, or other services.

Uniformly helpful contact has existed with other Federal agencies concerned with the perpetuation of fish life, principally with the Forest Service, Bureau of Biological Survey, and the National Park Service.

The maintenance of active cooperation with sportsmen's organizations for the purpose of operating rearing pools and nursery ponds was on a more restricted scale. Approximately 100 organizations received fish for rearing from the Bureau's hatcheries in comparison with 116 last year. Consequently the fish allotted dropped considerably below the 4 million mark which was exceeded during the previous year. The State of Pennsylvania assisted materially by furnishing 475,000 brook trout for the nurseries within that State. The Bureau has endeavored to assist sportsmen's groups otherwise by rendering advice on fish-cultural problems, making inspections where practicable, and any other feasible means.

In the collection of fishery statistics unusual cooperation has been accorded the Bureau by the Pacific Coast and Great Lakes States, and also Maryland and Virginia. In addition, various other States have supplied statistics on one or more of the fisheries conducted within their borders. In this work the Bureau represents the cor-

relating agency, performing necessary service beyond the scope of any one individual State.

The technological work of the Bureau has been aided materially by cooperation with other agencies. At the South Carolina Food Research Commission one of the Bureau's technologists studied the nutritive value of fishery products, with special attention being given to oysters from all sections of the country. In the feeding of fishery products to farm animals, the Bureau also cooperated with the Ohio State Agricultural Experiment Station, Wooster, Ohio; the North Carolina State Agricultural Experiment Station, Raleigh, N.C.; and the New York State Agricultural Experiment Station, Cornell University, Ithaca, N.Y. The nutritive value of kelp meal was studied in cooperation with the United States Department of Agriculture and producers of kelp meal. The preservation of cordage was studied in cooperation with the Navy Department at Boston. A portion of the Bureau's study of the preservation of textile fishing gear and twine was conducted in cooperation with the Weather Bureau, the Bureau of Standards, and various individual fishermen at various fishing centers. A study on the measurement of the size of mesh used in gill nets in the Great Lakes was aided by the Bureau of Standards and various States and certain Provinces of Canada bordering the Great Lakes. A study of the manufacture of salmon oil was begun in the vicinity of Seattle, with assistance from the salmon branch of the National Canners Association in Seattle. At Gloucester, Mass., the local fishing industry is making material contributions to the maintenance of the Bureau's technological laboratory located in that city by providing the building for the laboratory without cost to the Government. Members of the staff of the Massachusetts Agricultural College, Amherst, Mass., have aided the Bureau in developing programs for bacteriological studies of fishery products, and for the home canning of fishery products.

A market study was made of the fishing industry in Florida in cooperation with the State Marketing Bureau, and various individuals and companies in the State. In its marketing work the Bureau also cooperated with the State of Virginia, establishing marketing grades for certain fishery products in that State.

The biological investigations of the Bureau were aided by the cooperation of several States that provided funds, personnel, and equipment for projects in their territory. The State of New York continued the joint nutrition studies on trout at Cortland in cooperation with the College of Agriculture, Cornell University, and the enlarged program of pond-culture work at Rochester. Michigan and Wisconsin cooperated financially in the study of conservation of food fishes through the use of improved fishing gear. Georgia, Louisiana, and Texas continued their assistance with personnel and other contributions to the shrimp investigations. The oyster cultural research program in the South Atlantic and Gulf States has been aided by the help of North and South Carolina, Georgia, and Florida. California provided all the field expenses of the trout and oyster investigations. Mississippi assumed the expense of a survey of the fisheries in that State. The Bureau is continuing its oyster research in Connecticut with the laboratory and vessel put at its disposal by the State, and similar facilties are available in Puget

Sound through the cooperation of the State of Washington. The hydrographic program of the Bureau's North Atlantic investigation was enabled to be continued through the generous cooperation of the Woods Hole Oceanographic Institution in assigning its vessel *Atlantis* to continue the work threatened with disruption when the Bureau's vessel *Albatross II* was laid up for lack of funds.

CONSTRUCTION PROGRAM

No appropriation was made during 1933 to carry on the construction authorized by the act of May 21, 1930 (46 Stat. 371). However, the unexpended balances for certain projects carried in an appropriation of $448,500 for the previous year were continued. This permitted the completion to the limits of authorization of new hatcheries already started at Lake Mills, Wis.; Ennis, Mont.; Hagerman, Idaho; Crystal Lake, Colo.; Flintville, Tenn.; and Butte Falls, Oreg. The first three of these did not enter into production during 1933, however. In addition considerable preliminary development was accomplished at Marion, Ala., where a large and desirable site was acquired. Two hatcheries, previously operated under lease, at Mill Creek, Calif., and Cortland, N.Y., were acquired by purchase and improvements were effected. A reduction of 10 percent in the amount of all building authorizations imposed by Congress as an economy measure rendered it impossible to complete several of the new stations.

The Government now holds title to sites in Indiana and Pennsylvania, which will be developed through funds obtained from the Emergency Public Works program. Under authority of the Bureau's 5-year program a site was acquired gratis at Bear Lake, Utah, and developed as a trout-rearing unit. The new hatchery at Mount Rainier National Park, mentioned in last year's report, was completed and placed in operation. A trout-rearing establishment was also developed in Jackson Hole, Wyo., adjacent to Yellowstone Park. This is intended to serve the new Teton National Park.

PROPAGATION AND DISTRIBUTION OF FOOD AND GAME FISHES

The Federal fish-hatchery system operated by the Division of Fish Culture was successful in increasing its output of fish and eggs for the fiscal year to a total of over 7,202,155,000. This is an increase in production of 2 percent over the previous year. Fewer species were handled than in the previous year, but 18 out of more than 40 species propagated were produced in increased numbers. Five new hatcheries, located at Crystal Lake, Colo., Flintville, Tenn., Marion, Ala., Lake Mills, Wis., and Butte Falls, Oreg., entered into production for the first time. The size of the fish distributed, as well as their numbers, has an important bearing on the value of the work, since the survival of the planted stock is correlated with the size and age at planting. The larger fish, many of legal size, particularly among the game varieties, are termed fingerlings, and a distribution of over 182,338,000 in this category represents an increase of 22.7 percent over the previous year. Included in the figures for hatchery output are the figures covering the rescuing and salvaging of fishes in the overflowed area of the upper Mississippi River.

While the methods of operation largely followed those of past years, all worth-while developments and improvements in the way of fish-cultural technique, apparatus, equipment, etc., were given a trial and adopted where proved practical. Over 80 stations, substations, and egg-collecting units, practically the same number as in the previous year, were operated. There were several changes, however, owing to the closure of operations at several points and the opening of new stations at other locations.

PROPAGATION OF COMMERCIAL SPECIES

Marine species, Atlantic coast.—Inasmuch as the eggs of the cod, haddock, and flounder are easily secured in tremendous numbers, this group accounts for 86.7 percent of the total output of the commercial group. They are propagated at only three stations, all located in New England. Both the cod and the flounder show a marked increase in output; but smaller numbers of haddock, pollock, and mackerel were released in comparison with the output of the previous year.

Pacific salmons.—The only increase registered in this group was for the chum and sockeye salmon, the species of least and highest value. The Yes Bay (Alaska) station succeeded in raising approximately 15 million sockeyes to the large fingerling size, in contrast with the usual practice of releasing them at an early stage.

Anadromous species, Atlantic coast.—These include the species other than Pacific salmon which migrate from salt water to fresh water for spawning. The shad and glut herring comprise the greater proportion under this category and were produced in somewhat lesser quantities, because of weather conditions affecting the spawning runs. There was a slight decline in the output of Atlantic salmon, partially offset by an increase in the size of the fish planted. No striped bass were propagated in 1933.

Commercial species, interior waters.—A number of hatcheries on the Great Lakes and elsewhere propagated whitefish, lake trout, lake herring (ciscoes), and pike perch. They also handled carp, yellow perch, etc., during the off season for the other species. The only variety propagated in larger numbers during 1933 was the whitefish. A practically complete failure of the egg supply at the Cape Vincent (N.Y.) station, together with the closure of certain commercial fishing grounds in Lake Superior, limited the collection of lake-trout eggs. Reduced egg collections and the failure to operate a hatchery on Lake Champlain accounted for a reduction in the number of pike perch handled. No special effort was made to obtain a large output of carp and buffalofish. Suckers, formerly hatched in cooperation with the State of Pennsylvania, were not handled.

PROPAGATION OF GAME FISHES

Game fishes, while commonly considered as a recreational asset, are a distinctive economic resource as well, since they are the basis of livelihood for a large number of individuals who in one way or another cater to the angler. Consequently, the enlargement of fish-cultural facilities, both Federal and State, has been mainly for the

purpose of increasing the output of game fish. The Bureau's efforts in this direction in 1933 resulted in an increased output for three species of trout, for grayling, and for practically all forms of the pond fish or pan fish. It is particularly gratifying to report an output of almost 5¼ million largemouth and smallmouth black bass. The popularity of this fish is responsible for a heavy demand. In fact the demand for all species of game fish, as shown by the number of applications, has undergone no abatement. In addition, special effort has been made to increase the planting of fish in the public domain, particularly national forests and national parks. The supply of trout eggs obtained from wild fish or from station brood stock was adequate for all requirements, no eggs being acquired by direct purchase. The practice of distributing fish by truck was expanded, although the increased output required the full use of four distribution cars. It is desirable to emphasize that many of the species listed as commercial varieties—for example, the lake trout, pike perch, steelhead salmon, etc.—are eagerly sought by the sportsmen, and the actual replenishment of sport fishing is greater than is indicated in the relatively small percentage listed as the output of strictly game fishes.

RESCUE OPERATIONS

Rescue or salvage operations on the upper Mississippi River, chiefly within the confines of the Upper Mississippi Wild Life and Fish Refuge, covered the handling of over 72,180,000 fish, an increase of 20,569,000 over last year. In addition a considerable production of bass and other species was obtained from seminatural controlled ponds, operated as auxiliary hatching ponds within the refuge. As usual approximately 1 percent of the rescued fish were distributed to other than parental waters.

AQUARIUM

The aquarium, maintained in the basement of the Department of Commerce Building, was a focus of increasing public interest. Approximately 1,000 specimens of 57 different species of native and tropical fish were on display during the year, together with 10 species of aquatic reptiles, crustacea, etc. Hatching apparatus was installed to demonstrate the incubation of eggs of trout, salmon, shad, whitefish, pike perch, and yellow perch. A model fish ladder was also shown. Several rare and unusual forms, such as the Alaska blackfish and Eastern golden trout, were added to the collection.

STATISTICAL INVESTIGATIONS

FISHERIES OF THE UNITED STATES, 1931

New England States.—During 1931 the fisheries of Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut, employed 17,900 fishermen, or an increase of 5 percent over 1930. The catch amounted to 540,298,000 pounds, valued at $20,141,000—a decrease of 23 percent in the catch and 27 percent in the value as compared with 1930. Landings of fish by American fishing vessels at Boston and Gloucester, Mass., and Portland, Maine, amounted to 263,685,000

pounds as landed, valued at $9,249,000—a decrease of 25 percent in quantity and 28 percent in value from 1930.

Middle Atlantic States.—The fisheries of New York, New Jersey, Pennsylvania, and Delaware in 1931 employed 9,600 fishermen or 5 percent less than in 1930. The catch amounted to 164,899,000 pounds, valued at $9,211,000—a decrease of 15 percent in the catch and 29 percent in its value under 1930. Landings of fish at New York City and Groton, Conn., amounted to 51,854,000 pounds or 9 percent less than in 1930. On the Hudson River the shad fishery was carried on by 250 fishermen who caught 414,000 pounds of shad, valued at $49,800—a large increase over 1930.

Chesapeake Bay States.—In the calendar year 1931 the fisheries of Maryland and Virginia employed 20,700 fishermen or 7 percent more than in 1930. The catch amounted to 293,271,000 pounds, valued at $7,428,000—a decrease of 7 percent in the catch and 35 percent in its value as compared with the previous year. The shad and alewife fisheries of the Potomac River were prosecuted by 680 fishermen who caught 2,061,000 pounds of shad, valued at $193,000, and 7,352,000 pounds of alewives, valued at $55,500—a large increase over the previous year.

South Atlantic and Gulf States.—During 1931 the fisheries of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas, employed 23,700 fishermen or 1 percent more than in 1930. The catch amounted to 289,309,000 pounds, valued at $8,082,000—a decrease of 31 percent in the catch and 27 percent in its value as compared with the previous year.

Pacific Coast States.—The fisheries of Washington, Oregon, and California in 1931 employed 19,200 fishermen or 2 percent less than in 1930. The catch amounted to 597,306,000 pounds, valued at $13,512,000, a decrease of 28 percent in the catch and 41 percent in its value as compared with 1930. The total catch of halibut by United States and Canadian vessels amounted to 42,845,000 pounds, valued at $2,842,000, a decrease of 13 percent in quantity and 43 percent in value as compared with 1930.

Lake States.—During the calendar year 1931 the Lake fisheries (Lakes Ontario, Erie, Huron, Michigan, Superior, Namakan, and Rainy Lakes, and Lake of the Woods of the United States and Canada) produced 120,832,000 pounds of fish and shellfish. Of the total the United States accounted for 91,927,000 pounds, valued at $6,029,000, a decrease of 3 percent in quantity and less than one half of 1 percent in the value of the United States catch as compared with the previous year.

Mississippi River and tributaries.—During 1931 the fisheries of the Mississippi River and tributaries employed 15,900 fishermen, or 29 percent more than in 1922, when the first previous survey was made. The catch amounted to 82,382,000 pounds, valued at $2,897,000, a decrease of 22 percent in the catch and 36 percent in its value as compared with the previous survey.

MANUFACTURED PRODUCTS IN THE UNITED STATES AND ALASKA, 1931

The total value of manufactured fishery products of the United States and Alaska in 1931 amounted to about $128,000,000.

Fresh and frozen packaged products.—The production of fresh and frozen packaged fish and shellfish in 1931 amounted to 139,283,000

pounds, valued at $23,076,000, a decrease of 11 percent in quantity and 20 percent in value as compared with 1930. Important items in this group were fresh-shucked oysters, amounting to 5,438,000 gallons, valued at $8,372,000, and fresh and frozen haddock fillets, 42,014,000 pounds, valued at $6,109,000.

Frozen products.—The pack of frozen fishery products in 1931 amounted to 112,257,000 pounds which had an estimated value of $11,000,000. The volume of the pack was 19 percent less than in 1930. The more important products with respect to volume were halibut, salmon, haddock fillets, mackerel, and whiting.

Cured products.—During 1931 the output of cured fishery products (salted, spiced, smoked, and dried) amounted to 98,969,000 pounds, valued at $12,364,000—a decrease of 21 percent in quantity and 27 percent in value as compared with 1930. Important products were mild-cured salmon, 10,160,000 pounds, valued at $1,550,000; smoked salmon (produced from mild-cured salmon), 7,788,000 pounds, valued at $2,270,000; and boneless cod, 12,205,000 pounds, valued at $1,047,000.

Canned products.—Canned fishery products produced in 1931 amounted to 506,702,000 pounds, valued at $62,940,000—a decrease of 12 percent in quantity and 24 percent in value as compared with 1930. Canned salmon, amounting to 6,740,000 standard cases (323,522,000 pounds), valued at $38,083,000, was most important. Other important products were sardines, tuna and tunalike fishes, shrimp, clam products, and oysters.

Byproducts.—During 1931 the production of fishery byproducts amounted to $18,538,000, which was a considerable decrease from 1930. Important products in this group were marine-animal meals and scrap, aquatic shell products, and marine-animal oils.

MARKET INVESTIGATIONS

Aquatic shell products.—A survey of the oyster, marine clam, fresh-water mussel, and marine pearl shell industries, which in 1932 produced products valued at nearly $8,000,000, revealed the sources of raw material and methods for its production and manufacture into useful commodities, as well as practices followed in distributing the finished product.

Fishery byproducts industries of Maine.—A technical survey of the manufacture and marketing of fishery byproducts in Maine showed that present factories have ample facilities for the greater utilization of existing waste; that fish meals produced in Maine are not reaching markets that their good quality justifies; and that methods for producing fish oils could be improved.

Establishing marketing grades for fish.—Considerable confusion and disorder exist in the marketing of some fish because of the lack of uniform grades. Believing that this could be overcome in Virginia, authorities of this State requested the Bureau's assistance in establishing marketing grades for fish in their State. This invitation was accepted and after conferences by representatives of the Bureau and the Division of Markets of the Virginia State Department of Agriculture with fishermen, wholesalers, retailers, and others, a system was developed and established for grading various fish and fishery

products. The system was put into effect immediately in the State and has proved satisfactory in the more orderly marketing of these products with benefit to both sellers and buyers.

The red-snapper fishery and industry.—During 1932 a study of the red-snapper fishery and industry revealed that costs of producing red snapper might be lowered by the use of a fish pot which was shown to be very efficient for catching this fish. Also it was found that marketing conditions might be improved by more careful handling of the catch aboard vessel to retard deterioration, and by diversifying the type of red-snapper product offered for sale. In the latter connection, experiments showed that red snapper lends itself to smoking in the "finnan haddie" style.

TECHNOLOGICAL INVESTIGATIONS

Nutritive value of marine products.—In cooperation with and in the laboratories of the South Carolina Food Research Commission, Charleston, S.C., the Bureau's technologist completed an investigation in which oysters from different localities were analyzed for their iron, copper, and manganese content, and the dried oysters fed to anemic rats. All samples, regardless of locality from which they were obtained, induced regeneration of hemoglobin, thus giving evidence of the importance of oysters as a source of iron in addition to their other food factors.

Studies on the vitamin potency of salmon-liver oils have revealed that they are from 10 to 12 times as potent in vitamin A as salmon oil from general cannery trimmings. However, since the yield of oil from salmon livers is low and since it requires solvent extraction to obtain the oil from the livers, it is expected that adjustments will need to be effected before placing the manufacture of salmon-liver oil on a commercial basis.

Further work in cooperation with a producer of kelp meal has shown that kelp meal is a valuable supplement to rations composed of vegetable feedstuffs in which the protein is supplied by plant protein concentrates.

Preservation of fishery products for food.—Studies on the chemical and physical changes of fresh fish and frozen fish held in cold storage have shown that with improved methods the producers can offer to the public a product superior to those handled by the ordinary commercial procedure. These studies have dealt in detail with the rate of freezing, the temperature of cold storage at which the least change takes place in texture of the flesh, and the rate of change to be expected from fresh fish packed by the usual method in ice. An electrometric method for the determination of the relative freshness of fish flesh also has been developed, which may be of great value in grading fish for quality. Practical experiments in the home preservation of fish by salting and smoking were made before county agents, home economics experts, fishermen, and housewives, at various points along the South Atlantic and Gulf coasts. This work has shown that the outlets for fish can be expanded when consumers are acquainted with methods for preserving fish in rather large quantities for family use.

Bacteriology of fish preservation.—In a study of the bactericidal effect of smoke and salt brining on fish, it has been found that

contrary to the general belief neither smoke nor salt brine has a preservative effect on fish so preserved in ordinary commercial practice. In this work the technologists have been able to produce a smoked haddock containing a higher percentage of water than is ordinarily found in this product, which has retarded losses in this process; but to date a successful method has not been found for preserving smoked fish for a greater length of time at the usual room temperatures. Studies have been made of the bacterial spoilage of frozen fish and of fish packed in ice, and considerable progress has been made in developing methods for retarding or overcoming this spoilage which are an improvement over usual practice.

Preservation of fishery byproducts.—Researches in this field have shown where economies can be effected in the manufacture of fish meal to produce a more nutritious product, and have given fundamental information concerning the effect of manufacturing methods on the factors controlling the nutritive value of the product.

Studies of the manufacture of fish flour are still in the development stage, being concerned mainly with the study of methods for atomizing macerated fish waste in a heating medium in order to effect extremely rapid drying.

Research in the chemical and physical constants of haddock-liver oil have shown that while crude haddock-liver oil may be expected to come within the United States Pharmacopœia limits, the cold pressed oil may be expected to exceed the limit occasionally. The significance of this is confused somewhat by the lower vitamin potency of the oil. This research also has shown that the colorimetric method for determining vitamin A offers oil manufacturers a rapid and inexpensive estimation of the quality of the various lots of oil prepared.

Net preservation.—For several years this Bureau has been endeavoring to reduce depreciation and consequent cost of maintaining fish nets by developing net preservatives and encouraging improved handling of the nets. In 1932 the efficacy of covering dyed heavy webbing with a specification tar as previously recommended was confirmed. Chemicals also have been found which retard weed growth on fishing nets, and others which are efficacious antioxidants. Tests also confirmed previous recommendation of the Bureau for cleaning the net and drying in the shade to reduce deterioration. In this connection it has been found that washing nets with lime water appears to treble their life. Some preservative principles developed in this research may have application to the preservation of other textile materials, such as sails, awnings, and rope.

BIOLOGICAL FISHERY INVESTIGATIONS

All of the most essential major projects of research comprising the investigative program of the Division of Scientific Inquiry, developed through many years of careful planning and organization, have been continued during the past year with only moderate curtailment because of reduced appropriations.

Investigations of the commercial fisheries are concerned with the changes in abundance of the food fishes of the North and Middle Atlantic areas and with the correction of abuses in the commercial

fisheries of the Great Lakes. The shrimp fishery of the South Atlantic and Gulf has also been studied with the aim of discovering and preventing depletion of the supply; and the salmon and herring fisheries of Alaska are undergoing scientific analysis as a basis for their regulation. Aquicultural investigations include studies on the improvement of hatchery technique for both cold- and warm-water fishes and the planning of rational stocking policies in interior waters. Shellfishery investigations have been directed toward improving the quality of the oysters in the North and Middle Atlantic section and toward increasing the production by cultural methods in the South and on the Pacific coast. Even with reduced appropriations for field operations the Bureau's technical staff has made valuable contributions to science, all of which have practical application to the welfare of the fishery industries, to the angler, and to the water farmer, assuring continued productiveness of the natural supply and increased production and improved quality of cultivated aquatic products.

FISHERY INVESTIGATIONS OF THE ATLANTIC AND GULF COASTS

Fishery investigations have been concerned with the haddock and mackerel in the New England section; with the squeteague or weakfish, the butterfish, scup, and flounders in the Middle Atlantic section; and with the great shrimp fishery in the South Atlantic area. Investigations on shellfish in these areas will be considered later.

The haddock fishery, which is the most important on the Atlantic coast, reached a maximum production in 1927 and has fallen off sharply in succeeding years until a minimum was reached in 1931 of less than 183 million pounds. The maximum yields around 1927 were the result of unusually successful spawning during the years 1920 and 1922. A study of the statistics of the yield per unit of effort, combined with a study of the biology of the haddock stock, particularly size and age composition, growth rate and distribution, indicate that since these years no abundant year broods were produced until 1930. It was anticipated that when this abundant year class reached marketable size there would be an increase in landings. During the spring of 1933 catches by the trawling fleet have been extremely good, but prices have declined in the meantime so that only moderate production in the fishery has resulted.

Reduced funds have prevented the conduct of studies on the abundance of year classes below commercial size. Tagging experiments to trace the migrations of the haddock have also been reduced, but determination of migrations is essential to an accurate prediction of the trend of the fishery on Georges Bank, and this study will be resumed at the earliest opportunity.

The regular spring prediction of the mackerel fishery for 1933 was issued by the Bureau near the beginning of the season. At that time it appeared that a catch of about 44 million pounds was in prospect. Economic conditions, however, will prevent the fleet from realizing this yield, although the catches during the early part of the season indicate an abundance somewhat in excess of that of the previous year. Difficulties in compiling 1933 estimates of the mackerel fishery emphasize the need for a more thorough

understanding of the causes of rapid declines in the apparent abundance of certain year classes contrasted with the gradual declines in others. The situation urgently calls for tagging experiments to determine the commercial drain on the yearling mackerel. Such determination of the strain on the stock would not only render a prediction more certain but would also yield important evidence as to whether beneficial effects would attend a restriction of fishing on these younger mackerel.

When investigations of the shore fisheries of the Middle Atlantic States were begun in 1927, statistics of the yield presented the gloomy picture of declining yields of several important food and game fishes amounting in comparison with 1921 to 72 percent for bluefish, 21 percent for croakers, 37 percent for scup, and 36 percent for squeteague. Studies have been pursued to discover the causes of these observed declines and to formulate recommendations for the restoration and preservation of the resource. Most recent canvasses show a substantial recovery from the low yield of squeteague of 1926, particularly in New Jersey. Investigations have shown that this recovery was brought about by the appearance of large numbers of fish of the 1926 and 1927 year classes. The yield of butterfish has recovered to near record levels during the course of the investigations. In view of the fact that a complete natural recovery has occurred and that there is no prospect of a material increase in the fishing intensity of the future, regulation or restriction of this fishery is not recommended.

The yield of scup has likewise recovered naturally to very high levels. The development of a year-round trawl fishery during the past three years has increased the strain on this stock, however, and particular attention is being paid to a study of this fishery which is prosecuted off the Virginia capes during the winter seasons.

During the past spring a preliminary report on the life history of the most important commercial species of shrimp in the South Atlantic and Gulf areas was approved for publication by the Bureau. Field investigations in cooperation with the States of Georgia, Louisiana, and Texas have been conducted throughout the year and recently operations on the Atlantic coast have been extended from Georgia waters to include the shrimping areas of South Carolina and Florida. A study of the life history and migrations of the commercial shrimp has revealed the surprising and significant facts that this species spawns principally in the open ocean and Gulf, grows rapidly in the inshore waters of bays and estuaries, migrates seaward again where the life cycle is completed within a year by spawning and subsequent death. Hence, conservation measures must be applied promptly as soon as depletion is indicated in order to avoid serious consequences.

Ichthyological studies in the South Atlantic and Gulf areas have been concerned with an examination of the fish fauna of the Gulf coast, which have resulted in extensive revision in the taxonomy of such species as the various flounders, gobies, and others, and a study of the fishery resources in streams and lakes in the State of Mississippi. This latter survey, conducted in cooperation with the State authorities, is an effort of the newly formed fish and game commission to assess the fishery possibilities of the State as a basis for more effective conservation laws.

FISHERY INVESTIGATIONS IN INTERIOR WATERS

Investigations have been conducted on Lakes Michigan and Huron in the interest of overcoming wasteful and destructive practices of the commercial fisheries, which are responsible to a large degree for the depletion of the more valuable food fishes. An investigation conducted from a number of Michigan ports on the effects of deep trap nets was completed early in the fiscal year, indicating a considerable increase in the use of these nets for catching whitefish, and a wholesale transfer of these nets from certain fishing grounds long famous for their whitefish production to new grounds on account of the depletion of the supply on the former grounds. Illegal-sized fish are most numerous in deep water, hence recommendations have been offered limiting these nets to waters less than 80 feet deep and requiring an increase in the meshes of the lifting pots to permit the escape of undersized fish.

In Lake Michigan special attention has been given to the effect of chub nets fished on grounds where small lake trout are numerous. It was found that chubs and trout were more abundant in Michigan waters where gill nets with larger meshes are employed than in Wisconsin waters. Recommendations were proposed therefore for legislation to prohibit or curb the sale of immature lake trout and to provide for an increase in the mesh of nets to protect undersized chubs from unnecessary destruction. The Bureau also cooperated with the Wisconsin Geological and Natural History Survey in a series of limnological and fishery studies in the smaller lakes of northeastern Wisconsin.

At the close of the fiscal year a manuscript was completed on limnological investigations in western Lake Erie, which were conducted during the years 1926 to 1930 in cooperation with various State conservation departments and scientific institutions. This report correlates the technical studies of a number of collaborators and presents for the first time in assembled form a great mass of biological and physical data of fundamental importance to the conservation of the fisheries of the lake. It concludes that pollution, long suspected of adversely affecting the fisheries, is not responsible for the continued decline of the more important species.

FISHERY INVESTIGATIONS OF THE PACIFIC COAST AND ALASKA

The Bureau's investigators continued biological observations on the runs of red salmon in Bristol Bay and the Karluk, Copper, and Chignik Rivers in Alaska, in order to safeguard properly the salmon fishery resources of the Territory and to comply with the White Act of 1924. In addition, a study of the age composition of the runs and an enumeration of the spawning fish passing weirs on their way to head-water streams for propagation was made. The final section covering southeastern Alaska of the analysis of statistics of the salmon fisheries has been submitted for publication.

Heretofore little information has been available regarding the biology of the important runs of pink salmon in Alaska. An investigation has revealed that this species possesses a distinct homing

instinct similar to that of the red salmon returning for spawning with few exceptions to the streams in which the fish were hatched. The life cycle has definitely been establised as 2 years and further investigations regarding the biological factors responsible for fluctuations in time of appearance and abundance of the runs have progressed sufficiently to have practical application in devising regulations for the upbuilding and maintenance of the supply.

As a means of ascertaining more effectively the segregation of independent races of herring in Alaska, each of which is subject to overfishing without affecting neighboring supplies, a new method of tagging has been perfected for a study of their migrations. The method is unique in fisheries science inasmuch as electromagnets are utilized to recover metal tags in the factories in the process of manufacturing fish meal. Further studies of fluctuations in abundance from year to year demonstrate the effect of year class dominance as a cause of changing yields and indicate the necessity for regulation of the fishery in times of reduced supplies.

A study of the sockeye-salmon fishery in Puget Sound, undertaken during 1931, has shown that severe overfishing virtually destroys the big runs of salmon that occur every 4 years in the Frazier River system. Since this river supports the most valuable salmon fisheries in the State of Washington, efforts will be made to regulate the fishery so as to restore it to its former abundance.

FISH SCREEN AND LADDER INVESTIGATIONS

Investigations of methods of conserving the runs of anadromous fish on the Pacific coast by means of screens and ladders have been completed. Revolving mechanical screens have been found to be most effective and under certain circumstances electric screens have also proved their efficiency. Recommendations and perfected designs have been made for a large number of irrigation works in Washington, Oregon, Idaho, Utah, and Nevada, and recommendations for fish protective works at hydroelectric developments have been made to the Federal Power Commission.

AQUICULTURAL INVESTIGATIONS

Practical results of the Bureau's investigations in the interest of improved fish-cultural practices have been evidenced by a sustained output of large and vigorous fish from the Bureau's many hatcheries in the face of reduced appropriations. Studies conducted at the three experimental hatcheries have shown the feasibility of extensive utilization of cheaper ingredients in the diet of trout and the utility of fertilizers and forage fish in the economical production of bass and other warm-water fish. Trout breeding experiments have likewise demonstrated the superiority of selected strains of brood fish over wild stock in increased egg production, in more rapid growth, and in resistance to disease. It has been shown that hatchery production can be increased four times by doubling the rate of growth and the number of progeny from a single pair through selection of the brood stock. Progress has been made in solving the problems

of sanitation and prophylaxis against disease in hatcheries and in disseminating such information for practical application in fish hatcheries.

Cooperative investigations of the nutritional requirements of trout carried on jointly by the New York Conservation Department, Cornell University, and the Bureau of Fisheries at Cortland, N.Y., have progressed satisfactorily where synthetic diets have been employed in testing the vitamin requirements of trout and their ability to digest the various food materials.

Cooperative trout investigations in the State of California, because of the liberal support afforded by that State, have been continued without curtailment. Ecological studies of the coastal streams and of those in the high Sierras have been undertaken on a large scale to determine the capacity of various waters in sustaining fish life in relation to the food supply, the physical characteristics of the streams, and the drain upon the supply by the fishery as a basis for adequate stocking.

FISHERY STUDIES IN NATIONAL PARKS AND FORESTS

As a means of more fully discharging the responsibility of the Federal Government in maintaining the fish supply in the public domain, a survey of streams and lakes in Glacier National Park was completed during the year for the purpose of formulating a stocking policy to be followed in the future. Extensive collections and observations were made and analyzed for the purpose of determining the fish population and the available natural food present as factors in the carrying capacities of various streams. Assistance has been rendered various State fish and game departments in the inter-mountain region in solving particular problems regarding the stocking of fish in State waters.

SHELLFISHERY INVESTIGATIONS

Investigations on the various problems of the oyster industry were carried out in the North Atlantic and South Atlantic States and on the Pacific coast. In the Northeastern States where previous work of the Bureau has materially aided in increasing the propagation of seed oysters, main effort was directed toward a study of methods of growing and fattening oysters for market and in improving the nutritive quality of the product. Detailed analyses of the glycogen content throughout the year have been made on oysters from the cooperative experimental farms maintained with the State of Connecticut at Milford. In the laboratory at Woods Hole, Mass., and in Washington studies on the growth of natural oyster food give promise of solving the problem of increasing the food value of oysters and standardizing their nutritive qualities. In the South Atlantic, where the depleted state of the natural oyster reefs is most apparent, principal attention was given to methods of restocking and maintaining the productivity of natural and cultivated bottoms. Experimental oyster farms have been maintained in each of the South Atlantic States and extensive surveys in the State of Florida have revealed new areas suitable for oyster culture. On the Pacific coast studies of spawning and improved methods of seed collection

are proving of practical value in the cultivation of the native Olympia oyster.

Experiments on the artificial cultivation of fresh water mussels, which provide the raw material for the American pearl-button industry, have been prosecuted with success. Large quantities of the valuable species have been grown in artificial raceways at the Bureau's station at Fort Worth, Tex., and methods for feeding mussels have been devised, which materially accelerate their normal growth.

POLLUTION STUDIES

Efforts during the past several years to stock depleted streams of the Mississippi drainage with fresh water mussels, produced by artificial propagation, have failed because of the increased pollution in these waters from industrial and domestic wastes and silt eroded from the surface of the land. The presence of great quantities of silt, which is rapidly increasing, moreover, jeopardizes the continued existence of all of the more valuable forms of aquatic life throughout the drainage. This problem has been given much study from the point of view of determining definitely the menace of silt pollution and the extent of polluted waters in the hope of finding areas suitable for restocking with the valuable mussel species.

A careful investigation of the physiological effects of toxic substances found as pollutants in rivers of the Middle West has been continued in cooperation with the University of Missouri. Studies on the effects of arsenic, cyanide, and various heavy metals and acid mine wastes have demonstrated the disastrous effects upon aquatic life of these substances in the streams. During the fall a detailed investigation in the field, supported by laboratory studies, on the effects of mine pollution in the Coeur d'Alene district of Idaho, demonstrated the serious effects upon fish and invertebrate aquatic life of washings from stamp mills and from mine drainage, and recommendations were offered to the State outlining means of overcoming this menace to an important natural resource.

ALASKA FISHERIES SERVICE

ADMINISTRATION OF FISHERY LAWS AND REGULATIONS

The general abundance of the fisheries of Alaska in 1932 may be attributed primarily to the conservation program that has been carried on since the law of June 6, 1924, gave the Secretary of Commerce broad powers to control commercial fishing. Careful surveys of the fisheries were made throughout the season, and the regulations were modified to meet changing conditions. The Commissioner of Fisheries spent several weeks in Alaska for personal observation of the salmon fisheries, which constitute the Territory's most important economic resource.

Revised fishery regulations were issued on December 20, 1932, and became effective January 1, 1933. The restrictions in several regions were relaxed by extending the fishing season or by opening closed waters to limited operations. Trap fishing was further curtailed

in places where such action was deemed necessary to secure the escapement required by law of not less than 50 percent of the salmon runs, and additional restrictions were placed on the taking of razor clams in order to prevent depletion of the beds.

A patrol of the fishing grounds was maintained to enforce the laws and regulations for the protection of the fisheries. Twelve statutory employees and 206 temporary stream guards and special workmen were identified with this work in 1932, in addition to the crews of 15 Bureau vessels and 8 chartered boats.

Attention was given to the improvement of salmon streams by removing obstructions that prevented the ascent of salmon to the spawning grounds, and by destroying predatory enemies of salmon. The latter work was carried on chiefly in connection with the operation of salmon-counting weirs in parts of central and western Alaska. At its 1933 session the Territorial Legislature again made an appropriation for this purpose, and it is planned that a considerable part of the amount available will be spent for bounty on predatory trout in the Bristol Bay region.

ALASKA SALMON HATCHERIES

At the Government hatcheries at Afognak and on McDonald Lake 44,651,800 red-salmon eggs were collected in 1932, as well as 3,082,500 pink-salmon eggs. Shipments of 3,011,000 red-salmon eggs and 2,608,000 pink-salmon eggs in the eyed stage were forwarded to Seattle in the fall. At the privately owned hatchery, operated under the provisions of the Alaska fisheries act of June 26, 1906, 25,895,000 red-salmon eggs were collected.

PRODUCTS OF THE FISHERIES

Notwithstanding the marked curtailment of fishing effort in the Alaska salmon industry in 1932, the total output of fishery products exceeded that of the previous year because of a substantial increase in the herring production and the resumption of operations by one of the whaling stations. Although there was an increase of 1 percent in the total yield of fishery products, as compared with that for 1931, the total value decreased about 25 percent.

Salmon products comprised about 77 percent in quantity and 90 percent in value of the total output of the Alaska fisheries in 1932. Ninety-four percent of the salmon production consisted of canned salmon, the pack amounting to 5,254,000 cases, or 252,215,000 pounds, valued at $21,716,000. As compared with the pack of the preceding year, the output of canned salmon in 1932 showed a decrease of 3 percent in quantity and 25 percent in value. The number of canneries operated dropped from 116 in 1931 to 87 in 1932.

The total output of Alaska fishery products in 1932 was 349,635,000 pounds, valued at $25,029,000, as compared with an average of 361,590,000 pounds, valued at $43,356,000, for the 5-year period from 1927 to 1931, inclusive. The value of the 1932 catch to the fishermen was approximately $6,971,000, or about $3,072,000 less than in the preceding year. There were 20,000 persons employed in the various branches of the industry, as against 22,500 in 1931.

ALASKA FUR-SEAL SERVICE

GENERAL ACTIVITIES

Fur-seal operations at the Pribilof Islands were handled by the staff of regular employees aided by the resident native population and approximately 50 natives imported from the Aleutian Islands region for work during the active sealing season.

As far as possible, killings of seals were confined to surplus 3-year-old males, although limited numbers of other age groups were taken. Of the season's take of skins, about 65 percent were blubbered at the islands before being cured. A computation of the number of animals in the herd was made at the close of the sealing season.

Construction activities were curtailed considerably because of the lack of funds, but there was some extension of improved roads and continuation of work on buildings that had been begun during the previous year. The East Landing wharf at St. Paul Island was completed and the construction of boatways alongside was begun.

The annual supplies for the Pribilof Islands were forwarded from Seattle on the U.S.S. *Sirius*, and the sealskins secured during the season were transported on the return voyage. Valuable assistance in maintaining a patrol for the protection of the fur seals and in performing other services was rendered by the United States Coast Guard.

SEAL HERD

The computed number of animals in the Pribilof Islands fur-seal herd on August 10, 1932, was 1,219,961, an increase of 92,879, or 8.24 percent, over the corresponding figure for 1931.

TAKE OF SEALSKINS

In the calendar year 1932 there were taken on the Pribilof Islands 49,336 fur-seal skins, of which 39,490 were from St. Paul Island and 9,846 from St. George Island. This was a decrease of 188 from the number taken in 1931.

MARKING RESERVED SEALS

Twelve hundred 3-year-old male seals on St. Paul Island and 1,809 on St. George Island, a total of 3,009, were marked and reserved for future breeding stock. The reserve includes also a large number of seals of this age class that were not taken in the drives.

SALE OF SEALSKINS

Two public auction sales of fur-seal skins taken on the Pribilof Islands were held at St. Louis in the fiscal year 1933. On September 26, 1932, there were sold 15,521 black-dyed, 10,157 logwood brown-dyed, and 801 miscellaneous unhaired and raw-salted skins for a gross sum of $296,604.75. In addition, 31 confiscated sealskins, raw, yielded $15.50.

At the second sale, held on May 15, 1933, 20,621 black-dyed and 5,000 logwood brown-dyed skins were sold for $394,303.80. At the same time 282 black-dyed, 229 raw, and 1 unhaired Japanese fur-seal skins sold for $1,755.75. These 512 skins were the United States Government's share of sealskins taken by the Japanese Government at Robben Island in the years 1930 to 1932, inclusive. There was sold also 1 confiscated fur-seal skin, dyed logwood-brown, for $23.

Special sales of Pribilof Islands sealskins authorized by the Secretary of Commerce in the fiscal year 1933 consisted of 184 black dyed, 226 logwood brown-dyed, 10 raw, and 9 exhibition skins, at a total of $7,566.02.

FOXES

The blue-fox herds on St. Paul and St. George Islands are a profitable adjunct to the fur-seal industry, and provide employment during the inactive period of sealing operations.

In the fiscal year 1933 there were sold at public auction 1,401 blue and 25 white fox skins that had been taken in the 1931–32 season. The blue pelts brought $32,151.50, and the white pelts $336.50, a total of $32,488.

Foxing operations in the season of 1932–33 resulted in a take of 249 blue and 22 white fox skins on St. Paul Island and 871 blue and 1 white on St. George Island, a total of 1,143 skins. Thirty-two foxes trapped on St. Paul Island and 408 on St. George Island were marked and released for breeding purposes.

FUR-SEAL SKINS TAKEN BY NATIVES

Exercising the privilege granted them under the provisions of the North Pacific Sealing Convention of July 7, 1911, Indians of the United States and Canada took 1,938 fur-seal skins in 1932, which were duly authenticated by officials of the respective Governments. Of these skins, 78 were taken by natives of southeast Alaska, 73 by natives of Washington, and 1,787 by natives of British Columbia.

FUR-SEAL PATROL

A patrol for the protection of the fur-seal herd was maintained by vessels of the United States Coast Guard, supplemented in the spring by two of the Bureau's fishery patrol vessels.

PROTECTION OF SEA OTTERS, WALRUSES, AND SEA LIONS

No changes were made in the regulations for the protection of sea otters, walruses, and sea lions. The taking of sea otters is prohibited at all times, and the killing of walruses and sea lions is authorized only under specified conditions.

LAW ENFORCEMENT DIVISION

The appropriation for enforcing the law regulating interstate transportation of black bass, and for cooperation with local, State, and Federal authorities in protecting and increasing largemouth and smallmouth black bass was reduced 25 percent from last year's ap-

propriation; however, the Bureau has been able to continue and in some respects enlarge the work, securing a fair enforcement of the law in cooperation with the States east of the Rocky Mountains. This has been accomplished with 3 officers in the field, and 1 office assistant, a total of 4 employees, to carry out the intents and purposes of the law in 48 States.

During the year the number of regularly employed State fish and game protectors authorized by the Secretary to enforce the law was increased to 80, located principally in the Eastern and Central States where black bass are most plentiful. These trained State officers received no salary from the Federal Government, and frequently supplied the regularly employed Federal black bass law inspectors transportation and assistance without charge. This cooperation is supplied by the State principally for the reason that a violation of the Federal black bass law is predicated on an infraction of an existing State law followed by a transportation outside of the State.

Every effort has again been made this year to advertise the provisions and purposes of the law. This highly important educational work has been carried on through the daily press, sporting magazines, and radio, and through personal contact between the commercial fishermen and dealers. In addition, the three regularly employed field officers, in their travels from State to State in making market inspections and investigations of alleged illegal shipments of black bass, attended and addressed gatherings of sportsmen, anglers, and State authorities. In sections where this has been done those affected display an intense interest in the work and a sincere disposition to obey the law and cooperate.

It is essential that those who are enforcing the Federal black bass law, and the State officials and others, should be thoroughly familiar with the latest State laws protecting black bass. As the legislatures of 43 States met during the last half of this fiscal year, making many changes, a careful revision of the game-fish laws as formerly published in Fishery Circular No. 9 was made and will be available to those interested.

A large number of reports of violations of the Federal law were received and an investigation was made in every instance. The alleged illegal shipments came principally from the southeastern States, and were consigned to Maryland, Pennsylvania, Indiana, Kansas, Missouri, Tennessee, West Virginia, and other States. In some cases evidence of violation of State law was obtained and turned over to State authorities for action. In other cases, such as an alleged illegal shipment of black bass from Florida to Kansas, it was impossible owing to great distance between point of shipment and consignment for the Bureau officials to make personal investigation due to lack of funds; however, such cases were handled by one or more of the State deputies.

The Federal black bass law inspectors, along with their regular duties, have by request assisted State officers in enforcing the State laws protecting fish whenever possible, and aided in various matters pertaining to the welfare and increase of game fish. They have assisted and advised the States relative to perfecting their black bass laws, and a considerable amount of beneficial game-fish legislation advocated by the Bureau was adopted this year. Five States passed laws prohibiting the sale of black bass regardless of where taken;

2 States adopted State-wide measures for game-fish protection; 5 improved their daily limits, and 1 provided a closed season on black bass during the spawning period; 10 States adopted part-time non-resident angler's licenses at a cost considerably less than the fee for an annual license.

This division is charged with the issuance of permits for taking bait fish in the District of Columbia, and has issued, or renewed, a total of 29 permits during the fiscal year.

VESSELS

The Bureau's motor vessel *Fulmar* stationed at Charlevoix, Mich., and assigned to investigative duty with the Great Lakes scientific staff, was engaged from June 1 to September 13 in upper Lake Michigan north of Frankfort and Sturgeon Bay, Wis., in experimental fishing operations in connection with a study of the destruction occasioned by chub nets to small trout and immature chubs in the region. Owing to the lack of funds this work was discontinued and the vessel placed out of commission for the remainder of the year.

Sixteen vessels of the Alaska service cruised about 133,000 nautical miles in the fiscal year 1933, as compared with 148,500 nautical miles in the previous year. The *Penguin* covered approximately 28,200 miles; the *Teal*, 12,400 miles; the *Brant*, 11,800 miles; and the *Crane*, 10,900 miles.

The *Penguin* continued as tender for the Pribilof Islands with base at Unalaska. Five round trips were made to Seattle during the fiscal year for transporting personnel and emergency supplies.

Of the vessels that engaged in fishery protective work, the *Widgeon*, *Murre*, *Auklet*, and *Petrel* were employed in southeast Alaska throughout the season; the *Teal* was on duty at Cook Inlet until the middle of August and later assisted with the patrol and stream inspection in southeast Alaska; the *Kittiwake* was in the Seward-Katalla district; the *Crane* in the Alaska Peninsula area; the *Eider* in the Alaska Peninsula and Kodiak-Afognak areas; the *Blue Wing* and *Red Wing* in the Kodiak-Afognak area; the *Ibis* at Chignik; the *Scoter* on Bristol Bay; and the *Coot* on the Yukon River. The *Puffin*, which had been replaced by the *Merganser* as tender for the Yes Bay hatchery, participated in the fisheries patrol in the vicinity of Ketchikan.

The *Brant* was used in general supervisory work in southeast Alaska and Prince William Sound. It was engaged also for several weeks in patrolling waters off Neah Bay, Wash., to protect the fur-seal herd during its northward migration. The *Widgeon* performed similar duty in southeast Alaska.

After the close of fishery activities in the fall, the *Brant*, *Crane*, *Eider*, *Kittiwake*, *Murre*, *Scoter*, and *Teal* sailed for Seattle, where they were moored for a number of months. Before returning to Alaska in the spring they were given a general overhauling. The *Penguin* was overhauled at Seattle in November. Other vessels of the Alaska service were tied up for the winter at Alaska ports.

The *Albatross II*, owing to lack of funds, remained out of commission at our Woods Hole (Mass.) station during the entire past fiscal year. A caretaker is employed to look after the vessel.

The steamer *Phalarope*, which was also placed out of commission June 30, 1932, owing to our reduced vessel appropriation, was condemned and sold to the highest bidder.

The *Pelican* was detailed to the International Passamaquoddy Fisheries Commission to assist in special investigations for the commission until October 17, 1932, when the vessel was returned to the Boothbay Harbor (Maine) station to resume its usual fish-cultural activities.

The steamer *Shearwater* was engaged in the usual fish-cultural work at the Put-in-Bay (Ohio) station during the fall and winter months.

APPROPRIATIONS

Appropriations for the Bureau for the fiscal year aggregated $1,976,020, as follows:

Salaries	$175,000
Miscellaneous expenses:	
Administration	3,500
Propagation of food fishes	886,730
Maintenance of vessels	200,000
Inquiry respecting food fishes	200,000
Fishery industries	95,790
Protecting sponge fisheries	3,000
Protecting seal and salmon fisheries of Alaska	390,000
Upper Mississippi Wild Life and Fish Refuge	7,000
Enforcement of black bass law	15,000
Total	1,976,020

LIGHTHOUSE SERVICE

During the fiscal year important economies were introduced in the operation of the Lighthouse Service, especially through the discontinuance of various primary aids to navigation, such as some of the lightships and lighthouses, and the installation of automatic apparatus at a number of stations heretofore attended, and by other means. For the most part the personnel affected by these changes have been transferred to vacancies occurring, but the acceleration of the program this year has necessitated some furloughs; such furloughed employees are being given consideration for vacancies as they occur. The changes have been made after consultation with the marine interests concerned; these have been very cooperative in aid of the Government economy program. In the few cases where opposition has developed, very careful additional investigation has been made before final decision has been reached. Most of the aids affected were established when navigational requirements were different from those of the present time, and the original needs have passed, or materially changed. In a considerable proportion of the cases of discontinuances, other and less expensive aids have been substituted, resulting often in arrangements more helpful to navigation.

On June 30, 1933, there were 22,495 marine aids to navigation maintained by the Service, a net increase over the previous year of 921; this increase was mostly in the smaller and less expensive aids marking improved waterways. During the year various improvements were made in the aids; 103 lights were changed from fixed to flashing or occulting and the illuminant of lights was changed as follows: 153 to electric and 69 to acetylene. Four radiobeacons were established, increasing the total number to 104; radio and sound signals were synchronized for distance finding at 4 stations. The number of aids discontinued was 1,718.

Important projects in progress or completed during the year are set forth in detail under the heading "Progress of special works under construction or completed."

The aids to navigation in the outlying territory of Guantanamo Bay, the American Samoan Islands, and the island of Guam have been maintained, as heretofore, with the cooperation of the naval commandants.

The airways division, which had been conducted as a division of the Lighthouse Service, but under the administrative supervision of the Assistant Secretary for Aeronautics, was separated from this Service at the close of June 30, 1933.

IMPROVEMENTS IN APPARATUS AND EQUIPMENT

The use of electricity, especially in connection with automatic lights, has been extended. A 36-inch flashing unit, using a 1,000-watt electric lamp, has been developed for unwatched lights requiring high candlepower. A photo-electric-controlled alarm system was developed for checking the operation of an unwatched electric light. A new type of flashing light, using 18-inch and 10-inch pressed glass doublets and spherical mirror, and mounted in pairs on 2 drums and oriented for any desired group combination of flashes, was developed. Electric lamps better adapted for use with the various types of lighthouse lenses than are the commercial type of electric lamps, were developed. Reliable and efficient electric minor lights using duplex lanterns, lamp changers, primary cells, and single-unit photronic cells for control were developed. Battery relays for switching to standby battery, when the service battery becomes exhausted, have been introduced. Range lanterns using compound lenses and 4-volt miniature lamps developing 11,000 candlepower and operated on primary cells with photronic cell control have been placed in service.

A plan was developed for distinctive flashing light characteristics to distinguish between buoys at night, according to their purpose, and a service test of this system was commenced; by this means, for the first time, a buoy will show by its flash whether it marks the side of a channel, a danger or middle ground, a fairway, or a wreck, and the use of color of lights will be reserved to show the side on which to pass. A new flash characteristic, the interrupted quick flash, was made use of in this system.

The improvement of lighted buoys by the conversion of the Pintsch gas type to acetylene has been continued. Spar buoys continue to be replaced by steel nun and can buoys.

The improvement of fog signals was extended by the installation of Diesel and electric-driven compressors and air diaphones, typhons, and other types of modern signals. The conversion of steam fog-signal plants to modern air and electric fog signals was extended. Electric-control apparatus for fog signals has been further perfected. Improved types of fog-signal apparatus operating air horns consisting of self-contained units with electric motors direct connected to rotary-type compressors operating the signal on low pressure and with a minimum of air consumption and having semiautomatic control, have been introduced. With this type of apparatus the necessity for providing air receivers, extensive air-line systems, numerous valves, etc., for controlling the characteristic of the signal is eliminated, and it provides an efficient signal unit at a lower cost for installation and for annual maintenance and operation.

An extended test and demonstration was made on Lake Michigan of mobile radiobeacons for the avoidance of collisions, with favorable results. A new radiotelephone transmitter was constructed and installed at the Detroit Lighthouse Depot for direct communication with Detroit River light station, or with vessels equipped for service.

ADMINISTRATION

Appropriations for the maintenance of the Lighthouse Service totaled $9,799,280 for the fiscal year 1933, and for special works, $3,860,000; the larger part of this latter amount was, however, later

withdrawn; there were also allotted from Department appropriations for printing and binding, $23,000, and for contingent expenses, $5,825. There was received and deposited in the Treasury the following: From sale of Government property, $16,344.85, rent of buildings, etc., $4,391.93; forfeitures by contractors, $8.83; reimbursement for property destroyed or damaged, $3,062.84; work done for private interests, $1,198.09; commissions received on telephones, $22.93; total, $25,029.47.

In the interest of economy and efficiency in administration, the thirteenth and fourteenth lighthouse districts were consolidated with the fifteenth district on March 1, 1933, and the aids to navigation on the entire Mississippi River system were placed in charge of a civilian lighthouse engineer as superintendent, relieving the Army engineers heretofore detailed for that duty. The offices at Rock Island, Ill., and Cincinnati, Ohio, were discontinued, and all the river work placed under a single office at St. Louis, Mo.

Narragansett Bay was transferred from the third to the second district on July 1, 1933.

PERSONNEL

The total number of persons employed in the marine work of the Lighthouse Service on June 30, 1933, was 5,446. This is a net decrease of 151 from the previous year. There was a net decrease of 99 in lightkeepers, light attendants and lamplighters, and a decrease of 76 in officers and crews of lighthouse vessels.

The United States Employees' Compensation Commission gives the number of reported cases of injury subject to compensation for the calendar year 1931, of employees in the Lighthouse Service, as follows: Cases resulting in death, 1; cases resulting in permanent total or partial disability, 8; cases of temporary total disability, 166.

In addition to their regular duties, a number of employees of the Lighthouse Service rendered aid to those in distress. During the fiscal year about 93 instances of saving life and property or rendering valuable aid were reported. Many of these acts were performed at great risk to the employees, and some cases were especially meritorious, and the employees were commended by the Secretary of Commerce.

LIGHTHOUSE DEPOTS

Improvements were completed or were in active progress at several depots during the year. At Portland, Maine, a shop building is under construction, and the new depot is being completed. At Cheslsea, Mass., a steel sheet pile bulkhead has been constructed across the face of the property recently acquired, and on the sides and across the inner end of the west slip; the new property has been cleared of old buildings, and considerable dredging has been done. The outer end of the channel leading to the Woods Hole Depot, Mass., has been dredged. At Bristol, R.I., a retaining wall along the southerly side of the property was constructed and a brick storehouse provided. Three fabricated steel buildings have been erected at Charleston, S.C., and a considerable amount of grading has been done to make additional space in the depot available for use; concreted areas for storage space and new roadways connect-

ing buildings were laid. At the Mobile, Ala., depot the area enclosed by the new bulkhead has been filled and surfaced temporarily with cinders. A combined office building and storehouse of reinforced concrete is under construction at the San Juan, P.R., depot, and improved storage facilities have been provided in the basement of the officers' quarters. At Buffalo, N.Y., work on a concrete retaining wall which will enlarge the serviceable area is substantially completed; a timber crib wall with concrete superstructure to form a slip for berthing the tenders is under construction. Improvements have been made at Detroit, Mich., depot, and at Ketchikan, Alaska, depot.

LIGHTHOUSE TENDERS

Four new tenders were completed and placed in commission, as follows: The *Myrtle*, an additional tender for the eighth district; the *Hickory*, replacing the *Pansy* in the third district; the *Wistaria*, for the fifth district; and the *Arbutus*, replacing the *Azalea* in the second district; and the tender *Lilac* to replace the *Iris* in the fourth district. Two new tenders are being constructed under contract, the *Dahlia* and *Hemlock;* they are to replace the tenders *Thistle* and *Fern.* Plans have been completed for the construction of two additional tenders, the *Tamarack*, to replace the *Clover* in the eleventh district, and the *Hollyhock*, to replace the *Sumac* in the twelfth district. Plans are being prepared for the *Jasmine* to replace the *Cosmos* in the eighth district.

The tenders *Tulip* and *Cypress* have been converted to oil burning. New coal-burning, water-tube boilers were installed on the tender *Anemone.*

At the end of the year 55 tenders were in commission. Twenty-seven of the tenders in commission are fitted with radiocompasses and 30 have radio communication.

The following tenders have been extensively overhauled during the year: *Magnolia*, *Tulip*, *Hyacinth*, *Crocus*, *Sequoia*, *Cypress*, *Anemone*, and *Sunflower.*

The following were the number of tenders on June 30 of the years specified, omitting vessels not having regular crews: 1910, 51; 1920, 55; 1930, 55; 1933, 55. There are in addition 12 small depot tenders without regular crews.

The tender *Juniper* was sold on November 1, 1932, and the *Pansy* on January 29, 1933. Five additional tenders were laid up awaiting sale.

LIGHTSHIPS

At the close of the year lightships were maintained on 37 stations, and 47 lightships were in commission, of which 10 were regular relief ships. In addition there were 3 lightships, *No. 86*, *No. 87*, and *No. 78*, laid up awaiting extensive reconditioning, and 2 lightships, *No. 41* and *No. 13*, awaiting survey with a view to their being sold. When the above 3 lightships are reconditioned, it is expected that lightships *No. 49*, *No. 69*, *No. 74*, *No. 47*, and *No. 16* will be sold. Two lightships, *No. 89* and *No. 95*, are held in reserve for the Great Lakes. Seven lightship stations were permanently discontinued during the year as follows: Great Round Shoal, Mass.; Hedge Fence,

Mass.; Bartlett Reef, Conn.; Northeast End, N.J.; Fenwick Island, Del.; Charleston, S.C.; and Milwaukee, Wis.

The following was the total number of lightships on June 30 of the years mentioned: 1910, 68; 1920, 62; 1930, 57; 1933, 56. Lightship stations: 1910, 51; 1920, 49; 1930, 44; 1933, 37.

Of the present lightships in commission 38 have propelling power, 8 are provided with sail only, and 1 has no means of propulsion. The lightship stations may be classified as outside 24, inside 7 (all in the second and third districts), and Lake 6.

Lightship *No. 52* was sold on December 22, 1932, and *No. 68* on January 18, 1933. These vessels were beyond economical repair.

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OPERATION AND CONSTRUCTION, LIGHTHOUSE SERVICE, FISCAL YEAR 1933

PROGRESS OF VESSELS UNDER CONSTRUCTION

Tender "Lilac".—This tender, for service on the Delaware River and Bay to replace the tender *Iris*, is being built under contract of August 16, 1932, by the Pusey & Jones Corporation, Wilmington, Del., at a cost of $214,500. This tender is twin-screw, steam-propelled, with two water-tube, oil-burning boilers. On June 30 the vessel was 93 percent completed.

Tender "Dahlia".—This small tender, to replace the *Thistle* for service on the Detroit River, is being built under contract of February 25, 1933, by the Great Lakes Engineering Works, River Rouge, Mich., the cost to be $66,566. This tender is a single-screw Diesel-engine-propelled vessel. On June 30 it was 22 percent completed.

Tender "Hemlock".—This tender, to replace the *Fern* for service in the waters of southeastern Alaska, is being built under contract by the Berg Shipbuilding Co., Seattle, Wash., for $228,480.60. This tender is a twin-screw, steam-propelled vessel with two water-tube, oil-burning boilers. On June 30 it was 27 percent completed.

PROGRESS OF SPECIAL WORKS UNDER CONSTRUCTION OR COMPLETED

Portland Lighthouse Depot, Maine.—See annual report, 1932, page 18, and previous reports. Fresh water and sewer lines have been installed on wharf. Excavating for site of service and shop buildings, grading wharf, and placing crushed stone over main wharf and pier is approximately 75 percent completed. A 2-story and basement shop building is under construction. Total allotments for project to date, $275,578. Total cost to June 30, 1933, $256,992.

Whitehead Light Station, Maine.—Replacing steam fog signal with an air tyfon. Project practically completed. Cost to June 30, 1933, $11,136.

Raritan Bay and Arthur Kill, N.J.—Establishing lighted buoys in Raritan Bay Dredged Channel and Arthur Kill Dredged Channel. Project completed. Total cost, $12,327.

Great Salt Pond Light Station, R.I.—See annual report, 1932, page 19, and previous reports. Project substantially completed. Cost to June 30, 1933, $17,431.

Woods Hole Depot, Mass.—Dredging outer end of channel leading to the depot; 10,000 cubic yards of material, including some rock and boulders, were removed. Bids have been issued for removal of further material to complete the project satisfactorily. Cost to June 30, 1933, $3,954.

Lynn Harbor, Mass.—Placing rirap around dolphin lights in Lynn Harbor and installing new towers on riprap foundation. Project completed. Total cost, $14,984.

Chelsea Lighthouse Depot, Mass.—Construction of steel-sheet piling bulkhead in westerly slip and across face of property recently acquired. The site was cleared of old buildings and a steel-sheet piling bulkhead constructed across the face of the new property and on both sides and across the inner end of the west slip. Dredging for back fill is substantially completed. Cost to June 30, 1933, $42,827.

Bristol Lighthouse Depot, R.I.—See annual report, 1932, page 19. A buoy wharf comprising a concrete deck on creosoted piles was constructed. Total cost, $34,830. A retaining wall along the southerly side of the depot was constructed at a total cost of $17,396, and a brick storehouse built at a total cost of $5,465.

Black Rock Harbor Lights, Conn.—Discontinuing Black Rock Light and establishing Black Rock Harbor Lights Nos. 1 and 3, on riprap foundations. Project completed. Total cost, $17,755.

Gangway Rock, N.Y.—An acetylene light on riprap foundation established. Project completed. Total cost, $7,780.

Brandywine Shoal, Del.—Replacing worn-out fog signal and electrifying station. Work under way. Cost to June 30, 1933, $3,118.

Schuylkill River, Pa.—An electrically operated fog bell was installed at the entrance to the river and five minor lights established. Project completed. Total cost, $5,130.

Cape Hatteras, N.C.—A steel sheet pile groin to protect light station was built. Project completed. Total cost, $6,692.

Tangier Sound and Old Plantation Flats Light Stations, Va.—Riprap placed around these stations. Project completed. Total cost, $7,061.

Point Lookout Depot, Md.—Protecting beach against erosion of seas and for repairs to wharf damaged by storm of March 1932. About 200 linear feet of interlocking steel sheet piles were straightened up and anchored, 3,200 square feet of inshore wharf was rebuilt, two additional buoy skids 72 feet long each were built, and 350 tons of riprap placed on beach. Project completed. Total cost, $6,495.

Portsmouth Lighthouse Depot, Va.—Renewing roof on Storehouse No. 2, etc. Project substantially completed. Cost to June 30, 1933, $15,436.

Buoys, fifth lighthouse district.—Buoys in lieu of lightship, and to replace White Shoal Light Station, Va. Order for buoys has been placed. Cost to June 30, 1933, $18,198. Lighted buoys have been purchased for selected locations where unlighted buoys now serve. Cost to June 30, 1933, $58,188.

Charleston Lighthouse Depot, S.C.—Purchase and install two fabricated steel buildings. Project completed. Total cost, $8,383. Additional improvements cosisting of 8,000 cubic yards of dry fill, 2,034 square yards of 6-inch concrete surface for storage of buoys, and 4,812 square yards of concrete roadway was accomplished. An additional fabricated steel building was later erected and a concrete bulkhead constructed along the northwest edge of the filled area. All electric wiring, water, gas, and air lines were laid underground. Project completed. Total cost, $29,593.

Charleston Harbor and Cooper River Lights, S.C.—Replacing all oil lights in these waters. Twenty-six 150-mm flashing electric lanterns and four range lanterns, together with necessary primary cells have been purchased. Battery boxes have been completed. Cost to June 30, 1933, $10,949.

Lighted buoys, sixth lighthouse district.—Purchase of apparatus to take the place of attended stations. Cost to June 30, 1933, $15,851.

Intracoastal Waterway, Florida, buoys.—Purchase of 400 special type can and nun buoys to mark improved channel between St. Johns River and Miami. Cost to June 30, 1933, $10,764.

St. Johns River, Fla.—Change oil post lights above Jacksonville to battery operated electric lights. Cost to June 30, 1933, $18,915.

Smith Shoal, Fla.—See annual report, 1932, page 19. Foundation completed. Cost to June 30, 1933, $16,989.

Punta Rasa Range Lights, Fla.—Replacing two old structures in San Carlos Bay with iron structures. Metalwork fabricated and all material and illuminating apparatus on hand. Cost to June 30, 1933, $7,748.

Tennessee Reef Light, Fla.—A fixed iron skeleton structure to replace a lighted buoy. Structure fabricated, and all other material on hand. Cost to June 30, 1933, $12,213.

Tampa Bay, Fla.—Establishing 2 range lights on Mullet Key Shoal. Metal work fabricated and all other material on hand. Cost to June 30, 1933, $7,248.

Mobile Lighthouse Depot, Ala.—See annual report, 1932, page 20. Filling within the bulkheaded area and surfacing temporarily with cinders has been completed. Covering of the old piles with a creosoted apron wharf 16 feet by 82 feet has been accomplished. Cost to June 30, 1933, $39,593.

Corpus Christi Channel Lights, Tex.—Establishment of 21 primary cell lights to mark the dredged channel from Port Aransas to Corpus Christi, Tex. Project completed. Total cost, $24,403.

Restoring and improving aids, ninth lighthouse district.—Restoration of damage caused by the hurricane of September 1932. Work practically completed. Cost to June 30, 1933, $14,005.

San Juan Lighthouse Depot, P.R.—Office and storehouse. Constructing a reinforced concrete service and office building. This contract is practically com-

pleted. Cost to June 30, 1933, $14,631. Repairs to storage space under the tender officers' quarters also were completed at a total cost of $7,717.

Modern fog-signal apparatus.—Purchase of modern fog-signal apparatus for the Service at large; 38 sets of apparatus were purchased. Work under contract was completed April 27, 1933. Total cost, $46,475.

Buffalo Lighthouse Depot, N.Y.—See annual report, 1932, page 20, and previous reports. Completing the project for improving the lighthouse depot, providing a new slip, retaining wall, and fill, 4,500 yards of slag was placed. Battery piles were driven. Concrete retaining wall on south side of depot yard substantially completed. Construction of timber crib (stone filled), wall, and concrete superstructure to form boat slip is under way. Cost to June 30, 1933, $139,385.

Oswego, N.Y.—Completing the rearrangement of aids in Oswego Harbor, N.Y., made necessary by improvements to the harbor carried out by the United States Engineers. This project consists of the construction of a lighthouse with fog signal and radiobeacon at the end of the west breakwater, a keepers' dwelling, boathouse on shore, also a light on the east breakwater. Site for keepers' quarters purchased. Contract for building up concrete base for main structure completed. Steel for superstructure 80 percent complete. Fog signal equipment delivered. Cost to June 30, 1933, $25,688.

Replacement of steam fog signals, eleventh district.—Changing the steam fog signal at Raspberry Island Light Station to a diaphone. Installation includes all necessary facilities for the storing of distillate oil. Project completed. Total cost, $9,238. Under an allotment of $20,000, steam fog signal plants at Crisp Point, Port Austin Reef, and Fort Gratiot Light Stations, Mich., to be replaced by modern equipment. Cost to June 30, 1933, $8,673.

Conversion of Pintsch gas buoys to acetylene.—Allotment of $37,595 was made for completing this work. More than 30 buoys were converted. Project completed. Total cost, $33,574.

Fort Gratiot Light Station keeper's dwelling.—Provide an additional dwelling. Project completed. Total cost, $5,738.

St. Marys River, Mich.—See annual report, 1932, page 20, and previous reports. During the year the Pilot Island Range Light structures have been rebuilt. Lights 3 and 4 in the West Neebish Channel have been completed, Brush Point Range has been moved to the exact channel axis, and the front light structure entirely rebuilt. The installation of an automatic fog bell on Light no. 17, Lake Nicolet, is under way, as is also the electrification of Frenchette Point Range and Six Mile Point Range. Cost to June 30, 1933, $126,140.

Point Iroquois Light Station, Mich.—Modernizing the station. The work includes the removal of the present fog-signal apparatus, installing electrically operated air compressors, electric generators, storage battery, type "B" air diaphone, electricity for the main light and dwelling, remodeling dwellings, providing new boat, and extending dock at boat harbor. Cost to June 30, 1933, $7,513.

Wyandotte Light Station, Mich.—Consolidation of Grassy Island North Channel Range and Grosse Isle Light Stations. The site in Wyandotte has been purchased, plans for the dwelling, boathouse, etc., are complete, and lighting equipment for Grassy Island Range has been purchased, also a steel tower has been fabricated and the necessary dredging done. Cost to June 30, 1933, $8,834.

Detroit Lighthouse Depot, Mich., improvements.—An electrically operated freight elevator has been installed in the main storehouse building, a new combined punch and shear was provided for the structural shop, a portable yard crane of the gasoline engine driven type, with a trailer for hauling equipment, was purchased and placed in service; in addition an electrically operated hoister was purchased for use with the fixed yard crane for hauling heavy equipment. Cost to June 30, 1933, $13,771.

Frankfort, Mich.—See annual report, 1932, page 21, and previous reports. Total allotments, $46,830. Skeleton steel tower and electric light placed on north pier. Old wooden structure on north pierhead closed up. A daymark was established on the south pier and floodlight installed on the north pier to illuminate the daymark. The tower on the north pier moved to the north breakwater and installation of equipment completed. The power house and garage on shore have been completed. The dwelling formerly at Chicago Light Station was reconditioned. This project completed. Total cost, $40,202.

Replacing 10 obsolete fog-signal plants, twelfth district.—Allotments of $22,500 and $20,000 were made to replace steam fog signals at 10 light stations. All machinery practically completed. Cost to June 30, 1933, $41,037.

Racine Reef Light Station, Wis.—Consolidation of this station with Racine Pierhead; 18,000 feet of telephone and control cable was laid by tender *Hyacinth*, connecting the two stations. Placing of conduits and cable along shore from inner end of North Breakwater to dwelling at North Pierhead is in progress; 2,600 tons of stone were deposited around the Racine Reef structure. Cost to June 30, 1933, $6,716.

Upper Mississippi River aids.—One hundred and forty-five can-type metal buoys, 145 nun-type metal buoys, and 50 metal buoys for carrying hand lanterns were purchased. There were also purchased 200 concrete anchors for the buoys and 4 automatic marine beacon lanterns with necessary primary-cell power equipment. Project completed. Total cost, $5,720.

Illinois River waterway, Ottawa to Lockport.—Allotments totaling $13,900 were made for aids to navigation to mark new waterway to Chicago; 58 automatic marine beacon lanterns with lamp-changer equipment with necessary primary-cell power equipment were purchased; 300 can- and nun-type metal buoys were also purchased. Project completed. Total cost, $13,867.

Missouri River and Lower Mississippi River aids.—One hundred and thirteen Mississippi River minor light type structures were erected on the Missouri River. There was also purchased for the Lower Mississippi River 34 automatic marine beacon 150-mm. lanterns with lamp changers and necessary primary-cell power equipment. Project completed. Total cost, $12,327.

Ketchikan Lighthouse Depot, Alaska.—Constructing a traveling crane and buoy shed at the depot. Project completed. Total cost, $14,255. Under separate allotments totaling $5,730 the fender piles around the wharf were replaced with creosoted fir piles at a total cost of $5,100. Additional wharf repairs were also carried out at a total cost of $5,707.

Aids to navigation, Alaska.—One automatic light and two unlighted beacons were established during the fiscal year from an allotment of $12,000 and relief equipment was purchased during the year for unwatched acetylene lights at sites difficult of access. Cost to June 30, 1933, $10,800.

Cape Hinchinbrook Light Station, Alaska.—See annual report, 1932, page 21, and previous reports. Additional allotments totaling $65,000 were made to complete this project. Materials were landed during May 1933 and construction resumed on light and fog signal building. Work of installing forms for basement wall and main floor of building was under way. Cost to June 30, 1933, $39,150.

Columbia River, Oreg., improving aids.—See annual report, 1932, page 21, and previous reports. Project completed. Total cost, $99,967.

Grays Harbor Light Station, Wash.—Allotments of $8,350 and $1,200 were made for steel piling bulkhead protection at this station. The enclosed area thus provided was brought to grade with sand back fill, decked over with a reinforced concrete slab. To further protect the sand spit and the road approach wood-pile groins and bulkheads were constructed. Project completed. Total cost, $9,527.

Cape Flattery Light Station, Wash.—See annual report, 1932, page 21, and previous reports. The dwelling was wired and provided with electrical service, and a 25,000-gallon wood-stave water tank purchased to provide an adequate fresh-water supply. Project completed. Total cost, $9,050.

Bush Point Light Station, Wash.—See annual report, 1932, page 21, and previous reports. A pyramidal reinforced concrete tower 20 feet high, constructed. Commercial electric power operates the light and fog signal, which is semiautomatically controlled from the residence of the caretaker. Project completed. Total cost, $6,197.

New Dungeness Light Station, Wash.—Electrify station, including furnishing and laying 12,500 feet of submarine cable. All equipment has been purchased and submarine cable laid. Cost to June 30, 1933, $7,106.

Desdemona Sands Light Station, Oreg.—Electrify station, including semiautomatic control, requiring 8,000 feet of submarine cable, also the modernizing of lighting and fog signal equipment. Fog signal and lighting equipment and submarine cable purchased. Cost to June 30, 1933, $3,568.

Browns Point Light Station, Wash.—Reinforced concrete tower replacing old wood frame light and fog signal building was constructed, lighting and fog signal equipment modernized. Cost to June 30, 1933, $4,285.

Partridge Bank, Wash.—Lighted bell buoy. Buoy and all equipment purchased. Project substantially completed. Total cost, $11,800.

Lighted buoys, seventeenth district.—Under an allotment of $24,900 buoys were purchased for Tillamook Bay, Willapa Bay, Umpqua River, and Coos Bay. Project substantially completed. Total cost, $24,900.

Automatic apparatus, Columbia River and Puget Sound.—Allotments totaling $10,924 were made to change 55 post lights (oil) to automatic electric and acetylene gas lights. All equipment has been purchased. Project substantially completed. Total cost, $10,924.

Changing steam fog signal, eighteenth district.—Lime Rock steam whistle was changed to air whistle and motor-driven air compressor installed with gas-engine driven compressor for stand-by. Light electrified; station buildings wired for electric lights. Project completed. Total cost, $7,596.

San Joaquin River (Stockton Channel) aids, Calif.—An allotment of $29,770 was made for marking the 26-foot dredged channel in the San Joaquin River; 50 channel marking lights and 14 range lights were established. All are primary cell outfits. All channel marking lights and seven range lights are on timber towers or pile beacons. Project completed. Total cost, $30,746.

Humboldt Bay Fog Signal Station, Calif.—Construction of a rock jetty along shore line to prevent further erosion. Work partly completed. Cost to June 30, 1933, $2,585.

Nawiliwili Harbor Light Station, Hawaii.—See annual report, 1932, page 21. A 5-room frame dwelling, 500 feet of asphalt macadam roadway and a concrete pit with corrugated asbestos shed for gasoline storage tank were constructed. The grounds were also improved. Project completed. Total cost, $20,839.

Kauhola Point Light Station, Hawaii.—See annual report, 1932, page 21. A duplicate of the reinforced concrete tower erected at Nawiliwili Harbor Light Station, with a similar installation of two 36-inch airways beacons, etc., was constructed. Project completed. Total cost, $17,495.

Cape Kumukahi Light Station, Hawaii.—Improving the station. An asphalt macadam road was built from the paved highway to the station at a cost of $10,797. A reinforced concrete tower foundation, two 5-room dwellings, water tanks, outbuildings, sidewalks, etc., were constructed. Two 36-inch beacons, three 2-kilowatt engine-generator units and a 110-foot galvanized structural-steel tower were purchased. Plans and specifications for completing this project are prepared. Cost to June 30, 1933, $29,751.

Kaula Rock Light, Hawaii.—See annual report, 1930, page 42. Allotments totaling $8,800 have been made for establishing an automatic dual acetylene light on this rock. Project completed. Total cost, $7,980.

Makapuu Point Light Station, Hawaii.—Constructing a paved road to the station. This project completed. Total cost, $8,161.

Barbers Point Light Station, Hawaii.—An allotment of $20,000 was made for the construction of a reinforced concrete tower, sidewalks, etc., at this station. The work is in progress. Cost to June 30, 1933, $9,469.

SUMMARY OF APPROPRIATIONS, LIGHTHOUSE SERVICE, FISCAL YEARS 1929–1934

Item	Appropriations					
	1929	1930	1931	1932	1933	1934
MAINTENANCE						
Salaries, Bureau of Lighthouses	$103,070	$110,000	$112,115	$121,790	$110,000	$100,000
General expenses, Lighthouse Service	4,298,500	4,298,500	4,500,000	4,550,000	4,200,000	4,009,000
Salaries of keepers of lighthouses	2,074,750	2,062,780	2,100,280	2,105,280	2,105,280	1,783,500
Salaries, lighthouse vessels	2,346,360	2,346,360	2,398,360	2,402,260	2,370,000	2,221,800
Salaries, Lighthouse Service	617,340	617,340	647,320	653,080	600,000	589,000
Retired pay, Lighthouse Service	245,000	285,000	332,000	380,000	414,000	411,300
Repairs due to storm damages	129,934	220,000				
Total for maintenance	9,814,954	9,939,980	10,090,075	10,212,410	9,799,280	9,114,600
Unexpended balances (obligations estimated)	34,595	26,719	39,880	120,549	761,804	
PUBLIC WORKS						
Vessels for Lighthouse Service	1,100,000	1,155,000	550,000	950,000	950,000	
Other works	622,000	675,000	874,000	920,000	2,910,000	
Total for public works	1,722,000	1,830,000	1,424,000	1,870,000	3,860,000	
Total maintenance and public works	11,536,954	11,769,980	11,514,075	12,082,410	13,659,280	9,114,600

SUMMARY OF COSTS, LIGHTHOUSE SERVICE, FISCAL YEAR ENDED JUNE 30, 1933

[Amounts are stated to nearest even dollar, causing occasional minor discrepancies in totals]

TOTAL COSTS OF PRINCIPAL FEATURES

Feature	Maintenance expenses			Betterment expenses			Grand totals
	Salaries	Miscellaneous maintenance expenses	Total maintenance	Repairs and improvements	New works	Total	
Administration [1]	$581,330	$91,846	$673,176	$4,662	$39,155	$43,817	$716,993
Distributive charges [2]	1,698,916	950,287	2,649,203	464,595	1,368,887	1,833,482	4,482,685
Aids to navigation [3]	2,923,444	970,530	3,893,974	1,163,434	902,842	2,066,276	5,960,250
Total	5,203,690	2,012,663	7,216,353	1,632,691	2,310,884	3,943,575	11,159,928

TOTAL COSTS OF DETAILED FEATURES

Offices	$581,330	$108,654	$689,984	$4,662	$39,155	$43,817	$733,801
Depots	253,982	173,218	427,200	160,842	339,413	500,255	927,455
Tenders	1,444,934	760,261	2,205,195	303,753	1,029,474	1,333,227	3,538,422
Lightships	749,923	251,352	1,001,275	148,535	80,711	229,246	1,230,521
Light stations, attended	1,660,211	325,404	1,985,615	462,754	364,557	827,311	2,812,926
Other fixed aids	455,538	162,001	617,539	263,200	360,531	623,731	1,241,270
Buoys	57,772	231,773	289,545	288,945	97,043	385,988	675,533
Total	5,203,690	2,012,663	7,216,353	1,632,691	2,310,884	3,943,575	11,159,928

[1] Includes offices except expense of publications.
[2] Includes depots and tenders; also item excepted in footnote 1.
[3] Includes lightships, fixed aids, and buoys.

SUMMARY OF PUBLIC WORKS APPROPRIATIONS

(6x441) Aids to navigation, Lighthouse Service:	
Unallotted balance June 30, 1932	$65,137.86
Withdrawals from previous allotments	134,414.39
Total amount available for allotment	199,552.25
Allotments	101,823.70
Unallotted balance June 30, 1933	97,728.55
(6x442) Aids to navigation, Lighthouse Service:	
Emergency construction, act of July 21, 1922	2,860,000.00
Withdrawals from allotment	0.00
Total amount available for allotment	2,860,000.00
Allotments	1,360,476.99
Unallotted balance June 30, 1933	1,499,523.01
(6x433) Vessels for Lighthouse Service:	
Balance unallotted June 30, 1932	51,888.04
Withdrawals from previous allotments	478,170.01
Total amount available for allotment	530,058.05
Allotments	154,853.91
Unallotted balance June 30, 1933	375,204.14
(6x435) Vessels for Lighthouse Service:	
Emergency construction, act of July 21, 1932	950,000.00
Allotment	260,000.00
Unallotted balance June 30, 1933	690,000.00

COAST AND GEODETIC SURVEY

SCOPE OF ACTIVITIES

The past year has been a difficult one for the Coast and Geodetic Survey.

The background for an understanding of the history of 1933 is the appropriation for 1932. That appropriation was $3,075,933. That amount was fixed after a careful study, and represented the minimum sum necessary to place the Survey on an efficiently functioning basis with respect to the projects upon which it was then actually engaged. No new projects were included, and the rate of progress contemplated for existing projects was a moderate one, designed to spread the work over reasonable periods of years.

One important new project was reluctantly deferred. The Bureau repeatedly has stressed the growing obsolescence of its charts of the Atlantic and Gulf intracoastal waterways. The importance of these waters is partly indicated by the facts that for the section from Norfolk to Florida, by 1929 the Federal Government had spent or authorized some $62,540,354 for improvements and that its freight traffic in that year amounted to 52,517,693 tons, exclusive of the ocean freight to and from the larger ports of Norfolk, Charleston, Savannah, Jacksonville, and Miami.

The bureau proposed a 16-year program for modernizing its charts of these Atlantic and Gulf waters, but owing to the economic situation the proposal was not adopted. The 1932 appropriation, therefore, represented less than the minimum amount which under normal conditions would have been required to carry on urgently needed work.

The regular appropriation for 1933 was $2,399,813. This involved a large reduction in field work. Plans for this reduction were made, but before it became necessary to execute them the situation was relieved by the inclusion of an item of $1,250,000 for work in the Emergency Relief and Construction Act.

The primary purpose of this special appropriation was to provide work of public value as an aid in relieving unemployment. Every effort was made by the Bureau to conform to that purpose. A large fleet of condemned post-office motor trucks was overhauled by that Department to put them in shape for another year's service and turned over to this Bureau without charge. Many colleges and engineering schools loaned surveying instruments. Free office space was furnished in various places, a conspicuous example being in New York, where, through the cooperation of the American Society of Civil Engineers, the McGraw-Hill Publishing Co. furnished valuable space rent free for a period of about 9 months.

By these and other means the abnormal overhead expenses usually incident to a suddenly expanded engineering program were kept to a very small total. About 71 percent of the money spent was paid out directly as wages.

These wages were paid to 1,652 men employed for various periods. Cooperation was solicited from relief agencies in every State, and from the resulting deluge of applications preference was given to men having dependents, who were most urgently in need of work, and who could give full value in service for the money paid them.

About half of the emergency money was devoted to surveys of the intracoastal waters and to similar work on the Pacific coast. Surveys were made in a number of regions where the need was particularly urgent. There remains the task of applying the resulting data to the charts. When this has been accomplished, during the present fiscal year if possible, the results will be a notable improvement in this service to mariners.

The other half of the money was used chiefly for control surveys in the interior. Control surveys consist of triangulation and levels which give accurate distances and directions between, and accurate elevations of, permanently marked points. This information is essential to map making, highway construction, irrigation and reclamation, flood control, maintenance and building of railroads, power and pipe-line extensions, and various other engineering operations which require exact knowledge of the surface of an extensive region. There is scarcely an extensive engineering enterprise throughout the United States to which this work is not an important prerequisite. The work, while technical in character, is of such importance that in spite of the recent depression three States—North Carolina, California, and New Jersey—have voluntarily contributed State funds in order that the work within their boundaries might be completed more promptly than would otherwise be possible.

The regular appropriation made for the fiscal year 1934 is $2,205,090. This involved an even greater reduction of operations than the one deferred a year previously. However, an additional allotment of $2,600,000 of national industrial recovery funds is expected to be made.

These large fluctuations in the funds provided are an inevitable consequence of the abnormal national situation. They are recognized as unavoidable. However, they emphasize the need for the earliest possible adoption of long-range programs of work, which consider the projects in their entirety, so that the planning and execution of the parts contemplated for any one year can be based on reasonable certainties as to what can be undertaken in succeeding years. Such planning is one of the important essentials to the most efficient and economical execution of Survey work.

The Survey is saddened by the loss of its Assistant Director, Capt. Robert Lee Faris, who died suddenly on October 5, 1932. His profound technical knowledge is sorely missed. His attitude and example contributed largely to the maintenance of a high service morale. With him the work always ranked first. Every other consideration was subordinated to his desire for its efficient and economical performance. Yet in his daily applications of that desire his

obvious integrity of purpose, his sense of justice, and his kindly consideration for the personnel won him a lasting place in the affections of his associates. He was a man to whom the Federal service can point with pride.

FIELD OPERATIONS

HYDROGRAPHIC AND TOPOGRAPHIC WORK

Topographic and hydrographic surveys, including the necessary triangulation, were made on the Atlantic, Gulf, and Pacific coasts, in Alaska, and in the Philippine Islands. No work was done in the Hawaiian Islands, the curtailment of regular appropriations having necessitated the withdrawal of the *Pioneer*. Emergency relief and construction act funds permitted the employment of additional shore parties along the coasts of the United States.

Atlantic and Gulf coasts.—The survey of Georges Bank, begun in 1930, was completed in October of 1932 by the *Hydrographer*, *Oceanographer*, *Lydonia*, and *Gilbert*. These vessels thereupon proceeded to Norfolk for annual overhaul and reduction of field records before starting other work.

Early in 1933, the *Lydonia* took up the project of supplementing the first-order Atlantic coast arc of triangulation with second-order work and coordinating all existing schemes between Charleston and Edisto Island, S.C. A current survey was made of Charleston Harbor during the course of this work. Hydrographic work off the coasts of Maryland and Delaware was started in April, where the *Lydonia* was joined by the *Oceanographer* and *Gilbert* in May. This undertaking was in progress at the end of the fiscal year.

During the first part of January the *Hydrographer* took up hydrographic work in the Gulf of Mexico eastward from Calcasieu Pass, La. This project was in progress at the end of the year. The *Oceanographer* cooperated with the *Hydrographer* for several months before taking up the work off the Maryland-Delaware coast with the *Lydonia*. En route to and from the Gulf working grounds the *Oceanographer* ran offshore sounding lines along the Atlantic and Gulf coasts.

Before joining the *Lydonia* and *Oceanographer* the *Gilbert* revised the triangulation along the inland waterway on the North Carolina coast and established control for the reduction of aerial photographs.

A hydrographic and topographic survey of Wicomico River, Md., started at the close of the preceding fiscal year by the *Mikawe*, was completed in August of 1932 and was followed by resurveys in the vicinity of Kent Island, Md. The party then proceeded to North Carolina and took up work similar to that of the *Gilbert*. In the spring of 1933 the party started resurveys of the South, West, and Rhode Rivers, Md., on which it was engaged at the end of the fiscal year.

The *Natoma* made complete new surveys of the Hudson River, from Tarrytown to West Point, necessary to meet the needs of the deeper-draft vessels accommodated by the increased depths now being maintained to Albany. This was interrupted during the winter months, while this party extended triangulation northward from

Beaufort, S.C., connecting with the same class of work extended southward from Charleston by the *Lydonia*.

In November of 1932 three shore parties began coastal triangulation operations coordinating all existing triangulation and establishing control for the reduction of aerial photographs. One party operated in Pamlico, Albemarle, and Roanoke Sounds, N.C.; another between Savannah, Ga., and Jacksonville, Fla.; and a third from Lake Charles, La., to the Gulf of Mexico at Calcasieu Pass and thence westward along the coast to Atchafalaya Bay. The triangulation last named controls the surveys of the *Hydrographer*. The third party also took up similar work between Orange and Sabine Pass, Tex.

Revised surveys in the vicinity of Sandy Hook, N.Y., to correct charts for extensive changes, were executed by a small party in the fall of 1932.

A shore party was engaged on a hydrographic and topographic survey of New River, N.C., between November and March and then began operations on a resurvey of Shinnecock and Moriches Bays, Long Island, to obtain data for the reconstruction of charts based on surveys of some 50 years ago.

A party operated near the western end of Long Island Sound until November to obtain data for modernizing three charts of that area. Work was again taken up on this project in March and was in progress at the close of the year.

Surveys were started early in March in Great South and Peconic Bays, Long Island, to correct charts based on surveys made between 1870 and 1890.

From December 1 of 1932 to July 1 of 1933, a party in New York City was engaged on the compilation of air photographs of the San Joaquin and Sacramento River Delta, Calif., for the construction of new charts of that region.

During the first half of the fiscal year, a small field party was engaged in locating landmarks and coordinating triangulation in the vicinity of Bridgeport and New Haven Harbors, Conn.

Prior to the beginning of work by the three vessels operating off the Maryland-Delaware coast, a shore party established the necessary control, and at the end of the fiscal year was engaged in revising and coordinating all previous triangulation along this section of the coast.

The triangulation party which was engaged on the control net in the vicinity of New York City, started in 1930, completed this entire project in April. This furnishes a comprehensive control scheme for the entire New York district, essential in coordinating the extensive surveying and mapping operations conducted by Federal, State, municipal, and private agencies in this important area.

During March a hydrographic and topographic survey was made of Shark River Inlet, N.J., to correct the chart of that locality.

Two small shore parties operated in the Massachusetts Bay area during the latter part of the fiscal year, under the general supervision of the inspector of the Boston field station. One was engaged in recovering and revising descriptions of triangulation stations in the vicinity of Boston, and the other on hydrographic and topo-

graphic surveys in the vicinity of Cape Cod, for the purpose of constructing a new chart to replace the charts of Wellfleet and Provincetown Harbors.

From the middle of November to the end of the fiscal year a party was engaged on a hydrographic and topographic survey of Galveston Bay and approaches, for the reconstruction of the chart for that area.

From April to the close of the year, a party was engaged in field work covering a topographic survey along the new ship channel leading from the Gulf of Mexico to Lake Charles, La.

Pacific coast.—The *Guide* extended complete new surveys along the California coast, from Pigeon Point southward to Point Sur. This work extends 60 miles offshore and furnishes final data for modernizing the chart from Point Sur to San Francisco. During the last 3 months of the fiscal year, visual ship hydrography was carried southward from Point Sur to Point Piedras Blancas, and preparations made for offshore radio acoustic ranging work, to revise the chart from Point Conception to Point Sur.

The party on the *Guide* discovered and surveyed thoroughly several submarine features of value to the mariner for position determination. One consists of a plateau 6½ miles long about 20 miles west from Point Sur, covered by 450 fathoms of water and sloping rapidly to 600 fathoms. A second feature is a narrow gorge indenting the continental shelf a distance of over 3 miles. As all coastwise steamer tracks along this stretch of coast pass over or close to this gorge, its charting furnishes an excellent submarine landmark in thick weather. A third feature is a large submarine mountain about 45 miles off the Farallon Islands, the summit of which is covered to a depth of about 900 fathoms. It is surrounded by depths greater than 1,400 fathoms and on the seaward side slopes steeply to 1,800 fathoms.

At the beginning of the year, the *Pioneer* was laid up because of the shortage of funds, but in December work was started in the vicinity of San Nicholas Island, Calif., and extended westward to the 2,000-fathom curve, to modernize the chart of that region. A submarine mountain was discovered and surveyed, rising from depths of 10,000 feet to a ridge 6½ miles long and 1,800 feet deep. This feature is 15 miles westward of the general 2,000-fathom curve and 75 miles offshore from San Nicholas Island.

A shore party was engaged throughout the fiscal year on a hydrographic and topographic survey of Santa Barbara and San Nicholas Islands, Calif., obtaining the data necessary for the construction of large-scale charts desired by the Navy. This party established triangulation control for and made photographic compilations of the coast from San Pedro Harbor to Newport Bay, Calif.

Two triangulation parties were engaged the entire year in establishing coastal control along the California coast.

One shore party made hydrographic and topographic surveys in November of 1932 along the California coast in the vicinity of Ventura, for a new large-scale chart of that area, and then extended work eastward toward Point Conception.

A shore party was engaged for the entire year on the field inspection and control for the reduction of air photographs of the San Joaquin and Sacramento River Delta in connection with the data necessary for the construction of new charts.

Alaska.—At the beginning and close of the year, the *Explorer*, *Discoverer*, and *Surveyer*, were operating in Alaska. They returned to Seattle in the late fall for overhaul and completion of field records.

The *Explorer* carried on surveys in the vicinity of Revillagegido Channel and Dixon Entrance. The *Surveyer* and *Discoverer* were engaged on the east coasts of Kodiak and Afognak Islands during the 1932 season. In the spring of 1933, the *Discoverer* returned to that region while the *Surveyor* was assigned to unsurveyed areas in Prince William Sound and approaches.

Philippine Islands.—Two vessels, the *Pathfinder* and *Fathomer*, continued operations throughout the fiscal year. The *Pathfinder* made surveys on the northwest and north coasts of Luzon and on the west coast of Palawan. The *Fathomer* surveyed the entrance to San Bernandina Strait, in Albay Gulf, and on the west coast of Palawan.

At the beginning of the year, the *Marinduque* engaged in surveys in the vicinity of Sibutu Island, Sulu Archipelago. Field work was closed August 31, 1932, and the vessel returned to Manila, investigating en route a reported shoal in the Visayan Sea. On September 20 the vessel was decommissioned because of age and sold by the Philippine Government.

On account of the curtailment of the regular appropriations for the 1934 fiscal year, the *Pathfinder* was laid up at Manila for an indefinite period, with a sufficient crew retained to protect the vessel.

The survey of the more important areas of the Philippine Islands is now between 85 and 90 percent completed. The hydrography yet to be done consists of a comparatively small area along the northeast coast of Luzon and about 85 percent of the west coast of Palawan. About 10,000 square miles remain to be surveyed off the north coast of Borneo between the International Boundary and completed work in the southern part of the Sulu Sea.

United States Coast Pilots.—A field examination was made by one party for a new edition of the Coast Pilot series covering the Atlantic coast from the St. Croix River to Cape Cod, to replace the 1927 edition.

Another party made a field examination from Cape Cod to Sandy Hook, for a new edition of the publication for that area, previously issued in 1926.

Manuscripts for these two United States Coast Pilots, together with the manuscript for the United States Coast Pilot the Hawaiian Islands, field data for which were secured the previous fiscal year, were sent to the Government Printing Office.

After plotting the records of the 1932 Alaskan season in Seattle and prior to sailing north with the *Discoverer* this spring, the *Westdahl* made a field examination of Puget Sound to obtain data for use in a new edition of the Pacific Coast Pilot, covering California, Oregon, and Washington, previously issued in 1926.

Hydrography, topography, and triangulation accomplished

Locality	Hydrography			Topography		Coastal triangulation		
	Sounding lines	Area	Soundings	Length of shore line	Area	Length of scheme	Area	Geographic positions
	Miles	*Sq. mi.*	*Number*	*Miles*	*Sq. mi.*	*Miles*	*Sq. mi.*	*Number*
Provincetown, Mass	399	26	9,599	75	31			
Georges Bank, Mass	12,659	16,630	83,470			3	5	4
Nantucket to Bridgeport, Mass. and Conn						9	50	74
Long Island Sound, Conn. and and N.Y	[1] 100 608	[1] 25 41	[1] 187 23,244	169	26	14	12	20
Hudson River, N.Y	927	39	31,142	158	122	34	310	160
Long Island, N.Y	2,949	201	139,415	401	103	90	370	143
New York Harbor, N.Y. and N.J	49	1	1,902			50	300	415
Sandy Hook, N.J	273	22	7,459	23				
Delaware River, N.J						178	2,000	509
Shark River, N.J	34	2	2,581	12	2	4	10	23
South River and Kent Island Narrows, Md	108	37	26,939	102	24	17	49	56
Wicomico River, Md	175	3	16,803	36	19	33	305	82
Fenwick Island Light to Cape Charles, Md. and Va	3,455	3,164	27,402	43	4	80	320	60
Yorktown, Va				2		2	4	
Albemarle Sound to Cape Fear River, N.C	301	16	13,803	320	69	421	2,447	586
Charleston to Port Royal Sound, S.C						210	534	441
Savannah, Ga., to Jacksonville, Fla						214	989	544
Atchafalaya Bay to Port Arthur, La. and Tex						223	1,639	258
Vicinity of Calcasieu Pass, La	6,332	16,543	40,014	77	46			
Lake Charles to Calcasieu Lake, La				107	42			
Galveston, Tex	3,824	339	94,451	204	55	109	716	174
Oceanside to Point Sur, Calif						296	926	549
Newport Bay to Naples, Calif	3,752	382	58,498	310	208	76	520	139
Santa Barbara Islands, Calif	6,415	9,448	33,511			4	3	2
Point Piedras Blancas to Point Ano Nuevo, Calif	11,785	8,033	93,589	105	72			1
San Francisco Bay, Calif. (air-photo reduction)				89	88			
San Joaquin-Sacramento Delta (air-photo reduction and control)				877	704		900	250
Seattle to Eagle Harbor, Wash				2		15	30	9
Revillagigedo Channel, Alaska	3,023	371	55,542	311	246	110	274	163
Prince William Sound, Alaska	2,046	906	8,842	170	138	115	510	101
Afognak Island, Alaska	7,166	2,308	81,466	262	171	5	110	55
Kodiak Island, Alaska	10,956	4,777	105,703	222	142	75	165	145
Oahu Island, Hawaii	688	25	44,954	36	3	7	3	26
North, and northwest coasts, Luzon Island, P.I	6,788	3,708	92,717	97	110	44	154	26
Manila Harbor, Luzon Island, P.I	95	2	5,525					
North coast, Samar Island, P.I	4,575	796	53,632	122	63	38	203	44
West coast, Palawan Island, P.I	12,020	8,596	202,314	68	43			
Sibutu Islands, P.I	1,842	215	32,323	7	5			7
Total	103,344	76,656	1,387,027	4,407	2,536	2,476	13,858	5,066

[1] Wire-drag.

GEODETIC WORK

More geodetic work was done during the fiscal year 1933 than in any other year in the history of the Coast and Geodetic Survey.

As a result of these geodetic activities, 3,625 miles of first-order triangulation, and 11,324 miles of first-order and 2,940 miles of second-order leveling were added to the control nets of the country. In addition, 29 first-order base lines, with a total length of 196 miles, were measured; 147 gravity stations were occupied; and astronomical observations were made at 129 stations. This work was done by 5 triangulation parties, 11 leveling parties, and 1 party each on gravity, astronomy, and base measurements.

The arc of first-order triangulation being extended along the Atlantic coast was continued southward from the vicinity of New York City to Norfolk, Va., and thence along the James River to a connection with the eastern oblique arc triangulation near Charlottesville, Va. Connections with the eastern oblique arc were made also in central New Jersey and Delaware Bay.

The eastern shore of Lake Michigan arc of first-order triangulation, in progress at the beginning of the fiscal year, was completed, and an arc extended southward from Traverse City to Hillsdale, Mich., to a connection with the triangulation of the Lake Survey. Spur lines were run east and west at latitude 43°30′ and eastward to Detroit, where connection was made with the Lake Survey triangulation along the Detroit River. During the course of this work, additional triangulation stations were established in Detroit for the use of the city engineer.

First-order triangulation work was done from the vicinity of Augusta, Ga., to a connection with the Atlantic coast arc at Beaufort, S.C.; from a point south of Brunswick, Ga., continuing the Atlantic coast arc to Jacksonville, Fla.; westward to Tallahassee and thence northward to a connection with existing triangulation in the vicinity of Columbus, Ga.; and southward and eastward from Jacksonville, Fla., through St. Augustine, Palatka, Coala, and Dunnellon, following the route of a proposed cross-State canal and thence up the Florida west coast to a connection in the vicinity of Tallahassee.

Other arcs of first-order triangulation were extended from the eastern oblique arc, in the vicinity of Mount Airy, N.C., southeastward across that State to Jacksonville, N.C.; from Kinston southwestward to Dillon, S.C.; from Little River, N.C., along the North Carolina-South Carolina boundary to Statesville, N.C., thence via Charlotte to a connection with the eastern oblique arc in the vicinity of Morganton; and from Clarkesville, Va., toward Richmond, Va.

In the west, first-order triangulation was extended from Redondo, via Antelope Valley, to the vicinity of Bakersfield, Calif. This work was supplemented by second-order triangulation for use in earthquake studies. An arc was extended from Pendleton, Oreg., southwestward across that State through the mountains southwest of Bend, where the work was abandoned because of heavy snows and other unfavorable weather conditions.

A scheme of first- and second-order triangulation was extended from Taft, Calif., for the purpose of investigating earth movements. Additional observations at triangulation stations where the previous observations were incomplete were also made in the vicinity of San Francisco.

At the end of the year, an arc of first-order triangulation was in progress from Loop City, Nebr., westward to Pocatello, Idaho.

Lines of first- and second-order leveling were run in 35 States, including the District of Columbia. They were Alabama, Arizona, Arkansas, California, Colorado, District of Columbia, Florida, Georgia, Idaho, Illinois, Iowa, Maryland, Massachusetts, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Oklahoma, Oregon, Pennsylvania, South Carolina, Tennessee, Texas, Utah, Vermont, Virginia, Washington, and Wyoming.

In cooperation with the North Carolina State Highway Commission, in pursuance with an agreement which contemplates the completion of control work in that State within the 50-mile spacing, triangulation and leveling work were carried on in North Carolina through most of the year.

At the request of the State of New Jersey, 44 triangulation stations were established on the ocean side of the intracoastal waterway at intervals of about 2½ miles, between Bay Head and Cape May, in connection with the Atlantic coast arc. The cost of the additional observations was assumed by that State.

The Survey cooperated with the State of California, which contributed toward the cost of the work, in extending a number of first-order level lines.

The Jacksonville, Fla., Office of the Corps of Engineers, United States Army, cooperated with this Bureau by advancing $11,600 for the extension of triangulation along the route of the proposed cross-State canal, to coordinate other surveys preliminary to the selection of the final route.

Geodetic work accomplished

Locality	Length of scheme	Area covered
TRIANGULATION, FIRST ORDER		
	Miles	*Sq. mi.*
East shore Lake Michigan, Mich.	95	1,150
New York City to Norfolk, N.Y., N.J., Md., Del., and Va.	300	3,900
San Fernando to Bakersfield, Calif.	110	1,550
Grand Traverse Bay to Hillsdale, Mich.	470	4,700
Augusta to Beaufort, Ga. and S.C.	120	1,250
Brunswick to Jacksonville, Ga. and Fla.	70	550
Jacksonville to Tallahassee, Fla.	170	1,350
Tallahassee to Columbus, Fla. and Ga.	150	1,500
Norfolk to Gordonsville (James River), Va.	170	1,700
Arlington to Bend, Oreg.	125	2,750
Vicinity of Taft, Calif.	15	65
Vicinity of Big Sur, Calif.	60	250
Oblique arc to Jacksonville, N.C. and Va.	230	2,300
Goldsboro to Little River, N.C. and S.C.	130	1,150
Marietta to Lincolnton, N.C. and S.C.	140	1,500
Jacksonville to Port Inglis, Fla.	140	1,100
Loup City to Laramie, Nebr. and Wyo.	330	5,100
Mt. Airy to Murphy, N.C.	210	3,800
Pasco to Orofino, Wash. and Idaho	165	2,950
Colfax to International Boundary, Wash.	135	3,350
Dunnellon to Tallahassee, Fla.	160	1,450
Roxboro to Weldon to Richmond, N.C. and Va.	130	1,300
Total	3,625	44,715
BASE LINES, FIRST ORDER		
Howard, Mich.	7.4	
Pittsville, Md.	6.2	
Norfolk, Va.	6.6	
Richmond, Va.	4.4	
Rocky Mount, N.C.	9.5	
Durham, N.C.	4.6	
New Bern, N.C.	6.0	
Southport, N.C.	6.3	
South River, N.C.	10.0	
Dillon, N.C. and S.C.	7.9	
Charleston, S.C.	5.9	
Augusta, S.C.	5.5	
Ogeechee, Ga.	5.1	
Duval, Fla.	5.5	
Live Oak, Fla.	4.9	
Colquitt, Ga.	10.9	
Dunnellon, Fla.	5.8	
Titusville, Fla.	6.7	
Delray, Fla.	6.4	
Tamiami, Fla.	9.1	
Estero, Fla.	6.9	
Santa Ana, Calif. (remeasurement)	1.0	
St. Petersburg, Fla.	8.2	
Okeechobee, Fla.	7.6	
Salem, Fla.	7.2	
McIntyre, Fla.	6.0	
Point Washington, Fla.	10.4	
Union City, Ohio	8.4	
Smiths Grove, Ky.	5.6	
Total	196.0	
BASE LINE, SECOND ORDER		
Taft, Calif.	0.7	
RECONNAISSANCE, FIRST ORDER TRIANGULATION		
Roxboro to Kinston, N.C.	140	1,350
Goldboro to Little River, N.C. and S.C.	130	1,150
Marietta to Lincolnton, N.C. and S.C.	140	1,500
Mt. Airy to Murphy, N.C.	290	5,600
Washington to Pamlico Sound, N.C.	85	880
Newport to Core Sound, N.C.	25	215
San Fernando to Bakersfield, Calif.	60	850
Grand Traverse Bay to Hillsdale, Mich.	470	4,700

Geodetic work accomplished—Continued

Locality	Length of scheme	Area covered
RECONNAISSANCE, FIRST ORDER TRIANGULATION—continued		
	Miles	*Sq. mi.*
Charleston to Bristol, W.Va., Va., and N.C.	75	1,350
Pocatello to Loup City, Idaho, Wyo., and Nebr.	485	11,000
Lewiston revision, Idaho	110	2,100
Arlington to Klamath Falls, Oreg.	250	6,100
Jacksonville to Miami, Fla.	360	2,800
Miami to Estero, Fla. (traverse)	100	
Estero to Port Inglis, Fla.	205	1,600
St. Augustine to Port Inglis, Fla.	110	850
Port Inglis to Tallahassee, Fla.	160	1,450
Sarasota to Fort Pierce, Fla.	140	1,350
One hundred and seventeenth meridian, Oreg., Idaho, and Nev.	30	750
Ogallala to Perryton, Nebr., Kans., and Okla.	305	3,800
Vicinity of Taft, Calif.	15	65
Delaware River, N.J., Pa., and Del.	100	1,200
Belen to Las Cruces, N.Mex.	170	5,000
Colfax to International Boundary, Wash.	135	3,350
Pittsburgh westward, Pa., and Ohio	125	1,500
Richmond to Washington, Va., Md., and D.C.	110	900
Lander to Pocatello, Wyo.	95	3,370
Lynchburg to Christianburg, Va.	40	900
Total	4,350	64,585
LEVELING, FIRST ORDER		
Ithaca to Elmira, N.Y. (part)	23	
Salida to Bishop, Calif. (part)	192	
Redding to Alturas, Calif.	155	
Cape Girardeau to Hoxie, Mo., and Ark.	140	
Sacramento to Oakland, Calif.	154	
Hopland to Albion, Calif.	60	
Knoxville to Dillsboro, Tenn. and N.C.	124	
Spartanburg to Lynchburg, S.C. and Va.	327	
Atlanta to Dillsboro, Ga., and N.C.	157	
Cedar Keys to St. Augustine, Fla. (releveling)	143	
El Paso to Vaughn, Tex. and N.Mex.	238	
Junction to Fort Stockton to Monahans, Tex.	262	
Robstown to Laredo, Tex.	147	
Bristol to Hickory, Va. and N.C.	150	
Port Jervis to Reading, N.Y. and Pa.	165	
Chillicothe to Jericho, Tex.	124	
Cornelia to Spartanburg, Ga. and S.C.	132	
Desert Center to Salome, Calif. and Ariz.	117	
Dumbarton Bridge to Skyline Boulevard, via Palo Alto, Calif.	31	
Fort Pierce to Punto Gorda, Fla.	132	
Fort Stockton to Sanderson, Tex.	68	
Hamlet to Chadbourn, N.C.	94	
New Smyrna to Tampa, Fla.	157	

Locality	Length of scheme	Area covered
LEVELING, FIRST ORDER—con.		
	Miles	*Sq. mi.*
Palatka to Dunnellon and Port Inglis, and Dunnellon to Archer, Fla.	154	
Sweetwater to Bowie, Tex.	266	
Whiteland to Big Spring, Tex.	162	
Yuma to Needles, Ariz. and Calif.	176	
Anderson to Denmark, S.C.	170	
Washington to Baltimore and Annapolis, D.C. and Md.	91	
Ludlow to Beatty, Calif. and Nev.	168	
Mayport to Dunnellon, Fla.	834	
Reedsport to Newport, Oreg.	96	
Columbus to Selma, Ga. and Ala.	151	
Roswell to Tularosa, N.Mex.	107	
Jacksonville to Crowder, Tex. and Okla.	276	
Chadbourn to Savannah, N.C. and Ga.	283	
Fort Smith to El Reno, Ark. and Okla.	258	
Beatty to Olanoha, Nev. and Calif.	134	
Wood River to Julesburg, Nebr. and Colo.	206	
Bowie to Clemenceau, Ariz.	286	
San Jose to Santa Margarita, Calif. (releveling)	204	
Forrest City to Hazen, Ark. (releveling)	63	
Van Buren to Russellville, Ark. (releveling)	86	
Seligman to Fort Smith, Mo. and Ark. (releveling)	106	
Vicinity of San Antonio, Tex. (releveling)	63	
Vicinity of Houston, Tex. (releveling)	73	
Santa Ana to San Diego and Fall Brook, Calif. (releveling)	120	
San Francisco to San Jose to Oakland, Calif. (releveling)	101	
Vicinity of Elmira, N.Y.	26	
Vicinity of Watertown, N.Y.	35	
Aberdeen to Twin Rivers, Wash.	154	
Sterling to Crawford, Colo, and Nebr.	183	
Ithaca to Cayuga, N.Y.	40	
Oakland to Hamburg, Ill. and Iowa	525	
Albuquerque to Mears Junction, N.Mex. and Colo. (part)	263	
Duluth to International Falls, Minn. (part)	35	
West Point to Clarksdale, Miss.	211	
Bridgeport to Riverton, Ala.	261	
Green River to Laurel, Wyo. and Mont. (part)	321	
Perth Amboy to Port Jervis, N.J. and N.Y.	118	
Bemidji to Cass Lake, Minn. (releveling)	33	
Pipestone to St. Cloud, Minn.	172	
Springfield to Troy, Mass. and N.Y.	114	
Bonners Ferry to Shelby, Idaho and Mont. (part)	96	
Omak to Springdale, Wash.	137	
Table Rock to Wolcott, Wyo. and Colo.	237	
Puntenney to Flagstaff, Ariz.	121	

Geodetic work accomplished—Continued

Locality	Length of scheme	Area covered
LEVELING, FIRST ORDER—CON.	*Miles*	*Sq. mi.*
Mack to Green River, Colo. and Wyo. (part)	73	
White River Junction to Dover, Vt. and N.H. (part)	53	
Hamburg to Hastings, Iowa and Nebr. (part)	65	
Mina to Battle Mountain, Nev. (part)	125	
Total	11,324	
LEVELING, SECOND ORDER		
Lines on Long Island, N.Y.	221	
Truckee to Sacramento, Calif.	170	
Westwood to Keddie, Calif.	39	
Red Bluff to Flanigan, Calif. and Nev.	173	
Doyle to Reno, Calif. and Nev.	53	
Reno Junction to Richvale, Calif.	155	
Dillsboro to Spartanburg, N.C. and S.C.	127	
Beeville to Gardendale, Tex.	116	
Gilroy to Chowchilla, Calif.	84	
Granbury to Goldthwaite, Tex.	158	
Hebbronville to Rio Grande, Tex.	79	
Lampasas to Mason, Tex.	100	
Salisbury to Chester, N.C. and S.C.	167	
LEVELING, SECOND ORDER—CON.	*Miles*	*Sq. mi.*
San Lucas to Goshen, Calif.	120	
Statesville to Max Meadows, N.C. and Va.	130	
Wadesboro to Hamlet, N.C.	24	
West Point to Placedo Junction and Kenedy, Tex.	162	
Atlanta to Bushnell, Ga. and N.C.	180	
Mammoth Springs to Shirley, Ark. (releveling)	101	
Newport to Forrest City, Ark. (releveling)	72	
Wheatley to Helena, Ark. (releveling)	98	
Globe to Tucson, Ariz.	114	
Tempe to Wenden, Ariz.	118	
Matthie to Prescott, Ariz.	80	
Roosevelt to Maricopa, Ariz.	99	
Total	2,940	
SUMMARY		
First-order triangulation	3,625	44,715
First-order base lines	196.0	
Second-order base line	.7	
First-order triangulation, reconnaissance	4,350	64,585
First-order leveling	11,324	
Second-order leveling	2,940	

TIDE AND CURRENT WORK

The work of this division included the operation and inspection of primary tide stations, furnishing tidal control for the various regions, and the operation for short periods of numerous secondary tide stations and miscellaneous current observations, for use in hydrographic surveys.

Tide and current surveys.—The tide and current survey of New York Harbor, begun in 1932 in cooperation with United States Army Engineers, was completed. Tide gages were established at 18 stations, 3 of which were maintained the entire season. The engineer office established 139 gages, mostly staff. Pole and meter current observations were obtained at 85 stations for 50-hour periods, at which density and temperature observations were also secured. The United States Engineers secured observations at 29 stations for approximately 10-day periods. In connection with this survey, 31 new standard disk bench marks were established, and 28 bench marks recovered.

A tidal survey of the coast of Oregon was started during the year. Standard gages, to be operated 12 months, have been established at Newport, Walport, Florence, Gardiner, Brighton, Coos Bay Jetty, Bandon, Brookings, Port Orford, Garibaldi, and Taft, in Oregon, and at Crescent City, Calif. Portable gages were installed at Nehalem and Bar View. Another will be established at Tillamook Bay at the request of the Tillamook County Chamber of Commerce, for

use in establishing property boundaries. In connection with the proposed ship canal between the Columbia River and Puget Sound, Wash., portable gages were established in Bakers and Willapa Bays. These data are required in slope studies, for determining the necessity for a lock or sea level canal between these two places.

A tidal survey of the west coast of Florida was also commenced. Standard gages were established at St. Marks, Aripeka, Anna Maria, South Boca Grande, Punta Rasa, and Naples, and will be maintained for approximately 1 year. A portable gage was installed at Apalachicola.

These surveys, giving complete and up-to-date information relative to the more important harbors of the country, are made as funds become available, to meet the urgent and constantly growing demand from navigators, engineers, scientists, and the public generally, for they supply needed datum planes and are used in computing predictions.

Tide stations.—Of the 32 primary tide stations in operation at the close of the year, 19 were located on the Atlantic coast, 4 on the Gulf of Mexico coast, 6 on the Pacific coast, 2 in Alaska, and 1 in the Hawaiian Islands. Their locations are shown in the following table, in which stations maintained in cooperation with other agencies are indicated by an asterisk (*):

Eastport, Maine	Annapolis, Md.*	Galveston, Tex.
Portland, Maine	Washington, D.C.	San Diego, Calif.*
Portsmouth, N.H.*	Hampton Roads, Va.*	La Jolla, Calif.
Boston, Mass.	Southport, N.C.*	Los Angeles, Calif.*
Woods Hole, Mass.*	Charleston, S.C.	San Francisco, Calif.
Newport, R.I.*	Mayport, Fla.*	Astoria, Oreg.
Bridgeport, Conn.	Jacksonville, Fla.*	Seattle, Wash.
New York, N.Y.	Miami Beach, Fla.*	Ketchikan, Alaska.
Atlantic City, N.J.	Key West, Fla.	Seward, Alaska.
Philadelphia, Pa.	Pensacola, Fla.	Honolulu, Hawaii.*
Baltimore, Md.	Mobile, Ala.*	

Three of these stations were established during the year on a cooperative basis: One at Woods Hole, Mass., with the Woods Hole Oceanographic Institute, and the others at Mobile, Ala., and Southport, N.C., in conjunction with local United States Engineers.

The data secured from observations are essential for the determination of accurate datum planes, for the reduction of the results of short series of observations to mean values, for the determination of secular changes in relation of land to sea, and for hydrographic control.

Inspections were made of the following stations, where levels were run between the tide staff and adjacent bench marks:

Rockland, Maine	Bridgeport, Conn.	Southport, N.C.
Eastport, Maine	New Bedford, Conn.	Charleston, S.C.
Portland, Maine	New York, N.Y.	Mayport, Fla.
Portsmouth, N.H.	Oyster Bay, N.Y.	Jacksonville, Fla.
Boston, Mass.	Willets Point, N.Y.	Miami Beach, Fla.
Woods Hole, Mass.	Atlantic City, N.J.	Key West, Fla.
Newport, R.I.	Philadelphia, Pa.	

A total of some 281 secondary tide stations were also in operation for short periods in connection with hydrographic and tide and current surveys on both coasts of the United States, in Alaska, Hawaii, and the Philippines.

The Survey is appreciative of the cooperation of other organizations engaged in carrying on tide and current work. The value of such assistance was emphasized in connection with the curtailed appropriations. A number of tide stations are operated on this basis, whereby the tide station and observer are furnished by another agency and the instructions and supervision furnished by this Survey. These stations are subject to the usual inspection and the records given this Bureau for its archives. Similar data are also exchanged with individuals and organizations of other countries.

Cooperation with the United States Engineers has been helpful to both organizations, especially in connection with the tide and current survey of New York Harbor. Tide stations were maintained at Southport, N.C., Miami Beach, Fla., Jacksonville, Fla., and Mobile, Ala.

The Navy Department has likewise rendered valuable assistance, maintaining tide stations at Newport, R.I., Annapolis, Md., Hampton Roads, Va., San Diego, Calif., Portsmouth, N.H., and Bellevue, D.C.

Interested research institutions and universities have assisted by maintaining cooperative stations at Woods Hole, Mass. (Woods Hole Oceanographic Institute); Friday Harbor (Oceanographic Laboratory of the University of Washington); and St. Georges, Bermuda (Biological Research Bureau). Gages have been loaned the American Geographical Society for tide observations along the east coast of Greenland, where such information is very meager.

Other stations are at this time maintained at Mission Bay, Calif., by the State park commission, to secure accurate datums in an area of increasing land values; Berkeley and Richmond, Calif., by the Berkeley Waterfront Co.; Bladensburg, Md., by the Washington Suburban Sanitary District, for the study of sewage disposal in the metropolitan area of Washington; Santa Monica, Calif., by State authorities, for datum studies in connection with State road building close to the ocean beach; Nassau, Bahamas, by the public works department; Santa Ana and Los Patos, Calif., by the Orange County authorities; Los Angeles by the Los Angeles Harbor Department; and Honolulu, Hawaii, by the surveyor of that Territory.

Miscellaneous current observations.—Short series of current observations were made in connection with hydrographic surveys in Long Island Sound; Georges Bank; Behm Canal and Revillagigedo Channel, Alaska; Wicomico River, Md.; and Charleston Harbor.

Density and temperature observations.—Water density and temperature observations were taken daily at 19 primary tide stations. Observations were also taken at each of the current stations in connection with the tide and current survey of New York Harbor.

MAGNETIC AND SEISMOLOGICAL WORK

Magnetic work.—The magnetic survey of the United States can never be finished. Although observations have been made at some 6,000 places in the United States, including nearly every county seat, the observations are not final because at each of these places the direction of the magnetic needle and the forces acting on it are changing constantly.

That is the reason why continuous photographic records are being made at 5 magnetic observatories and also, since these are so limited in number, why "repeat observations" are made at many places at regular 5-year intervals. The primary object of these data is to keep the magnetic information on charts and airway maps revised, that they may show authoritatively the conditions at the date of issue and changes that occur from year to year.

Largely as a result of the use of relief money, many triangulation stations are being added to the control net in all parts of the United States, at many of which azimuth marks are established, from which it is easy to obtain the direction of true north, a factor necessary in magnetic observations. Earlier magnetic stations were placed in towns, convenient to county surveyors in checking their compasses and transits. The development of power plants, improvements in sewage systems, new roads, and the automobile, however, have brought influences disturbing magnetic conditions near town stations, and various developments have destroyed magnetic station marks and the prominent objects whose true bearings are determined.

Triangulation stations in the country, usually free from these objections, are used to good advantage as magnetic stations. This means, however, that for repeat station purposes a selected triangulation station and a former magnetic station in the same general region must be occupied simultaneously, that the records of change may be continuous.

Observations at repeat stations, placed about 200 miles apart, give the direction of measurements and forces acting on the magnetic needle. Declination stations are established at some 50-mile intervals along the route followed, for the ready access of county surveyors. Observations at the latter, which give only the direction of the magnetic needle with regard to true north, afford widely scattered values for the use of the mariner, the aviator, and the local surveyor. A special effort is also made to replace needed stations requested. This work was carried into the States listed below:

Alabama	5	Missouri	3
Alaska [1]	68	New Mexico	12
Arizona	9	Oklahoma	3
Arkansas	3	Philippine Islands	16
California	11	Puerto Rico	1
Georgia	1	Tennessee	4
Illinois	3	Texas	42
Indiana	1	Virginia	5
Kentucky	2	Washington	1
Louisiana	3	Wisconsin	5
Maryland	1		
Michigan	2	Total	203
Mississippi	2		

At the five observatories, the photographic recording of the magnetic elements is unending. At the Cheltenham, Md., observatory, designated by international organizations as the standard observatory of the United States, field instruments are standardized and new and improved instruments and methods are developed and tested. At the San Juan, Tucson, Sitka, and Honolulu stations the continuous recording is the chief work, although at Tucson atmospheric

[1] Special examination was also made of an area of local attraction in southeastern Alaska.

electric and earth current observations, closely related not only to magnetism but to disturbances in cable, telegraph, and telephone transmission, are made in cooperation with the Carnegie Institution of Washington and the Mountain States Telegraph & Telephone Co., a subsidiary of the Bell Telephone System.

The specialized observatory buildings were erected by this Bureau. They contain no magnetic material whatsoever. Through the use of emergency relief funds, disasters which might have resulted in the suspension of operations and the loss of instruments, were averted both at Cheltenham and San Juan. One of the Cheltenham buildings, seriously damaged by termites, was so reconstructed as to make the structure more secure for future work. The San Juan buildings, damaged by the hurricanes of 1928 and 1932, were incased in concrete reinforced by the novel use of nonmagnetic trolley wire brought down by the hurricanes. This use of copper reinforcing is practical only in the Tropics, where the temperature remains uniform, since copper does not change with temperature at the same rate with concrete.

The second polar year program.—The "polar year" for 1932–33 was the natural outgrowth of the first polar year of 1882–83, in which the United States took active part at Point Barrow, and also in Greenland by the ill-fated Greely expedition.

The present polar year, participated in by 33 nations occupying 98 stations, in polar regions and other parts of the earth, was organized by the International Polar Year Commission, of which the chief of this division is a member. The active participation is through the establishment of a polar-year station at College, near Fairbanks, Alaska, which in cooperation with Government and other organizations, is one of the most complete of all the stations.

Through the cooperation of the Naval Research Laboratory, Signal Corps, Bureau of Standards, Rockefeller Foundation, Carnegie Institution of Washington, and Alaska Agricultural College and School of Mines, the very complete program includes observations of the earth's magnetism by four different types of instruments, newly developed for this work; of atmospheric electricity; earth currents; the measurement of the height of the Kennelly-Heaviside layer; and other allied matters that affect radio transmission. This is all in addition to the extensive program of the United States Weather Bureau.

The important point is that all these phenomena, many of which are interrelated, have never heretofore been measured at the same places at the same time, at points widely scattered throughout the earth.

The construction of the necessary buildings was carried on expeditiously although presenting unusually difficult problems, caused by Arctic conditions and perpetual ground frost. The numerous piers supporting the instruments had to be carried to a depth of 13 feet below the surface, 70 tons of earth had to be removed, 50 tons replaced, and 20 tons of concrete laid.

Seismological work.—The seismological program naturally divides into several parts: The collection and compilation of reports from witnesses of earthquakes, the location and study of earthquakes

distant from recording instruments, and the recording of strong earth motions that can damage buildings and other structures.

Reports are collected from some of the 25,000 cooperative observers whenever a quake occurs. Many of these are employees of large corporations, public service, railroad, and others. For the western United States they are collected at the San Francisco field station, while for the balance of the country, including Alaska, they come to the Washington office. Most valuable information is immediately available through these reports.

As a result of the operation of seismograph stations, directly operated by the survey at San Juan, Tucson, Ukiah, and Sitka; through cooperative arrangements at Columbia, S.C., Chicago, Ill., Bozeman, Mont., and Honolulu, Hawaii, and through reports from six other stations, all earthquakes occurring in or near the United States, as well as the more important disturbances in other parts of the earth, are accurately located and facts about them made available for study.

During the year 42 instruments for recording strong earth motions were installed in 20 cities in California and 1 in the Panama Canal. These are well distributed, principally with regard to cities in regions where history shows destructive earthquakes occur. This is a new field of study, not heretofore investigated except in Japan. Japanese results, however, cannot well be applied in this country, because of the differences in types of buildings and geological ground structure.

In cooperation with the Bureau of Standards, Massachusetts Institute of Technology, and the University of Virginia, automatic, self-contained, instruments were developed and installed. The electrical operation is independent of any local electrical disturbance that might be cut off. They are inert until stimulated into action by a strong earth motion, when they write a record far more comprehensive than can possibly be obtained from the impressions of observers. In fact, they give the only absolutely accurate measures of the earthquake intensity.

The installation program in California was made possible through the help of many persons and organizations. Sites were tendered in suitable buildings and the plans aided in many other ways. Three of these instruments were in the vicinity of the Long Beach earthquake of March 10, 1933; two in the midst of the destruction.

There were no failures in operation. Engineers have offered the opinion that the records of these instruments, the installation and maintenance of which is comparatively small, provided the only absolutely accurate information resulting from the total loss of over $40,000,000.

Interesting effects of a distant earthquake were recorded in the San Francisco Bay region on the occurrence of the Nevada earthquake of June 25, 1933, over 200 miles away, to which 8 of the California instruments responded.

Records of this type are necessary in the establishment of proper building codes and have been used and are essential to the proper design of such structures as the control towers of Boulder Dam, the Oakland Bridge, and the Golden Gate Bridge in the San Francisco Bay region.

Tilt meters, developed in cooperation with the Bureau of Standards, which measure the tilting of the ground as a possible and a very probable means, according to Japanese experience, of predicting earthquakes a few days or hours in advance, have been installed at the University of California, along the Hayward fault.

WASHINGTON OFFICE

The number of persons in the service at the close of the year is shown in the following table:

Staffs	Commissioned	Civilian				Total
		Classified	Unclassified			
			Laborers	Seamen	Hands	
Washington office	14	245	4			263
Field service	157	71		567	824	1,619
Total	171	316	4	567	824	[1] 1,882

[1] Does not include 40 civilian employees of the Manila field station, nor 102 members of crews of the *Fathomer* and *Marinduque*. While paid by the insular government, they are under the jurisdiction of officers of the Coast and Geodetic Survey. There is, therefore, a total of 2,024 actually serving with the Survey.

There were received in the library and archives 102 hydrographic and 82 topographic sheets, representing new surveys accomplished by the Survey. Other additions included 2,459 charts; 1,280 maps; 1,017 blueprints (mostly of surveys by engineers of the United States Army); 8,133 field, office, and observatory records; 152 photographs and negatives; 341 prints; 69 lantern slides; 837 books; and 4,280 periodicals.

DIVISION OF ACCOUNTS

The regular annual appropriations for the United States Coast and Geodetic Survey for the fiscal year ended June 30, 1933, totaling $2,413,013, were supplemented by $1,377,850, covered by the following special appropriations and transfers from other departments:

Party expenses, 1933, emergency construction	$1,250,000
Air navigation facilities, 1933	65,000
Second polar-year program (State transfer to Commerce, Coast and Geodetic Survey), 1932–34	30,000
Working fund, Department of Commerce	15,350
Topographic survey of United States, contributions	17,500

These additional funds aggregate $3,790,863. By reason of transfers of appropriations, however, this sum was reduced by $62,753.36, leaving a net amount of $3,728,109.64 available.

Actual disbursements during the period of the fiscal year, totaling $3,422,263.95, were distributed among the various appropriations, as follows:

Party expenses, 1931	$12.50
General expenses, 1931	27.33
Pay, officers and men, vessels, 1931	.33
Repairs of vessels, 1931–32	1,004.64
Party expenses, 1932	152,435.98

General expenses, 1932	$14,454.11
Pay and allowances, commissioned officers, 1932	66,991.75
Pay, officers and men, vessels, 1932	115,079.13
Repairs of vessels, 1932	16,365.28
Air navigation facilities, 1932	27,389.66
Salaries, 1933	487,053.94
Party expenses, 1933	451,563.15
General expenses, 1933	42,301.88
Party expenses, 1933, emergency construction	873,252.10
Pay and allowances, commissioned officers, 1933	557,969.33
Pay, officers and men, vessels, 1933	450,890.19
Repairs of vessels, 1933	51,694.07
Air navigation facilities, 1933	57,258.25
War transfer to Commerce Department	9,159.38
Topographic survey of United States, contributions	11,376.33
Second polar year program (State transfer to Commerce Department), 1932–34	21,225.83
Working fund, Department of Commerce	13,823.76
Chicago World's Fair Centennial Celebration	935.03
Total	3,422,263.95

Receipts from the sale of nautical charts, publications, and from all other sources, deposited in the Treasury Department to the account of miscellaneous receipts, totaled $51,269.48.

INSTRUMENT DIVISION

The functions of the instrument division are peculiarly vital to all activities of the Survey, for it provides all the instrumental equipment and much of the general property; designs new instruments: and purchases, services, and issues these materials as needed by field parties and the Washington office.

Some of the most notable accomplishments of the division during the past year are:

A new and extremely rigid tripod designed for precision instrument use. The instrument is attached to this tripod by means of a flat leaf spring, in such a manner that no stress is introduced into the instrument itself to disturb the accuracy. The metal parts are made principally of a light, strong, aluminum alloy to reduce the weight, and the tripod has been designed in such a manner that it may now be used for three different types of instruments, thus avoiding duplication and lessening the quantity to be stocked. It is planned to adapt other instruments to this design of tripod.

Progress has been made in standardizing level vials, so that fewer sizes need be carried. A number of the newer instruments now use interchangeable level assemblies.

A new magnetograph recorder cylinder was developed, in conjunction with the division of terrestrial magnetism and seismology, making use of the same general design as is used in the portable tide gage.

A pendulum starting accelerometer was devised for use with strong motion earthquake-recording apparatus. A number of these have been installed and the device was instrumental in successfully recording the initial waves of the Long Beach earthquake, this being the first time such a record has been obtained.

Improvements were made in the method of constructing and graduating level rods. The time required to make rods was very materially reduced.

DIVISION OF HYDROGRAPHY AND TOPOGRAPHY

This division has charge of the hydrographic and topographic surveys of the Bureau and for administrative purposes is composed of the sections of field work, vessels and equipment, and coast pilot. The training section was discontinued, since the present law prevents new appointments.

Extensive studies were made in the section of field work for a systematic planning of field operations. Detailed instructions were issued the various field parties for hydrographic, topographic, and control work.

An officer continued the planning and supervision of air photo-topographic projects, and the reduction of photographs to the finished maps. Considerable time was allotted to improvement of methods and instruments in this comparatively new field. Photographs of the coast of southern California and of several sections of the Atlantic coast were being compiled at the close of the year.

Two electrical engineers were responsible for the upkeep and improvement of the echo-sounding apparatus and other electrical devices used on surveying ships. Satisfactory work was accomplished in connection with the construction of a shoal water fathometer for use on launches as well as ships. This, if successful, will provide another means of expediting inshore hydrography, with a further decrease in unit costs.

Research was done to improve the radio acoustic sound ranging used in offshore hydrographic surveying. This system has been developed to a high state of efficiency and is largely responsible for the large amount of hydrography accomplished during the year.

The section of vessels and equipment has general supervision over the construction and repair of vessels, including boats and launches and special equipment such as sounding machines. The pilot houses and chart rooms of the *Oceanographer* and *Lydonia* were rebuilt and enlarged from plans drawn in the section. Plans for the 30-foot launches were revised to provide a canopy of stainless steel instead of wood. Six launch sounding machines purchased were constructed from plans prepared in this section. A large quantity of other equipment was also purchased or transferred from other Government services.

DIVISION OF GEODESY

This division plans the geodetic field work, makes computations and adjustments of field observations, and prepares information for the use of the public. It also assists engineers, scientists, and others, to interpret the vast quantity of results for scientific studies.

The program that is being followed, after conference with officers of the United States Geological Survey, is to cover the country with a comprehensive network of geodetic control, well broken up into comparatively small areas, so that triangulation and leveling data may be secured on short notice wherever topographic mapping is undertaken. The country is now so well covered with trunk lines of triangulation and leveling that intermediate shorter arcs and lines are readily fitted in without distorting any of the old work.

These data had accumulated faster than they could be prepared for public use, due to the lack of technical and clerical personnel. As a result of the employment of a number of computers in New York City from relief funds, however, the division is more nearly current than it would be otherwise, in spite of the mass of records received from field operations.

Perhaps three times as much office computation and adjustment of geodetic observations were made as during any previous year in the history of the Survey.

DIVISION OF CHARTS

The increased activity in the field divisions was not immediately reflected in the chart division, as field results are just beginning to flow into the Washington office. They will continue for months to furnish material from which existing charts are modernized and improved and new charts constructed.

Heavy demands for new harbor charts, occasioned by local needs for stimulating business, resulted in a series of three new charts of the Houston Ship Channel from Houston to the sea. With the completion of a ship channel and harbor at Stockton, Calif., a preliminary chart was issued of the main channel following the San Joaquin River in advance of a comprehensive chart of that river and the network of navigable sloughs on either side.

A new chart was issued, especially designed for the use of fishermen, embracing the eastern end of Georges Bank, 150 miles from the New England mainland but nevertheless in such detail that commercial fishermen can determine therefrom with their fathomer equipment whether the bottom is suitable for trawling operations. With the issuance of a companion chart to the westward, now in process, this important fishing ground will be adequately covered. Because they show only a relatively small area far from land, a radio location plotted on each chart indicates the course to steer to port.

Several phototopographic sheets were printed from aerial photographs, making it possible at nominal cost to furnish exact copies of the original data to scale and on durable paper instead of photographic copies at five times the cost. The value of these maps to engineers and contractors for development projects is fully attested by the increasing calls.

There has been a decided advancement in the office practice of directing chiefs of parties relative to their field work. Instead of forwarding copies of former surveys as a basis for their work, the interpretation is made at the Washington office, conforming to one standard for all in the field. Party chiefs are supplied a projection of the region, laid down to the scale called for in the instructions, on which are plotted the triangulation and shore line; the channels, soundings, shoals, and obstructions to be investigated; the areas to receive the additional development required in modern marine surveys; and any other points revealed by the critical examination of all previous surveys on file. While this exacts additional time of the office personnel in preparation, the resulting field sheets require less research and are of a quality warranting classification as basic surveys behind which it should be unnecessary to go for charting data.

Sectional airway maps now adequately cover continuous passage by many of the more heavily traveled routes. The sales of these maps and comments on their value by airmen have been most gratifying. The number of new maps published was greater than in any previous year. The many changes in aids, requiring frequent new editions, necessitated an increasing proportion of time spent on maintenance.

Construction and maintenance

Items	Nautical charts	Airway maps	Items	Nautical charts	Airway maps
New	21	12	Reprints	67	----------
New editions	152	12	Cancelations	7	----------
New prints	277	----------	Hand corrections	[1] 1,668,148	237,967

[1] Does not include Manila field station.

Charting material received

Items	1933	1932	1931	1930	1929
Topographic field sheets	82	62	75	176	80
Hydrographic field sheets	99	102	102	134	146
Blueprints of surveys from other organizations	1,223	1,271	701	724	645
Letters containing charting data	816	894	651	722	668

Nautical charts and books and airway maps issued by Washington office

Items	1933	1932	1931	1930	1929
Nautical charts	216,936	249,311	259,862	258,286	231,741
Coast Pilots	4,116	5,825	6,480	7,651	6,288
Intracoastal Pilots	1,399	2,255	1,909	2,208	1,756
Tide and current tables	31,609	49,014	50,306	42,737	37,378
Tidal current charts	958	635	1,784	326	[1] 1,453
Commerce airway maps	29,369	19,402	17,468	[2] 12,004	----------

[1] First issued in 1929. Good for any year.
[2] Previously distributed by Aeronautics Branch.

DIVISION OF TIDES AND CURRENTS

The past year has shown a steady increase in the demand for accurate tidal and current information.

Owing to the importance of New York Harbor and its ever-changing waterways, a comprehensive tide and current survey of this region was undertaken in cooperation with the United States Engineers, the results of which are being reduced and correlated for publication when funds are available.

Owing to the curtailment of printing appropriations, no new bench mark or tide and current survey publications were printed, although the work of reducing and correlating the records on hand and bringing them up to date from new surveys has been continued.

The establishment of additional primary and secondary tide stations has increased the amount of records to be reduced and tabulated. Records from the United States Engineers and the State

Engineers of California covering observations in San Francisco Bay were worked up in connection with a study of the salt-water barrier. Datum planes were determined at 90 places, and the elevations and descriptions of 135 bench marks established along our coasts compiled.

The annual tide and current tables were issued. The consolidation of the three volumes of tide tables into two under the titles Tide Tables, Atlantic Ocean, and Tide Tables, Pacific Ocean and Indian Ocean, has simplified the preparation of the manuscript, expedited printing, and resulted in an annual saving of approximately $1,000. The pamphlet Tide Tables, United States and Foreign Ports is, therefore, no longer issued.

The tide tables for 1934 include daily predictions for 96 reference stations, and differences and constants for 3,900 stations. Daily predictions for Los Angeles, Calif., and Zanzibar, Africa, are given for the first time. In addition to cooperation with Federal, State, and municipal agencies, predictions for these tables are exchanged with the following foreign organizations: British Admiralty, 21 stations; Canadian Hydrographic Service, 4 stations; Deutsche Seewarte, 6 stations; Service Hydrographique, France, 4 stations; and Geodetic Branch, Survey of India, 5 stations.

The 1934 current tables contain daily predictions for 24 reference stations, and differences and constants for approximately 1,200 other places. A new table for obtaining the velocity of the current at any time and a revised current diagram for Puget Sound are included.

A new edition of Tidal Current Charts, New York Harbor, was published from revised material.

Records received	Stations	Months	Days
Automatic tide gage	313	2,050	
Current	202		651
Level	146		
Density and temperature	108	235	240

DIVISION OF TERRESTRIAL MAGNETISM AND SEISMOLOGY

Terrestrial magnetism.—Magnetic data were furnished for 154 nautical charts and 28 airway maps. Requests from a large number of local surveyors were met for information needed in relocating old surveys.

While the publication of needed information from the observatory and field results was discontinued because of lack of funds, certain urgently needed data were furnished in mimeograph form. This, of course, is only a makeshift, as many important investigations are handicapped by the delay in publishing these data.

The observatory records are in immediate and constant demand by those studying geology by geophysical methods, especially in connection with the search for oil and minerals. Activities in the entire Southwest are aided and controlled by observations at Tucson.

Records of all the observatories are regularly furnished radio-broadcasting and commercial-communications organizations. It is

interesting to note that international broadcasts of special importance are now scheduled in advance with regard to the probability of favorable conditions as based on the study of Survey magnetic observatory records.

At the request of the International Scientific Radio Union, the daily conditions of the magnetism as observed at Tucson, Ariz., are telegraphed to Washington where they are included in the daily naval radio broadcast in regard to solar and other conditions that affect radio transmission.

Seismology.—The publication, United States Earthquakes, 1931, was issued, and work on the 1932 edition well advanced. Mimeographed instrumental reports were prepared and distributed to cooperating organizations.

Reports of witnesses of earthquakes are not only studied at the Washington office, but copies are furnished the University of California and the Seismological Research Laboratory at Pasadena, where important local investigations on nearby earthquakes are centered.

While the Survey has previously published an earthquake history of the United States, the Pacific coast area was excluded. The earthquake of March 10, 1933, aroused so much interest and demand for authoritative information, however, that a list of destructive and near-destructive earthquakes, from the earliest known records to the present time, was compiled and issued in mimeograph form to those interested in serious studies.

Earthquakes are located from the records of the various seismological stations. In the case of the more important quakes this is done immediately from telegraphic reports, through the cooperation of news and scientific agencies, and the epicenters are broadcast by naval radio. With reports received through a large area extending eastward to Europe and westward to China, earthquakes in remote regions, from which no news can arrive in several months, are located in a few hours.

The records of strong earth motion, which in their original form are somewhat complex, are analyzed and the information summarized for use by engineers and architects interested in the designs of buildings and other structures. Such information is promulgated by press releases and the publication of articles of interest to magazine readers.

Considerable information was compiled for the American Red Cross, representatives of which organization visited the Washington office for several months to obtain data vital to their studies.

BUREAU OF NAVIGATION AND STEAMBOAT INSPECTION

AMERICAN SHIPPING ON JUNE 30, 1933

On June 30, 1933, the merchant marine of the United States, including all kinds of documented craft, comprised 24,868 vessels of 15,060,157 gross tons, as compared with 25,156 vessels of 15,838,655 gross tons on June 30, 1932. On the latter date 1,816 seagoing vessels of 9,181,936 gross tons were of 1,000 tons or over, as compared with 1,967 vessels of 9,937,717 gross tons on June 30, 1932. Following is an analysis of the ownership of seagoing tonnage compared with one year ago:

Ownership and date	Steel		Wood		Total	
	Number	*Gross tons*	*Number*	*Gross tons*	*Number*	*Gross tons*
Private ownership (500 gross tons and over):						
July 1, 1932	1,490	7,593,370	365	451,388	1,855	8,044,758
July 1, 1933	1,530	7,819,951	271	371,722	1,801	8,191,673
U.S. Shipping Board (1,000 gross tons and over):						
July 1, 1932	362	2,088,864			362	2,088,864
July 1, 1933	196	1,152,217			196	1,152,217
Total, 1932	1,852	9,682,234	365	451,388	2,217	10,133,622
Total, 1933	1,726	8,972,168	271	371,722	1,997	9,343,890

Of these totals 747 vessels of 3,923,165 gross tons were engaged in the foreign trade and 1,250 vessels of 5,420,725 gross tons in the coasting trade.

Since June 1, 1921, when our foreign trade reached its greatest volume, 10,699,596 gross tons, there has been a gradual decline, until June 30, 1933, it amounted to only 3,923,165 gross tons, a falling off of 6,776,431 gross tons. The decrease in the foreign trade is due principally to the scrapping of large vessels which belonged to the Shipping Board and to changes from foreign to coasting trade because of greater opportunities in that service.

Since June 1, 1921, the coasting trade, exclusive of the trade on the Great Lakes, has increased 2,976,279 gross tons. During the same 12 years the total seagoing tonnage has decreased 3,800,152 gross tons.

During the year 642 vessels of 190,803 gross tons were built and documented, and on July 1, 1933, there were building or under contract to build in our shipyards for private shipowners 60 vessels of 34,846 gross tons. The corresponding figures for 1932 were 722 vessels of 212,892 gross tons built and 96 vessels of 179,911 gross tons under contract to build.

The new tonnage includes 11 steel passenger steamers of 135,821 gross tons, 2 steel steam cargo vessels of 16,122 gross tons, and 1 steel

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cargo motor ship of 1,169 gross tons, aggregating 151,943 gross tons. These figures include only steel steam and motor vessels of 1,000 gross tons and over, all of which are seagoing.

The total horsepower of these new vessels is 184,300 compared with 182,900 for the same class of vessels built during the year ended June 30, 1932.

On June 30, 1933, the laid-up seagoing tonnage of the United States aggregated 667 vessels of 2,497,639 gross tons, as against 831 vessels of 3,603,426 gross tons on June 30, 1932.

Details of the world's laid-up tonnage, classification of American vessels by size, service, and power, and of vessels launched and under construction may be found in Merchant Marine Statistics for 1933, a publication prepared by this office.

INTERNATIONAL CONVENTION ON SAFETY OF LIFE AT SEA

This convention signed in London on May 31, 1929, by 18 of the principal maritime nations, is before the United States Senate awaiting ratification.

It is recognized by marine experts, government departments, technical societies, owners, operators and builders of ships, both in this country and abroad, as a marked advance in reducing the hazard to which ships, passengers, and crew are exposed. It already has been ratified by the other principal maritime nations of the world, and the interest of safety for our people, our ships and their crews, emphasizes the importance of its ratification by this country.

Should the convention not be ratified it is not improbable that very considerable delay and obstruction to commerce may result in the case of our vessels doing business out of foreign ports.

INSPECTION OF MOTOR SHIPS

By the act of June 13, 1933, Congress extended to internal-combustion-engine vessels the protection of our laws regarding the inspection of their propelling and electric machinery and equipment. There still remains, however, many other provisions of the steamboat inspection laws having to do with lifeboats and other lifesaving equipment now applying only to steam vessels which should also apply to the increasing number of large vessels propelled by internal-combustion engines. There are nearly a million tons of such vessels under the American flag carrying passengers and cargo in transoceanic trade and navigated under conditions equally dangerous with those of smaller vessels propelled by steam.

It would seem that these internal-combustion-engine vessels should be under the same requirements as to lifesaving equipment and inspection.

There are in the United States over 300,000 small vessels operating on sheltered waters where perhaps such inspection would not be necessary. It doubtless would be advisable therefore that such legislation should be restricted to vessels of a fixed tonnage and possibly engaged in ocean or Great Lakes trade.

EXAMINATION OF MOTOR BOAT OPERATORS

The act of June 9, 1910, commonly known as the Motor Boat Act, provides "That the words 'motor boat' where used in this Act shall include every vessel propelled by machinery and not more than 65 feet in length except tugboats and towboats propelled by steam." The Act also provides that "* * * no such boat while so carrying passengers for hire shall be operated or navigated except in charge of a person duly licensed for such service by the local board of inspectors. No examination shall be required as the condition of obtaining such a license, * * *."

This law should be so amended as to permit the local inspectors having jurisdiction to require that applicants for operator's license shall be examined as to visual acuity, color sense, and a knowledge of the rules of the road.

REVISION OF GENERAL RULES AND REGULATIONS OF THE BOARD OF SUPERVISING INSPECTORS

For some time slow but steady constructive progress has been made in the work of revising the rules and regulations, not only with a view to improving the form of expression but also of making these regulations modern and in keeping with the development of shipping.

The act of June 13, 1933, amending sections 4399, 4418, 4428, 4429, 4430, 4431, 4432, 4433, and 4434, Revised Statutes, as amended, relating to the construction and inspection of boilers, unfired pressure vessels, and the appurtenances thereof, is very necessary legislation which now makes it possible for the Board of Supervising Inspectors to prescribe rules and regulations covering these subjects that are thoroughly modern in every respect. It gives the Board of Supervising Inspectors a discretion that heretofore it did not possess, and it gives it an express authority to do many things that have not heretofore been undertaken. Before the end of the present calendar year the Bureau will be able to put into effect a new boiler code that will be a great step forward in the direction of safety and which will have the support of the entire industry.

The necessity for an electrical code has been felt and consistent with the general revision now being undertaken, it is hoped that within the next year the Board of Supervising Inspectors will be in a position to present such a code for the consideration of the industry and which will result in making safer conditions.

The first development of power engineering revolved entirely around steam as the means of propulsion, but during recent years, as is well known, the internal-combustion engine has come into its own and vessels are now equipped with Diesel engines. It is necessary that a code be developed covering this feature, and it is anticipated that such a code will be ready during the coming year.

Work has been going on for the last several years looking to the revision of those rules and regulations that relate to life-saving appliances, such as lifeboats, life rafts, life preservers, etc., the licensing of officers, fire protection, and construction and subdivision of hulls.

If the convention that was adopted at the International Conference on Safety of Life at Sea in London in 1929 is ratified by the Senate, it will be necessary to so amend the rules and regulations prescribed by the Board of Supervising Inspectors as to make them consistent with that convention, and even if the convention is not ratified, it will be desirable to make such changes in the rules and regulations as may be necessary to make them conform in standard with that of the convention.

COASTING TRADE

The importance of the coasting trade of the United States, with its great Atlantic, Pacific, and Gulf seaboards and the Great Lakes, has been recognized since the earliest days of our Government, and progressive effort has been made by Congress to preserve that trade to vessels documented under the laws of the United States. Congress has succeeded in throwing around the transportation of merchandise in that trade a fair degree of protection, but there is a constant invasion of our domestic trade by foreign vessels in the transportation of passengers. The only law we have on this subject is section 2 of the act of February 17, 1898, which reads as follows:

> No foreign vessel shall transport passengers between ports or places in the United States either directly or by way of a foreign port, under penalty of $200 for each passenger so transported and landed.

Under this law foreign vessels may take on passengers at an American port, for instance, and land them at a foreign port, where they are taken on by another vessel of the same line and landed at another American port, even though their destination when they left the first American port was the second American port. Passengers may be taken out of one port for a sightseeing voyage, perhaps, at many other United States ports and return to the port of departure.

It would seem that the same effort should be made to confine to our vessels the transportation of passengers in the coastwise trade that Congress has deemed proper to extend in the case of merchandise. It is difficult for American vessels to compete successfully with foreign vessels in the domestic trade because of the difference of our laws and the conditions governing foreign vessels on the high seas.

ADMINISTRATION

The general work of the superintendence of the commercial marine and merchant seamen vested in this Bureau by its organic act has proceeded along regularly established lines. The construction and administration of the navigation and steamboat inspection laws covering documentation, inspection of hulls, boilers, and equipment, examination and licensing of officers, certification of able seamen and lifeboat men, ship mortgage act, entry and clearance of vessels, movement of vessels, welfare of seamen, admeasurement, load line, adjudication of fines, collection of fees, tonnage tax, etc., and the compilation of Federal statistics of the merchant marine have been carried forward.

In the enforcement of the rules and regulations governing the movement of vessels in the St. Mary's River, patrol of courses

during regattas and marine parades, the Bureau is indebted to the Coast Guard service, which operated in its usual efficient manner under rules and regulations of this Department.

During the year, 9,152 violations of the navigation laws were considered in connection with the mitigation or remission of the penalties incurred. This is an increase of 1,100 over the fiscal year 1932. The following table shows the enforcement of such laws by customs districts and the laws violated:

Headquarters port	Total	Steamboat laws	Motorboat laws	Surrendered license	Seamen's act	Anchorage and St. Marys River rules	Passenger act	Enrollment and license	Entry and clearance	Name on vessel	Change of master	Unlading	Load line act	Numbering act	Miscellaneous
Baltimore	485	11	411	12				1		1				49	
Boston	250	14	99	47	1		4	16	9	4	4		11	18	23
Bridgeport	165	3	122	17				8		9	1			5	
Buffalo	21	2	18											1	
Charleston	45		11	26						2	1			5	
Chicago	123	3	77	5				1		4				32	1
Cleveland	83	2	49	6	3							3		19	1
Detroit	174	2	90	37		6		6	9	2	1			21	
Duluth	3			2										1	
Galveston	15	2	3	5					1				3		1
Honolulu	68	1	36	1				1	1	1				20	7
Indianapolis	2		2												
Juneau	52	4	5	21				4	1	15				2	
Los Angeles	278	10	91	33				27	9	7			10	10	81
Louisville	49		38	11											
Memphis	87	1	9	15				8		11	1			41	1
Milwaukee	28		20							2				6	
Mobile	171	2	108	41				1		5				13	1
New Orleans	755	6	425	15				5	1	57	3			234	9
New York	2,598	15	2,079	159				15	5	116	4			168	37
Norfolk	335	11	224	29				7	2	6	4			33	19
Ogdensburg	9		4	3										2	
Philadelphia	498	1	293	84				3		18	6	1		87	5
Pittsburgh	13	1	1	5										6	
Port Arthur	120	5	52	8				2		3			3	46	1
Portland, Maine	50	2	27	11				1					2	7	
Portland, Oreg	87		47	14					3	2	1		1	17	2
Providence	16	1	11						4						
Rochester	34		27	3										4	
St. Albans	1			1											
St. Louis	4			4											
San Antonio	46		17	2						4				23	
San Diego	9	2		3								1		3	
San Francisco	202	12	51	17	7		19	5		14	4		4	47	22
San Juan	17		7	3					1		1		2	1	2
Savannah	84		59	2						4			1	18	
Seattle	450	43	74	53	1		2	13	35	36	3	6	105	68	11
Tampa	1,688	14	805	55				23	32	12	5	5	2	723	12
Wilmington	37	9	14	11	1			1							1
Total	9,152	179	5,406	761	13	6	25	148	113	335	39	16	144	1,730	237

The following table shows the number of violations of law reported to the Department by the various branches of the Federal service engaged in the enforcement of the navigation laws:

Headquarters port	Total	*Sequoia*	*Kilkenny*	*Tarragon*	*Eala*	*Siwash*	*Psyche*	Coast Guard	Local inspectors	Customs	Navigation inspectors
Baltimore	485	432			25	1		4	10	13	
Boston	250							47	3	200	
Bridgeport	165					126		13		26	
Buffalo	21							8	2	11	
Charleston	45		4					12		29	
Chicago	123						73	25	3	7	15
Cleveland	83						18	3	5	23	34
Detroit	174						91	11	3	69	
Duluth	3									3	
Galveston	15							2		13	
Honolulu	68									68	
Indianapolis	2										2
Juneau	52							9		43	
Los Angeles	278							24	7	154	93
Louisville	49							5		8	36
Memphis	87									87	
Milwaukee	28						26	2			
Mobile	171			120				6		45	
New Orleans	755			674				42	7	32	
New York	2,598					2,349		46	18	185	
Norfolk	335	231						38	3	61	2
Ogdensburg	9									9	
Philadelphia	498	6				264		73	2	153	
Pittsburgh	13								1	12	
Port Arthur	120			78						42	
Portland, Maine	50							20	2	27	1
Portland, Oreg	87									31	56
Providence	16					1		5			10
Rochester	34							11		5	18
St. Albans	1									1	
St. Louis	4									4	
San Antonio	46									46	
San Diego	9								2	7	
San Francisco	202							90	6	106	
San Juan	17									17	
Savannah	84		61					2		21	
Seattle	450							86		347	17
Tampa	1,688		796					23		869	
Wilmington	37							25	2	10	
Total	9,152	669	861	872	25	2,741	208	632	76	2,784	284

HULLS AND EQUIPMENT STATISTICS

VESSELS INSPECTED AND CERTIFICATES OF INSPECTION ISSUED TO STEAM AND MOTOR VESSELS AND TO BARGES

CERTIFICATES OF INSPECTION ISSUED BY DISTRICTS

Supervising district	Local district	Domestic vessels										Foreign passenger steam and motor vessels		Total	
		Steam vessels		Motor vessels		Passenger barges		Seagoing barges		Total					
		Number	Gross tonnage	Number	Gross tonnage	Number	Gross tonnage	Number	Gross tonnage	Number	Gross tonnage	Number	Gross tonnage	Number	Gross tonnage
First	San Francisco, Calif	291	1,139,238	107	59,871	1	44	2	2,964	401	1,202,117	32	248,688	433	1,450,805
	Honolulu, Hawaii	8	11,183	8	935					16	12,118	16	238,302	32	250,420
	Los Angeles, Calif	64	266,411	24	32,143			2	4,646	90	303,200	15	110,208	105	413,408
	Portland, Oreg	45	101,463	18	2,111	1	538			64	104,112	2	19,491	66	123,603
Second	New York, N.Y	1,044	1,956,553	188	199,864	2	1,822	81	85,264	1,315	2,243,503	133	2,467,403	1,448	4,710,906
	Albany, N.Y	77	31,984	22	10,360					99	42,344	1	94	100	42,438
	New Haven, Conn	26	5,248	32	1,455					58	6,703			58	6,703
	Philadelphia, Pa	202	465,459	63	123,892			44	37,044	309	626,395			309	626,395
Third	Norfolk, Va	154	267,520	123	18,684	3	667	61	81,417	341	368,288			341	368,288
	Baltimore, Md	216	546,463	111	25,373			9	6,250	336	578,086			336	578,086
	Charleston, S.C	17	20,423	43	1,897			1	816	61	23,136			61	23,136
	Jacksonville, Fla	24	54,548	80	5,176			9	7,024	113	66,748	1	1,498	114	68,246
	Savannah, Ga	25	70,386	10	466					35	70,852			35	70,852
Fourth	St. Louis, Mo	66	17,348	21	797					87	18,145			87	18,145
	Dubuque, Iowa	32	4,714	26	1,188					58	5,902			58	5,902
Fifth	Boston, Mass	139	396,239	15	3,510			15	14,956	169	414,705	15	111,082	184	525,787
	Bangor, Maine	5	6,973	21	643			2	2,834	28	10,450	2	1,106	30	11,556
	New London, Conn	15	11,383	15	960			1	1,583	31	13,926			31	13,926
	Portland, Maine	25	3,549	18	1,436			13	13,689	56	18,674			56	18,674
	Providence, R.I	40	94,553	7	3,328			1	1,253	48	99,134			48	99,134
Sixth	Louisville, Ky	15	3,465	7	927					22	4,392			22	4,392
	Evansville, Ind	18	7,217	9	522					27	7,739			27	7,739
	Memphis, Tenn	44	10,019	8	424					52	10,443			52	10,443
	Nashville, Tenn	30	4,743	3	149					33	4,892			33	4,892
Seventh	Pittsburgh, Pa	65	20,213	14	919					79	21,132			79	21,132
	Cincinnati, Ohio	27	6,587	4	168					31	6,755			31	6,755
	Point Pleasant, W.Va	19	2,607	6	131	1	109			26	2,847			26	2,847

VESSELS INSPECTED AND CERTIFICATES OF INSPECTION ISSUED TO STEAM AND MOTOR VESSELS AND TO BARGES—contd.

CERTIFICATES OF INSPECTION ISSUED BY DISTRICTS

Supervising district	Local district	Domestic vessels										Foreign passenger steam and motor vessels		Total	
		Steam vessels		Motor vessels		Passenger barges		Seagoing barges		Total					
		Number	Gross tonnage	Number	Gross tonnage	Number	Gross tonnage	Number	Gross tonnage	Number	Gross tonnage	Number	Gross tonnage	Number	Gross tonnage
Eighth	Detroit, Mich	61	137,752	9	21,376					70	159,128	2	2,622	72	161,750
	Chicago, Ill	66	175,843	6	7,936					72	183,779			72	183,779
	Duluth, Minn	29	88,654							29	88,654			29	88,654
	Grand Haven, Mich	23	43,908	8	433					31	44,341			31	44,341
	Marquette, Mich	22	16,988	1	60					23	17,048	1	198	24	17,246
	Milwaukee, Wis	54	154,861	10	1,672					64	156,533			64	156,533
	Port Huron, Mich	23	29,268	8	241					31	29,509	4	15,523	35	45,032
Ninth	Cleveland, Ohio	79	302,955	1	858					80	303,813			80	303,813
	Buffalo, N.Y	167	589,287	6	5,376	2	233			175	594,896	5	14,978	180	609,874
	Oswego, N.Y	18	11,985	18	2,127					36	14,112	7	2,570	43	16,682
	Toledo, Ohio	56	191,738	5	295					61	192,033	2	922	63	192,955
Tenth	New Orleans, La	179	408,473	36	6,263	5	5,961	2	7,394	222	428,091	15	87,486	237	515,577
	Galveston, Tex	112	426,538	10	19,932	1	945	21	27,576	144	474,991	2	20,945	146	495,936
	Mobile, Ala	92	370,214	19	14,431			7	10,151	118	394,796			118	394,796
	San Juan, P.R	11	29,346	6	400					17	29,746	15	102,272	32	132,018
	Tampa, Fla	16	45,721	15	717			1	2,117	32	48,555			32	48,555
Eleventh	Seattle, Wash	142	392,786	66	18,785			2	3,238	210	414,809	23	161,080	233	575,889
	Hoquiam, Wash	9	8,851	1	22					10	8,873			10	8,873
	Juneau, Alaska	5	437	29	4,298			2	2,179	36	6,914			36	6,914
	St. Michael, Alaska	6	2,520	7	285					13	2,805	3	2,750	16	5,555
	Total, 1933	3,903	8,954,614	1,264	602,836	16	10,319	276	312,395	5,459	9,880,164	296	3,609,218	5,755	13,489,382
	Total, 1932	4,086	8,679,637	1,214	620,090	16	10,281	286	311,319	5,602	9,621,327	317	3,877,629	5,919	13,498,956
	Increase (+) or decrease (−)	−183	+274,977	+50	−17,254		+38	−10	+1,076	−143	+258,837	−21	−268,411	−164	−9,574

VESSELS INSPECTED, BY GEOGRAPHIC DIVISIONS

Pacific coast	570	1,922,889	260	118,450	2	582	8	13,027	840	2,054,948	91	780,519	931	2,835,467
Atlantic coast	2,020	3,960,627	754	397,444	5	2,489	237	252,130	3,016	4,612,690	167	2,683,455	3,183	7,296,145
Western rivers	316	76,913	98	5,225	1	109			415	82,247			415	82,247
Great Lakes	598	1,743,239	72	40,374	2	233			672	1,783,846	21	36,813	693	1,820,659
Gulf coast	399	1,250,946	80	41,343	6	6,906	31	47,238	516	1,346,433	17	108,431	533	1,454,864
Total, 1933	3,903	8,954,614	1,264	602,836	16	10,319	276	312,395	5,459	9,880,164	296	3,609,218	5,755	13,489,382

MISCELLANEOUS INSPECTIONS

Statement of steam vessels granted letters of approval of designs of boilers, engines, and other operating machinery inspected under an act of Congress approved June 9, 1910, which vessels are not inspected annually, only one inspection being made for letter of approval; hulls of United States Government vessels inspected; and boilers in or for United States Government steamers and buildings, and for other United States governmental purposes.

Local inspection district (port)	Steam vessels granted letters of approval		Government vessels inspected	Government boilers inspected	Local inspection district (port)	Steam vessels granted letters of approval		Government vessels inspected	Government boilers inspected
	Number	Gross tonnage				Number	Gross tonnage		
San Francisco, Calif.				55	Point Pleasant, W.Va.				52
Honolulu, Hawaii				31	Detroit, Mich.				7
Los Angeles, Calif.				38	Chicago, Ill.			1	31
Portland, Oreg.				32	Duluth, Minn.			2	11
New York, N.Y.			6	138	Grand Haven, Mich.			1	11
Albany, N.Y.				14	Marquette, Mich.			1	13
New Haven, Conn.				7	Milwaukee, Wis.			7	35
Philadelphia, Pa.				68	Port Huron, Mich.	1	15		
Norfolk, Va.				64	Cleveland, Ohio			4	9
Baltimore, Md.			1	197	Buffalo, N.Y.			5	8
Charleston, S.C.				43	Oswego, N.Y.				11
Jacksonville, Fla.				16	Toledo, Ohio			1	6
Savannah, Ga.				42	New Orleans, La.			42	189
St. Louis, Mo.			4	181	Galveston, Tex.				86
Dubuque, Iowa				117	Mobile, Ala.			7	140
Boston, Mass.			5	46	San Juan, P.R.				3
New London, Conn.				10	Tampa, Fla.				11
Portland, Maine			2	16	Seattle, Wash.	2	98	1	29
Providence, R.I.				2	Juneau, Alaska			1	4
Louisville, Ky.				42					
Evansville, Ind.				49	Total, 1933	3	113	91	2,161
Memphis, Tenn.				75	Total, 1932	8	222	72	2,225
Nashville, Tenn.				38					
Pittsburgh, Pa.				67	Increase (+) or decrease (−)	−5	−109	+19	−64
Cincinnati, Ohio				117					

REINSPECTIONS

Local inspection district (port)	Steam vessels	Motor vessels	Barges, etc.	Total	Local inspection district (port)	Steam vessels	Motor vessels	Barges, etc.	Total
San Francisco, Calif.	262	134		396	Detroit, Mich.	76	15		91
Los Angeles, Calif.	20	11		31	Chicago, Ill.	37	5		42
Portland, Oreg.	14	9		23	Duluth, Minn.	15			15
New York, N.Y.	907	274	5	1,186	Grand Haven, Mich.	47	3		50
Albany, N.Y.	48	26		74	Marquette, Mich.	22	2		24
New Haven, Conn.	13	48		61	Milwaukee, Wis.	50	9		59
Philadelphia, Pa.	184	27		211	Port Huron, Mich.	8	21		29
Norfolk, Va.	65	8	1	74	Cleveland, Ohio	9			9
Baltimore, Md.	58	5		63	Buffalo, N.Y.	38		4	42
Charleston, S.C.		2		2	Oswego, N.Y.	18	25		43
Jacksonville, Fla.	23	81		104	Toledo, Ohio	13	4		17
Savannah, Ga.	27	18		45	New Orleans, La.	119	46	12	177
St. Louis, Mo.	7	1		8	Galveston, Tex.	6	15	3	24
Dubuque, Iowa	13			13	Mobile, Ala.	10	2		12
Boston, Mass.	125			125	San Juan, P.R.	3			3
Bangor, Maine	19	4	4	27	Tampa, Fla.	9	3		12
New London, Conn.	12	21		33	Seattle, Wash.	106	77		183
Portland, Maine	111	9		120	Juneau, Alaska	1	9		10
Providence, R.I.	38	6		44					
Louisville, Ky.	2			2	Total, 1933	2,588	920	29	3,537
Memphis, Tenn.	4			4	Total, 1932	3,030	927	25	3,982
Nashville, Tenn.	1			1					
Pittsburgh, Pa.	7			7	Increase (+) or decrease (−)	−442	−7	+4	−445
Cincinnati, Ohio	31			31					
Pt. Pleasant, W.Va.	10			10					

CERTIFICATES WITHDRAWN OR REFUSED

Vessels from which certificates of inspection were withdrawn	10
Vessels refused certificates of inspection:	
Domestic steam vessels	62
Domestic vessels propelled by gas, fluid, naphtha, or electric motor	13
Domestic seagoing barges of 100 gross tons or over	1
Foreign steam vessels	4
Total	90

CARGO VESSELS EXAMINED TO CARRY PERSONS IN ADDITION TO CREW

During the year ended June 30, 1933, 1,608 cargo vessels were examined to carry persons in addition to crew, under the provisions of the act of Congress approved June 5, 1920.

NEW LIFE PRESERVERS INSPECTED

Kind	Inspected	Passed	Rejected
Block cork	92,308	91,998	310
Balsa block	5,635	5,619	16
Kapok	3,978	3,962	16
Total, 1933	101,921	101,579	342
Total, 1932	117,416	116,019	1,397
Decrease	15,495	14,440	1,055

LIFE-SAVING APPARATUS INSPECTED AT FACTORIES

Kind	Inspected	Passed	Rejected
New cork-ring life buoys	3,868	3,861	7
New balsa wood life buoys	97	87	10
New lifeboats	229	229	----
New life rafts	102	102	----
New boat davits	37	37	----

WORK PERFORMED BY INSPECTORS IN CENTRAL OFFICE

Vessels inclined	114
Reinspections of vessels	164

BOILERS

Boilers inspected:	
Steel (riveted plates)	7,252
Iron (riveted plates)	33
Pipe	1,836
Total	9,121
Boilers found defective:	
Gave way under hydrostatic pressure:	
Steel (riveted plates)	162
Iron (riveted plates)	2
Pipe	3
Total	167

BOILERS—Continued

Boilers found defective—Continued.	
Defective from other causes:	
Steel (riveted plates)	1,234
Iron (riveted plates)	13
Pipe	68
Total	1,315
Boilers condemned from further use	14
Defects in boilers and attachments:	
Sheets	752
Heads	252
Steam and mud drums	129
Flues and tubes	44,731
Steam pipes	168
Stay bolts	15,497
Braces	668
Other parts	8,940
Total	71,137

MARINE BOILER PLATES TESTED

Inspected by assistant inspector at—	Plates rejected because of—							Total		
	Tensile strength	Surface defect	Light gage	Heavy gage	Lost	Lamination	Elongation	Rejected	Inspected	Accepted
Coatesville, Pa.	1	5						6	218	212
Philadelphia, Pa.							1	1	45	44
Pittsburgh, Pa.		2						2	28	26
Chicago, Ill.	2					1		3	24	21
Cleveland, Ohio									44	44
Total, 1933	3	7				1	1	12	359	347
Total, 1932	2	7	1	18	1	3		32	609	577
Increase (+) or decrease (−)	+1		−1	−18	−1	−2	+1	−20	−250	−230

STEEL BARS AND FORGINGS TESTED

Tested by assistant inspector at—	Samples of bars		Samples of forgings		Bars		Forgings	
	Tested	Rejected	Tested	Rejected	Accepted	Rejected	Accepted	Rejected
Coatesville, Pa.	8		8		4		4	
Pittsburgh, Pa.	8				134			
Cleveland, Ohio	2				182			
Buffalo, N.Y.	4				3			
Total, 1933	22		8		323		4	

STATISTICS CONCERNING SHIPS' PERSONNEL

OFFICERS LICENSED

Local district	Steam and motor vessels					Steam vessels		Motor vessels		Sail vessels of over 700 gross tons		Masters of barges of over 100 gross tons	Total
	Masters	Mates		First-class pilots	Second-class and special pilots	Chief engineers	Assistant and special engineers	Engineers	Operators	Masters	Chief mates		
		Ocean	Inland										
San Francisco, Calif.	435	186	40	7	5	406	270	210	707	49	----	----	2,315
Honolulu, Hawaii	11	11	----	----	----	10	9	13	63	1	----	----	118
Los Angeles, Calif.	122	69	2	1	5	120	57	78	475	19	----	----	948
Portland, Oreg.	72	14	12	2	2	70	31	38	203	5	1	----	450
New York, N.Y.	1,117	374	36	96	7	1,351	583	316	1,477	52	2	1	5,412
Albany, N.Y.	63	1	12	29	7	107	4	33	44	----	----	----	300
New Haven, Conn.	33	6	2	11	2	32	4	11	155	1	----	----	257
Philadelphia, Pa.	206	117	8	18	9	271	120	73	693	17	----	----	1,532
Norfolk, Va.	127	16	2	28	18	168	42	43	384	7	----	----	835
Baltimore, Md.	165	78	10	22	14	211	85	47	614	9	----	----	1,255
Charleston, S.C.	25	2	----	5	6	39	8	10	131	1	----	----	227
Jacksonville, Fla.	71	49	5	12	4	66	57	55	487	7	1	----	814
Savannah, Ga.	23	15	5	6	----	43	15	13	72	2	----	----	194
St. Louis, Mo.	36	3	24	29	----	75	12	15	333	----	----	----	527
Dubuque, Iowa	16	----	4	12	----	44	5	5	122	----	----	1	209
Boston, Mass.	176	129	8	14	7	193	116	33	410	21	----	----	1,107
Bangor, Maine	23	4	3	----	2	36	5	12	116	1	----	----	202
New London, Conn.	30	7	2	4	2	52	9	20	186	2	----	----	314
Portland, Maine	40	23	1	3	5	66	10	7	156	9	----	----	320
Providence, R.I.	60	12	1	7	6	59	15	11	119	5	----	----	295
Louisville, Ky.	8	----	5	10	----	26	4	6	54	----	----	----	113
Evansville, Ind.	13	----	7	4	1	17	2	4	95	----	----	----	143
Memphis, Tenn.	16	----	7	9	1	48	4	----	101	----	----	----	186
Nashville, Tenn.	11	----	8	15	----	26	7	3	60	----	----	----	130
Pittsburgh, Pa.	61	----	19	3	----	56	12	2	117	----	----	----	270
Cincinnati, Ohio	25	----	11	10	----	36	4	5	50	----	----	----	141
Point Pleasant, W.Va.	16	----	6	11	----	24	4	3	77	----	----	1	142
Detroit, Mich.	62	2	----	25	2	102	34	10	93	----	----	----	330
Chicago, Ill.	49	8	1	18	1	70	23	12	562	1	----	----	745
Duluth, Minn.	18	----	----	13	3	30	7	2	14	----	----	----	87
Grand Haven, Mich.	23	----	----	11	4	54	20	4	92	----	----	----	208
Marquette, Mich.	19	1	----	9	7	22	7	1	61	----	----	----	127
Milwaukee, Wis.	46	2	----	16	3	79	27	10	59	----	----	----	242
Port Huron, Mich.	48	----	----	14	1	61	26	1	33	1	----	----	185
Cleveland, Ohio	70	3	----	45	2	153	48	10	106	1	----	----	438
Buffalo, N.Y.	59	2	----	36	7	118	43	12	131	----	----	----	408
Oswego, N.Y.	24	----	----	17	6	42	9	7	158	----	----	----	263
Toledo, Ohio	23	3	----	20	----	51	14	4	61	----	----	----	176
New Orleans, La.	217	76	24	35	34	285	123	91	207	14	1	1	1,108
Galveston, Tex.	113	44	----	10	5	138	39	32	253	7	----	----	641
Mobile, Ala.	77	17	3	13	6	93	26	15	149	5	----	----	404
San Juan, P.R.	10	2	----	----	2	8	10	7	38	1	----	----	78
Tampa, Fla.	26	11	2	4	5	36	26	26	301	8	----	----	445
Seattle, Wash.	185	73	42	----	7	230	68	101	297	19	2	----	1,024
Hoquiam, Wash.	7	4	6	----	1	12	4	4	7	1	----	----	46
Juneau, Alaska	18	4	4	----	10	16	4	29	227	1	----	----	313
St. Michael, Alaska	8	----	3	1	1	5	----	1	45	----	----	----	64
Total, 1933	4,103	1,368	325	655	210	5,257	2,052	1,445	10,395	267	7	4	26,088
Total, 1932	4,082	1,438	339	686	217	4,871	2,186	1,478	9,802	244	7	3	25,353
Increase (+) or decrease (−)	+21	−70	−14	−31	−7	+386	−134	−33	+593	+23	----	+1	+735

RESULTS OF ACTION AGAINST LICENSES

	Page
Licenses suspended	182
Licenses revoked	12
Licenses refused	121
Licenses canceled	29
Violations of the law:	
Cases investigated	789
Cases dismissed	622
Cases reported to district attorneys and chief officers of customs	104
Number of appeals from decisions of local boards	21
Decisions of local boards reversed by supervising inspectors	6
Decisions of local boards modified by supervising inspectors	2
Decisions of local boards sustained by supervising inspectors	13

EXAMINATIONS FOR COLOR BLINDNESS

During the year ended June 30, 1933, 6,814 applicants for original licenses and for renewals of licenses were examined for visual defects, 47 of whom were found color-blind, or had other visual defects, and were rejected, and 6,767 were passed. As compared with the previous year, these figures show a decrease of 243 in the number examined and of 236 in the number passed.

CERTIFICATES OF SERVICE ISSUED TO ABLE SEAMEN AND TO LIFEBOAT MEN

ABLE SEAMEN

Issued by—	Applications received	Applications rejected	Certificates issued	Issued by—	Applications received	Applications rejected	Certificates issued
INSPECTION DISTRICT				INSPECTION DISTRICT—con.			
San Francisco, Calif.	411	38	373	Marquette, Mich.	7	1	6
Honolulu, Hawaii	51	3	48	Milwaukee, Wis.	50	----	50
Los Angeles, Calif.	150	12	138	Port Huron, Mich.	27	7	20
Portland, Oreg.	56	11	45	Cleveland, Ohio	99	8	91
New York, N.Y.	935	34	901	Buffalo, N.Y.	76	6	70
New Haven, Conn.	7	----	7	Oswego, N.Y.	4	2	2
Philadelphia, Pa.	257	16	241	Toledo, Ohio	42	2	40
Norfolk, Va.	117	8	109	New Orleans, La.	211	4	207
Baltimore, Md.	346	43	303	Galveston, Tex.	108	9	99
Charleston, S.C.	10	----	10	Mobile, Ala.	91	10	81
Jacksonville, Fla.	122	12	110	San Juan, P.R.	13	1	12
Savannah, Ga.	48	2	46	Tampa, Fla.	54	3	51
St. Louis, Mo.	2	----	2	Seattle, Wash.	207	4	203
Boston, Mass.	261	5	256	Hoquiam, Wash.	2	----	2
Bangor, Maine	11	----	11	Juneau, Alaska	29	1	28
New London, Conn.	15	----	15	St. Michael, Alaska	6	----	6
Portland, Maine	37	2	35				
Providence, R.I.	73	10	63	Total, 1933	4,125	276	3,849
Detroit, Mich.	80	11	69	Total, 1932	5,058	391	4,667
Chicago, Ill.	60	5	55				
Duluth, Minn.	26	2	24	Decrease	933	115	818
Grand Haven, Mich.	24	4	20				

LIFEBOAT MEN

Issued by—	Applications received	Applications rejected	Certificates issued
Local inspectors of vessels:			
San Francisco, Calif.	107	------	107
Los Angeles, Calif.	36	------	36
Portland, Oreg.	17	------	17
New York, N.Y.	247	------	247
Albany, N.Y.	6	------	6
New Haven, Conn.	3	------	3
Philadelphia, Pa.	39	------	39
Norfolk, Va.	30	------	30
Baltimore, Md.	165	------	165
Jacksonville, Fla.	292	------	292
Savannah, Ga.	65	------	65
St. Louis, Mo.	1	------	1
Boston, Mass.	357	------	357
Bangor, Maine	9	------	9
New London, Conn.	40	------	40
Portland, Maine	61	------	61
Providence, R.I.	191	------	191
Detroit, Mich.	33	------	33
Chicago, Ill.	2	------	2
Duluth, Minn.	3	------	3
Grand Haven, Mich.	2	------	2
Milwaukee, Wis.	6	------	6
Port Huron, Mich.	1	------	1
Cleveland, Ohio	8	------	8
Buffalo, N.Y.	12	------	12
Toledo, Ohio	4	------	4
New Orleans, La.	222	1	221
Galveston, Tex.	20	------	20
Mobile, Ala.	7	------	7
San Juan, P.R.	4	------	4
Tampa, Fla.	17	------	17
Local inspectors of vessels—Continued.			
Seattle, Wash.	2,786	1,572	1,214
Hoquiam, Wash.	11	------	11
Juneau, Alaska	128	7	121
St. Michael, Alaska	5	------	5
Total by local inspectors.	4,937	1,580	3,357
Navy Department: Navy yards:			
New York, N.Y.	283	21	262
Portsmouth, Va.	108	12	96
Receiving station, Philadelphia, Pa.	145	6	139
U.S. Coast Guard, Treasury Department	3,828	1,359	2,469
Coast and Geodetic Survey, Department of Commerce	13	------	13
Bureau of Lighthouses, Department of Commerce	637	120	517
Massachusetts nautical school ship *Nantucket*	67	------	67
California nautical school ship *California State*	27	------	27
New York State Merchant Marine Academy	41	------	41
Total, 1933	10,086	3,098	6,988
Total, 1932	13,823	6,297	7,526
Decrease	3,737	3,199	538

TRANSPORTATION AND LOSS OF LIFE

PASSENGERS CARRIED

During the fiscal year 238,750,264 passengers were carried on vessels that are required by law to report the number of passengers carried. Dividing this number by 130, the total number of passengers lost, shows that 1,836,540 passengers were carried for each one lost.

LIVES SAVED

During the year, 383 lives were directly saved by means of the life-saving appliances required by law.

LIVES LOST ON VESSELS SUBJECT TO INSPECTION, BY DISTRICTS

Cause	First		Second		Third		Fourth		Fifth		Sixth	
	Passengers	Crew	Passengers	Crew	Passengers	Crew	Passengers	Crew	Passengers	Crew	Passengers	Crew
Fire:												
Passenger steamers				1								
Nonpassenger steamers												
Collision: Nonpassenger steamers				1		2						
Explosion, escape of steam, etc.:						3						
Passenger steamers			68	3								
Nonpassenger steamers				1		1						
Sinking: Nonpassenger steamers:				4								2
Wreck: Nonpassenger steamers		34										
Accidental drowning:												
Passenger steamers				2								
Nonpassenger steamers		1		3				3				1
Suicide:												
Passenger steamers	10		14	1	4				3			
Nonpassenger steamers		1		3		1				2		
Miscellaneous:												
Passenger steamers	4	5	7	3					1	2		
Nonpassenger steamers		7		5		4				2		
Total:												
Passenger steamers	14	5	89	10	4				4	2		
Nonpassenger steamers		43		17		11		3		4		3
Grand total	14	48	89	27	4	11		3	4	6		3
Last year	12	13	22	35	6	12			6	10	1	1
Increase (+) or decrease (−)	+2	+35	+67	−8	−2	−1		+3	−2	−4	−1	+2

Cause	Seventh		Eighth		Ninth		Tenth		Eleventh		Total	
	Passengers	Crew	Passengers	Crew	Passengers	Crew	Passengers	Crew	Passengers	Crew	Passengers	Crew
Fire:												
Passenger steamers												1
Nonpassenger steamers												2
Collision: Nonpassenger steamers												4
Explosion, escape of steam, etc.:												
Passenger steamers											68	3
Nonpassenger steamers												2
Sinking: Nonpassenger steamers								5				11
Wreck: Nonpassenger steamers												34
Accidental drowning:												
Passenger steamers	4									1	4	3
Nonpassenger steamers		2		1				3				14
Suicide:												
Passenger steamers			7				3		1		42	1
Nonpassenger steamers												7
Miscellaneous:												
Passenger steamers	1		2						1		16	10
Nonpassenger steamers				1		2		6		1		28
Total:												
Passenger steamers	5		9				3		2	1	130	18
Nonpassenger steamers		2		2		2		14		1		102
Grand total	5	2	9	2		2	3	14	2	2	130	120
Last year		2		4	1	6	7	10		1	55	94
Increase (+) or decrease (−)	+5		+9	−2	−1	−4	−4	+4	+2	+1	+75	+26

The total number of lives lost from all causes, passengers and crew, was 250, an increase of 101 over the previous year. Of the lives lost, 125 were from suicide, accidental drowning, and other causes beyond the power of the service to prevent, leaving a loss of

125 fairly chargeable to accidents, collision, sinking, explosion, wreck, etc.

ACCIDENTS RESULTING IN LOSS OF LIFE

The total number of accidents resulting in loss of life during the past year was 11.

The following disasters resulted in an unusual loss of life:

On the morning of September 9, 1932, at about 8 a.m., the inland passenger steamer *Observation*, of 122 gross tons, left her dock in the vicinity of the foot of East One hundred and thirty-fifth Street, East River, New York City, bound for Rikers Island, N.Y. Very shortly after casting off lines an explosion occurred on board, which totally destroyed the vessel and resulted in the loss of 68 passengers and 3 members of the crew.

At about 8 p.m. on September 27, 1932, the freight steamer *Nevada*, of 5,645 gross tons, while en route from Portland, Oreg., to the Orient, was wrecked on a rock off Amatignak Island, Aleutian Islands, claiming 34 lives, all hands with the exception of three members of the crew being lost. Estimated loss to vessel and cargo, $305,000.

VESSELS LOST

Steam vessels	27
Motor vessels	9
Sail vessels	1
Barges, etc	11
Total	48

PROPERTY LOST

By explosion or accidental escape of steam	$508,800
By wreck or founder	1,031,623
By collision	1,322,204
By fire	22,548,826
By snags	96,042
From miscellaneous causes	1,480,754
Total	26,988,249

SHIPPING COMMISSIONERS

During the year 476,615 seamen were shipped, reshipped, and discharged as compared with 515,051 the year before. The average cost to the Government per man was 26 cents.

Collectors of customs acting at ports where shipping commissioner offices have not been established, shipped and discharged during the year 20,438 officers and men as compared with 20,196 during the previous year.

Of the 254,887 men shipped before shipping commissioners, 148,274 were native Americans and 50,795 were naturalized Americans—199,069 in all, or 78.1 percent.

In addition to these numbers there are shipped in the foreign trade for the round voyage many seamen who do not appear before our shipping commissioners. These numbers are not included in the above figures.

The following table shows the aggregate work and salaries of the shipping service for the past 14 years:

Year	Seamen shipped, reshipped, and discharged	Salaries	Average cost per man	Year	Seamen shipped, reshipped, and discharged	Salaries	Average cost per man
1920	628,980	$89,949	$0.13	1927	561,061	$122,398	$0.22
1921	650,840	99,646	.15	1928	547,732	123,961	.23
1922	541,952	92,318	.17	1929	627,392	139,454	.22
1923	538,755	94,476	.17	1930	650,673	147,873	.23
1924	555,633	94,476	.17	1931	589,901	152,003	.26
1925	552,124	123,726	.22	1932	515,051	158,616	.31
1926	534,493	123,183	.23	1933	476,615	124,305	.26

The shipping commissioner service furnishes the medium through which voluminous laws for the protection, welfare, and discipline of American seamen are effectuated. In order that no advantage may be taken of the seaman and also that he may understand his responsibilities, his contract of employment is supervised by our shipping commissioners and where there are any unusual provisions because of the nature of the voyage or of the cargo carried, those provisions are explained to him in detail.

Any disputes which may arise during the voyage may be arbitrated before the shipping commissioner without cost to the seaman and without delay. Under the law the shipping commissioner's decision is final as to the facts.

For the benefit of dependents the shipping commissioner issues allotment notes payable to such dependents from the seamen's wages as earned. In case of death of the seaman his wages and effects are taken care of by the shipping commissioner.

This is a beneficent service as it insures to the seamen the benefits of the laws which Congress has passed in their behalf.

ADMEASUREMENT OF VESSELS

The measurement of vessels through marine divisions of the customhouses proceeded throughout the year with the usual activity. About 1,200 vessels aggregating 241,713 gross tons were admeasured for documentation. The plans and blueprints of the principal vessels were checked in the Washington office for the purpose of securing uniformity and the technically correct application of the law.

This service is still handicapped through the performance of the work which is of a highly technical character, through the employees of another department, many of whom are not sufficiently trained in the methods of mathematical and geometric calculations necessary to the work.

LOAD LINES

The enforcement of the load line act of March 2, 1929, has been actively prosecuted through the marine divisions of the customhouses, with the result that there is now a reasonable compliance with the law by vessels of the United States and foreign vessels

leaving our ports in the foreign trade; 14,877 inspections were made at the time of clearance and but 144 violations of the law, technical or otherwise, were discovered.

During the year 880 load-line certificates on the international form were issued to our vessels to conform with the international load-line convention. During the same period negotiations have been carried on with Canada with a view to the exemption of vessels from the requirements of the load line while navigating sheltered waters on the northwest coast of North America, as authorized by Senate Resolution 265, second session, Seventy-first Congress.

NAVIGATION PATROL SERVICE

The Bureau's patrol fleet of five vessels covering the larger portion of the Atlantic and Gulf coasts and the Great Lakes has been actively engaged during the year not only in securing the enforcement of the life-protection laws on small motor vessels, but also in inspecting larger vessels to see that their equipment and manning are in accord with their certificates of inspection.

Supervision also has been exercised over the fleets of oyster and fishing vessels to gain assurance that the crews receive their wages, have proper quarters, food, and treatment to which they are entitled by law.

Through the imposition of fines, penalties, and forfeitures, this service is nearly self-supporting, and through cooperation with motor-boat owners, associations, yacht clubs, etc., a reasonable compliance with the law is maintained without the imposition of unnecessary hardships.

Of the 9,152 violations reported, 5,375 were discovered by the various patrol boats, an increase of 1,642 cases. Record of the work of these vessels, however, is better shown by the fact that during the year they made 32,003 inspections.

The following is a comparative statement of cases of violations of the navigation laws, 1919–33:

Port	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
Baltimore	500	633	699	482	480	419	161	300	361	551	517	746	584	471	485
Boston	243	626	607	898	711	566	767	800	833	513	534	441	509	693	250
Bridgeport	95	97	200	50	287	131	206	131	310	231	199	182	163	63	165
Buffalo	168	143	188	62	116	262	90	24	34	257	103	43	83	24	21
Charleston	109	40	44	68	192	136	105	82	110	82	57	68	49	52	45
Chicago	88	119	171	97	179	165	139	76	97	30	68	49	37	24	123
Cleveland	499	1,096	252	160	154	303	187	97	84	168	144	172	167	180	83
Des Moines	27	40	141	32	62	48	11			3					
Detroit	142	122	168	67	184	311	80	83	184	182	202	234	185	191	174
Duluth	282	241	73	68	245	79	44	42	38	33	46	30	27	20	3
Eagle Pass															
Galveston	21	24	41	8	10	167	78	57	26	31	14	32	39	65	15
Great Falls						3					1				
Honolulu	10	3	95	35	22	16	45	10	12	18	14	32	15	35	68
Indianapolis	32	34	29	37	3	2	4		7	4	8	12	4	4	2
Juneau	43	39	60	36	77	130	106	78	51	45	55	58	47	71	52
Los Angeles	192	125	183	185	178	131	127	171	261	281	405	336	400	237	278
Louisville	49	64	35	57	29	26	28	54	35	18	44	8	9	15	49
Memphis	67	83	66	86	62	162	150	154	120	49	81	35	48	54	87
Milwaukee	81	133	33	14	79	17	5	7	104	1	25	26	9	2	28
Mobile	98	122	301	203	334	234	191	96	263	42	186	76	95	269	171
New Orleans	501	487	779	294	467	790	371	411	186	285	226	217	187	937	755
New York	626	1,349	849	2,698	1,475	663	1,625	2,454	1,185	1,170	1,233	951	828	589	2,598
Nogales		8	21	13		7	12	10	14	3	9	2		5	
Norfolk	814	618	846	680	682	412	375	842	434	345	354	448	228	214	335
Ogdensburg	54	18	8	85	85	18	112	58	142	50	87	36	28	21	9
Omaha			1							2	2				

Port	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
Pembina											1	1		1	
Philadelphia	532	600	684	778	624	360	854	549	303	493	466	568	511	340	498
Pittsburgh	9	28	16	22	14	41	35	16	53	39	43	23	9	21	13
Port Arthur	203	256	112	21	17	216	84	52	15	61	29	24	26	13	120
Portland, Maine	53	55	320	346	440	295	393	684	159	645	337	264	315	370	50
Portland, Oreg	120	182	107	83	101	171	291	237	84	100	125	86	129	118	87
Providence	65	137	175	181	98	94	144	169	217	104	113	103	47	151	16
Rochester	14	24	55	10	61	57	53	18	24	130	34	75	86	37	34
St. Albans	1	1	3	96	2		4	4	22			41	170		1
St. Louis	291	396	182	173	179	127	89	100	64	57	46	9	6	4	4
St. Paul	4							1					2	11	
San Antonio	2	7	9	10	25	23	28	15	8	9	34	16	72	44	46
San Diego		1	22	34	32								22	30	9
San Francisco	223	765	466	213	291	288	284	281	238	277	227	327	232	252	202
San Juan	8	14	10	14	19	18	26	25	22	23	25	10	23	15	17
Savannah	77	68	149	165	163	126	126	67	47	60	95	105	91	90	84
Seattle	266	320	310	272	1,223	294	564	755	328	360	290	336	581	1,176	450
Tampa	1,303	1,247	1,770	2,300	1,649	1,386	1,398	1,690	1,519	1,609	1,075	977	928	1,037	1,688
Wilmington, N.C.	261	302	426	263	200	173	152	78	312	282	333	218	196	116	37
Total	8,173	10,667	10,706	11,396	11,251	8,867	9,544	10,778	8,306	8,643	7,887	7,417	7,187	8,062	9,152

PREVENTING OVERCROWDING OF PASSENGER VESSELS

The service of preventing the overcrowding of passenger vessels at 22 of the principal ports of the country was effective. Owing to present conditions there was a material falling off in the number of excursionists, that number having dropped from 5,021,788 in 1932 to 3,979,084 in 1933.

The following table shows the counts made by the navigation and customs services by ports:

Port	Navigation		Customs		Total	
	Counts	Passengers	Counts	Passengers	Counts	Passengers
Baltimore	1,762	542,933			1,762	542,933
Boston	35	28,123	302	217,596	337	245,719
Bridgeport			1	367	1	367
Buffalo			1,056	462,374	1,056	462,374
Chicago	1,595	250,892	31	20,465	1,626	271,357
Cleveland	329	312,390	42	22,919	371	335,309
Detroit	514	464,900	1	1,829	515	466,729
Duluth	70	17,729			70	17,729
Galveston			10	1,284	10	1,284
Indianapolis	6	1,128			6	1,128
Los Angeles	4	3,785			4	3,785
Louisville	81	21,886			81	21,886
Mobile	130	5,803			130	5,803
New York			899	1,358,959	899	1,358,959
Norfolk	497	48,762	9	3,181	506	51,943
Philadelphia			74	50,777	74	50,777
Portland, Maine	158	22,174			158	22,174
Portland, Oreg	8	1,277			8	1,277
Providence	97	39,350			97	39,350
Rochester	35	6,114			35	6,114
San Francisco	4	872	655	25,652	659	26,524
Seattle	443	37,978	498	7,585	941	45,563
Total, 1933	5,768	1,806,096	3,578	2,172,988	9,346	3,979,064

There are few violations of the law in connection with the overcrowding of passenger steamers for the reason that our inspectors prevent additional passengers going on board when the limit of safety has been reached.

On 381 occasions the inspectors prevented additional passengers from going on board, involving the safety of 170,021 such passengers. The following table shows in detail, by ports, these shut-offs:

	July 1932		August 1932		September 1932		October 1932		February 1933		June 1933		Total	
	Counts	Passengers	Counts	Passengers	Counts	Passengers	Counts	Passengers	Counts	Passengers	Counts	Passengers	Counts	Passengers
Baltimore	4	4,500	2	2,600							3	4,100	9	11,200
Boston	18	24,241	18	24,334									36	48,575
Buffalo			2	5,900									2	5,900
Chicago	8	8,625	7	9,872							2	567	17	19,064
Detroit	5	16,537	4	12,515							1	3,000	10	32,052
Cleveland	2	566	8	22,400	2	3,200							12	26,166
Duluth			2	2,080									2	2,080
New York	3	242	2	1,520							36	4,155	41	5,917
Norfolk	1	685	6	1,926									7	2,611
Portland, Maine	3	7,200											3	7,200
Providence	6	158											6	158
San Francisco							1	65	45	3,874			46	3,939
Seattle	2	623	187	4,311	1	225							190	5,159
Total, 1933	52	63,377	238	87,458	3	3,425	1	65	45	3,874	42	11,822	381	170,021

PASSENGER ACT OF 1882

The enforcement of this law through the marine divisions of the customhouses has affected 1,062 voyages involving 182,662 steerage passengers. The purpose of the act is to provide for the welfare, health conditions, food, separation of the sexes, and care in case of sickness of future citizens of our country.

APPROPRIATIONS

The following is a statement of the appropriations to the Bureau for 1933, segregated by services:

Salaries, departmental	$100,000
Admeasurement of vessels	4,000
Enforcement navigation laws	100,000
Preventing overcrowding passenger vessels	15,000
Shipping commissioner service	144,100
Load lines on American vessels	19,440
Steamboat inspectors	833,625
Clerk hire, steamboat inspection	150,000
Contingent expenses	110,000
Total	1,476,165

NAVIGATION RECEIPTS

During the year the Bureau has collected through tonnage duties, navigation fees, and navigation fines $1,639,395.17. The following table shows these collections in detail:

June 30—	Tonnage duties	Navigation fees	Navigation fines	Total
1933	$1,418,774.87	$169,121.32	$51,498.98	$1,639,395.17
1932	1,601,226.43	188,975.96	57,823.11	1,848,025.50
1917	1,393,743.16	159,808.03	49,962.37	1,603,513.56

PATENT OFFICE

The year 1929, notable for its unprecedented business and commercial activity, witnessed the filing of a record-breaking number of patent applications. In the 12 months ended June 30, 1930, an aggregate of 91,430 patent applications and the staggering total of 117,790 applications of all forms were filed. The succeeding years have been featured by a recession in business and industry and this has been accompanied by a corresponding decrease in patent and other applications, culminating in the year just closed in the filing of 59,408 patent applications and a total of 79,822 for all applications. The Patent Office has not witnessed such a low ebb in new business since 1908 when only 58,527 patent applications were filed.

DOWNWARD TREND HALTED

In spite of a marked decrease in the volume of new work presented to the office, the number of patents actually issued was comparatively large, namely, 50,766. This total is the highest in the history of the Patent Office with the single exception of that reached in the preceding year, when 52,572 patents were granted. The issued patents attained this high level as the result of the increase in personnel, examining and clerical, in 1932 which, owing to the decline in new work, could devote more time to winding up old cases. There is evidence that the decline which began several years ago has ceased, the last 6 months of the fiscal year showing a slight upward trend. It should be noted also that the issuance of patents and registration of trade marks have undergone little decrease compared with 1932, and none at all in comparison with 1929, the last year before the industrial recession. Patents on plants and designs were more numerous in 1933 than in 1932. In the case of design patents the increase was from 2,728 in 1932 to 2,934 in 1933.

The decrease in the volume of business in 1932 did not find a comparative reflection in the annual receipts, which totaled $4,423,563.18, a decrease of approximately $141,000 from those of the fiscal year ended June 1931, which so far as receipts are concerned, was the banner year enjoyed by the Patent Office. The high total of receipts in 1932, notwithstanding a substantial recession in the volume of new business, may be attributed, first, to the increase in the filing fee and the final fee from $25 to $30, which rates were in force for a complete fiscal year for the first time, and secondly, to the large number of patents actually issued.

On June 30, 49,050 patent applications were awaiting action as compared with 76,723 on the same date of the preceding year, a reduction of 27,673 (36 percent). The reduction in the number of applications awaiting official action has greatly reduced the time during

which applicants must wait for official actions in the individual cases.

As contrasted with conditions existing a year ago, there are now 4 rather than 2 examining divisions under 2 months, 20 rather than 8 under 3 months, and 40 rather than 28 under 4 months. Thirty-seven divisions then operating 5 months behind have now been brought within the 4-month period. This is an accomplishment which merits comment because it represents progress not wholly attributable to the decrease in volume of business, for the gain has been made with a personnel greatly reduced from that of the preceding year. Because of the restrictions placed upon the filling of vacancies resulting from resignations, retirements, and deaths, the office operated during the past year with an average of 29 vacancies in the examining corps, 30 vacancies in the clerical force, and one on the Board of Appeals.

The Board of Appeals continued to make progress in reducing the number of pending appeal cases. Appeals awaiting action at the end of the fiscal year numbered 1,283, as compared to 2,120 at the close of the previous year. An aggregate of 2,994 appeals were decided by the Board during the year. The oldest ex parte appeal awaiting decision was filed on June 7, 1933, and the oldest interference appeal was lodged on June 9, 1933.

The divisions handling patents on designs, trade marks, labels, and prints have kept up-to-date in a gratifying manner, both the new and amended work being within a month, which is practically current.

WORK IMPEDED BY VACANCIES

To satisfy the universal demand of inventors and industry for greater promptness in acting upon patent applications, the constant endeavor of the Patent Office should be to bring its work into such condition that patent applications, both amended and new, may be acted upon within 60 days. Unless this is accomplished during the period in which work is at a comparatively low ebb, as it is at present, the desired result may never be attained. While every effort will be put forth to increase the efficiency and output of the personnel so that gains may continue, it nevertheless would seem advisable to fill some of the existing vacancies in the force so that the patent work may be brought within the desired 60-day period before the expected revival of business again floods the office with new work.

The closing year resulted in a deficit of approximately $165,000 as compared with a deficit of $827,000 for the preceding year. Economies have been effected which are calculated to extinguish this deficit during the present year and thus once more place the Patent Office on a self-supporting basis. When, and only if, this is accomplished, a reduction in fees will be favored, an objective which has many ardent supporters in the professional and industrial fields.

SPECIAL COMMITTEE AT WORK

During the summer a committee of representative lawyers selected from various sections of the country was appointed by the Department to make a thorough study of conditions in the Patent Office and, as a result of its investigation, to make appropriate recommenda-

tions as to changes or modifications of the patent law, and respecting procedure and practices in the Patent Office, in order to increase efficiency of operation, to remedy certain abuses, and to remove causes of complaint and dissatisfaction. This committee is composed of Loyd H. Sutton, Esq., chairman, Washington, D.C.; George Ramsey, Esq., New York City; John A. Dienner, Esq., Chicago, Ill.; August B. Stoughton, Esq., Philadelphia, Pa.; Justin W. Macklin, Esq., Cleveland, Ohio; John W. Townsend, Esq., Washington, D.C.; Capt. R. S. Patton, Director United States Coast and Geodetic Survey, Washington, D.C.; and J. H. Lightfoot, supervisory examiner United States Patent Office.

The committee has communicated with and invited suggestions from the patent law associations, individual members of the patent bar, and the leading manufacturing and engineering organizations interested in the Patent Office and the patent system. It is hoped and believed that the work which the committee has undertaken with admirable energy and conscientious application will eventuate in such needed reforms and revisions in the practice as will enable the Patent Office to perform its duties more expeditiously and capably than has been possible under the existing procedure, which in many instances was adopted years ago and has long since become obsolete.

While the final report of the committee may not be expected for several months, because of the vastness of its task and the multitude of suggestions to be considered, it has already submitted, in the form of a preliminary report, three definite and worthy recommendations.

SPECIAL COMMITTEE'S RECOMMENDATIONS

The first of these recommendations was that the authority and duties of the supervisory examiners should be enlarged so as more effectively to coordinate and unify the procedure and action in the several examining divisions and to expedite the flow of cases through the office.

The second recommendation contemplates the establishment and maintenance of an adequate classification division to carry out in spirit, as well as in letter, the act of June 10, 1898, and pursuant to the program of classification announced in 1912 by the President's Committee on Economy and Efficiency.

The cost of reclassification may be regarded as a permanent capital expenditure which will be productive of future efficiency and economy.

The patent statutes expressly charge the Commissioner of Patents with the duty of revising and perfecting classification of patents and publications. Since the passage of the Classification Act, this work has been carried on with varied degrees of enthusiasm and intensity, except for the last decade, during which, because of the pressure of new business and the need for every available man in the examining divisions to handle the tremendous volume of work, it has considerably and detrimentally slackened. During the period from 1899 to 1903 an average of 10½ examiners were devoted to classification work; from 1904 to 1908 an average of 7⅗ examiners; from 1909 to 1913 an average of 21 examiners; from 1914 to 1918 an

average of 20½ examiners; from 1919 to 1923 an average of 12½ examiners; and from 1924 to 1932 the average dwindled to 4⅖ examiners.

INADEQUATE CLASSIFICATION CAUSES DELAY

The approximately 1,900,000 United States patents issued by the office since 1836 are divided into 300 classes, each of which is further divided into from 50 to 350 subclasses. Of the principal classes 48 have not been revised for many years, in some cases not for more than half a century. The present classification of patents has not kept pace with progress in the arts and necessarily the searches of the examiners have become increasingly difficult each year. In addition to the United States patents the number of foreign patents is ever growing and the same is true of publications, both of which should be searched if the examination is to be complete.

For want of adequate and effective classification, the Patent Office is faced with two definite alternatives. The search of the individual examiners becomes year after year increasingly longer and more difficult by reason of the constant issue of new patents, domestic and foreign, and the appearance of new publications. Accordingly, in the absence of revised, accurate, and modern classification, the production of the individual examiner must decrease, thereby requiring periodic increases in the personnel to handle the work presented to the office. Adoption of this alternative would mean, therefore, an ever increasing personnel until in the future the office will assume mammoth proportions. If, on the other hand, the personnel is not increased to correspond, the work will accumulate and applicants will be forced to wait undesirably long periods for their patents, or else the work will be handled in such a hurried fashion after an unreliable search as will inevitably result in the issuance of a higher percentage of invalid patents than our patent system should permit.

It is only through modern, scientific, and accurate classification of the patents and literature that the examiner's work is lightened to the point where he can continue to handle the volume of new business in an efficient and expeditious manner without new additions to the personnel.

CLASSIFICATION WOULD SAVE $174,000

The present situation may be likened to that of a manufacturer who, having spent his money and devoted his whole force of employees to the principal purpose of achieving and maintaining maximum production, at the sacrifice of replacements, repairs, and betterments in his plant and its equipment, at last finds it so obsolete and insufficient that output can be continued only by enlarging the personnel. Proper and adequate classification of the arts in the Patent Office probably would increase the efficiency of the examiners by not less than 10 percent. This increase in efficiency would, it is estimated, effect an ultimate annual saving of approximately $174,000 on the basis of salaries now paid to the examining corps.

Examiners now assigned to examining divisions cannot be withdrawn from their ordinary work to perform this task of classification as their number is already reduced to the extent of 45 by retire-

ments, resignations, and deaths. However, in view of the urgency of the situation and because of the fact that it would be a capital investment destined to bring heavy returns over a period of years, it is believed that the Patent Office should be permitted to fill immediately at least 25 of the existing vacancies in the examining corps and assign an equivalent number of men (to the classification division) to begin the classification work. These 25 examiners and 20 additional clerks needed to assist in the classification work could be obtained at an annual expense of approximately $80,000.

A third recommendation in the preliminary report of the committee was that an administrative assistant to the Commissioner of Patents should be appointed in order to relieve the Commissioner of detailed duties and to afford him time, not now available, to consider matters of general importance relative to office management and particularly to increase the efficiency of the Patent Office. This recommendation has already received approval and an administrative assistant has been appointed.

It is also desired to invite attention to the necessity for a higher standard in the requirements for registration to practice before this office. The present system of registration, based upon the submission of affidavits, is neither reliable nor satisfactory, and the result is that attorneys may have their names entered on the register who, in many instances, at least, are not qualified to render inventors the valuable advice and assistance which they are entitled to receive. It is suggested that there be established an examination system under which an applicant for registration as an attorney in this office shall be subjected to a thorough examination as to his moral, legal, and technical qualifications; that a committee known as the "Enrollment and disbarment committee" be appointed by the Commissioner of Patents, to be composed of 3 officials in the Patent Office and 2 patent attorneys of standing in the profession; that it shall prepare a written examination for applicants for registration, correct the examinations, and pass upon the fitness of candidates, and consider and decide complaints of violation of ethics and unscrupulous practices by registered attorneys, the work of such committee being under the direction of the Commissioner of Patents and its reports subject to his approval.

AID GIVEN TO INDUSTRY

The policy was continued through the year of giving special status to an application whenever the patent would result in the employment of men and investment of additional capital. Reports filed with the Commissioner indicate that the practice justified itself, as a substantial amount of capital was released and numerous positions were created for men who otherwise would have been unemployed.

Following is an appendix giving the usual statistical information.

APPENDIX

STATISTICS

Applications received during the fiscal year ended June 30, 1933 [1]

With fees:		
Applications for patents for inventions	59,408	
Applications for patents for designs	4,395	
Applications for reissues of patents	441	
		64,244
Applications for registration of trade marks [2]	12,701	
Applications for registration of labels and prints	2,524	
		15,225
Total, with fees		79,469
Without fees: Applications for inventions (Act Mar. 3, 1883)		353
Grand total		79,822

Applications for patents for inventions with fees

Year ended June 30—		Year ended June 30—	
1924	76,024	1929	87,039
1925	77,926	1930	91,430
1926	80,682	1931	84,097
1927	84,511	1932	73,465
1928	88,482	1933	59,408

Applications for patents, including reissues, designs, trade marks, labels and prints, with fees

Year ended June 30—		Year ended June 30—	
1924	99,574	1929	114,496
1925	103,591	1930	117,569
1926	110,030	1931	106,717
1927	113,783	1932	93,859
1928	116,844	1933	79,469

Patent applications awaiting action

June 30—		June 30—	
1924	60,334	1929	103,236
1925	44,556	1930	119,597
1926	43,765	1931	92,203
1927	64,646	1932	76,723
1928	106,575	1933	49,050

Patents withheld and patents expired

	1932	1933
Letters patent withheld for nonpayment of final fees	13,000	14,072
Applications allowed awaiting payment of final fees	23,928	23,448
Patents expired	44,235	42,328
Applications in which issue of patent has been deferred under section 4885, Revised Statutes	248	345
Applications in process of issue	3,931	4,108

[1] Including applications in which fees were refunded and transferred.
[2] Includes 1,663 applications for renewal of trade-mark registrations.

Patents granted and trade marks, labels, and prints registered

	1929	1930	1931	1932	1933
Letters patent	43,617	49,599	44,317	52,572	50,766
Plant patents				17	52
Design patents	3,201	2,598	3,089	2,728	2,934
Reissue patents	329	374	400	392	375
Trade marks	14,391	13,897	12,437	10,901	8,909
Labels	1,774	1,610	1,787	1,492	1,458
Prints	933	723	678	483	479
Total	64,245	68,801	62,708	68,585	64,973

Statement of receipts and earnings for the fiscal year ended June 30, 1933

Unearned balance at close of business June 30, 1932			$181,120.30
Collections during fiscal year ended June 30, 1933			4,269,781.73
Total			4,450,902.03
Refundments			27,338.85
Net collections			4,423,563.18

Earnings

Inventions, first fees	$1,742,260.00		
Extra claims	37,336.00		
Reissues	13,230.00		
Designs	46,680.00		
Design, extensions	15,660.00		
Trade marks	188,715.00		
Labels and prints	11,622.00		
Total		$2,055,503.00	
Final fees	1,464,630.00		
Extra claims	27,401.00		
Total		1,492,031.00	
Appeals	43,365.00		
Oppositions	6,550.00		
Disclaimers	1,230.00		
Revivals	5,700.00		
Total		56,845.00	
Printed copies, etc	333,820.60		
Photoprints	10,648.75		
Photostats	54,472.45		
Manuscript	80,838.85		
Certified printed copies, etc	6,224.40		
Recording articles of incorporation	488.00		
Recording international trade marks			
Registration of attorneys	955.00		
Total		487,448.05	
Drawings		19,041.05	
Assignments		135,031.22	
Total earnings			4,245,899.32
Unearned balance June 30, 1933			177,663.86
Net receipts			4,423,563.18

Receipts and expenditures

Receipts from all sources	$4,423,563.18
Expenditures	4,588,585.02
Deficit	165,021.84
Receipts from sale of Official Gazette and other publications (Superintendent of Documents)	65,119.04
Actual net deficit	99,902.80

Comparative statement

June 30—	Receipts	Expenditures	Deficit
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
1927	3,524,155.55	3,769,604.03	245,448.48
1928	3,705,338.31	3,839,771.66	134,433.35
1929	3,783,481.65	4,391,860.16	608,378.51
1930	4,096,825.43	4,552,685.41	455,859.98
1931	4,565,377.08	4,832,277.96	266,900.88
1932	[2] 4,487,508.78	5,314,851.59	[2] 827,342.81
1933	[2] 4,423,563.18	4,588,585.02	[2] 165,021.84

[1] Including increase in compensation (bonus).
[2] This does not include the amount received by the Superintendent of Documents for the Official Gazette.

Comparative statement of expenditures under separate appropriations

Appropriation	1932	1933
Salaries	$3,460,181.18	$3,032,802.58
Public use of inventions, etc	379.40	5.00
Photolithographing	302,334.14	233,377.13
Printing and binding	1,368,408.21	1,239,909.85
Miscellaneous printing and binding	41,872.71	45,156.01
Furniture and filing cases	108,572.43	12,475.70
Contingent expenses, including library stock	33,103.52	24,858.75
Total	5,314,851.59	4,588,585.02

Litigated cases

Patent:		
Interferences declared		2,418
Interferences disposed of before final hearing		1,882
Interferences disposed of after final hearing		278
Interferences awaiting decision		60
Trade-mark:		
Interferences declared		106
Oppositions instituted		670
Cancelations instituted		141
Interferences disposed of before final hearing		663
Interferences disposed of after final hearing		287
Interferences awaiting decision		36
Before the Board of Appeals:		
Appeals in ex parte cases	2,338	
Appeals in interference cases:		
Priorities	166	
Motions	214	
	380	
		2,718
Ex parte appeals disposed of	2,615	

Litigated cases—Continued

Before the Board of Appeals—Continued			
Appeals in interference cases disposed of:			
Priorities	187		
Motions	192		
		379	
			2,994
Ex parte cases awaiting action		1,122	
Interference cases awaiting action		151	
			1,273
Oldest ex parte case awaiting action, June 7, 1933.			
Oldest interference case awaiting action, June 9, 1933.			
To the Commissioner:			
Appeals in trade-mark interferences	4		
Appeals in trade-mark oppositions	52		
Appeals in trade-mark cancelations	11		
Appeals in ex parte trade-mark cases	30		
Interlocutory appeals	11		
		108	
Petitions to Commissioner:			
Ex parte	7,869		
Inter partes	144		
		8,013	
			8,121
Cases disposed of by Commissioner:			
Appeals in trade-mark interference	4		
Appeals in trade-mark oppositions	50		
Appeals in trade-mark cancelations	10		
Appeals in ex parte trade marks	27		
Interlocutory appeals	11		
		102	
Petitions disposed of:			
Ex parte	7,799		
Inter partes	133		
		7,932	
			8,034
Notices of appeals to United States Court of Customs and Patent Appeals:			
In ex parte cases (including 4 trade marks)		145	
In inter partes cases		72	
In trade-mark oppositions		19	
In trade-mark cancelations		6	
In design applications		8	
			250
To Supreme Court, District of Columbia, in equity (including 2 trade marks)			90

OTHER DETAILS OF BUSINESS FOR THE FISCAL YEAR

As to the volume of business, the office received during the year 64,244 applications for patents, reissues, and designs; 11,038 trade-mark applications and 1,663 applications for renewal of trade-mark registrations; and 2,524 label and print applications; 228,788 amendments to patent applications, 5,744 amendments to design applications, and 14,892 amendments to trade-mark, label, and print applications.

The number of letters constituting the miscellaneous correspondence received and indexed was 411,219. In addition, 34,007 letters were returned with information.

The number of printed copies of patents sold was 3,281,973; 1,450,979 copies of patents were shipped to foreign governments,

and 824,678 copies furnished public libraries. The total number of copies of patents furnished was 6,032,765, including those for office use and other departments.

The office received for record 41,299 deeds of assignment.

The drafting division made 591 drawings for inventors, and corrected 16,600 drawings on request of inventors; 110,379 sheets of drawings were inspected, and 18,228 letters answered.

Typewritten copies of 3,308,800 words were furnished at 10 cents per hundred words. The office certified to 10,695 manuscript copies, and furnished 5,509 miscellaneous certified copies. The office also furnished 341,536 photostat copies of manuscript pages; 38,071 photographic copies, and 271,368 photostat copies of publications and foreign patents, for sale; 22,682 photostat-manuscript pages; 86 certified manuscript copies and 8,966 photostat copies for Government Departments, without charge; 25,722 photostat and 13,276 photographic copies for use of the Patent Office; 15,270 photostat copies for sale through photo-print section, and 183 photostats for office use; also 70,413 photostats for assignments, grants, and disclaimers for official use; in all, 756,140 photostat and 51,347 photographic copies.

BUREAU OF MINES

FINANCES

Total funds available to the Bureau of Mines for the fiscal year ended June 30, 1933, were $2,398,947.38. Of this amount $1,908,010.96 was spent, leaving an unexpended balance of $490,936.42, mainly owing to uncompleted work in the helium program for the Army and Navy; which resulted in carrying over $234,590.79 of helium-plant funds as authorized expenditures for the fiscal year 1934, less a reduction of $50,000 as provided in the appropriation act for 1934.

On the regular work of the Bureau $1,705,472.04 was expended directly; this figure is subject to slight corrections due to unpaid obligations.

In addition, for the helium program, which is purely service work for the Army and Navy and has no part in the regular plans of the Bureau, $286,213.96 was appropriated directly to the Bureau and $184,000 was transferred from the Army and Navy for the purchase at cost of helium produced by the Bureau for this military-service branch. Table 1 presents classified and complete information regarding the financial history of the Bureau since its transfer to the Department of Commerce July 1, 1925.

A statement of the distribution of congressional appropriations to branches and divisions within the Bureau and the expenditures of these funds in 1933 by the various divisions of the Bureau is given in table 2.

TABLE 1.—*Bureau of Mines appropriations and expenditures, 1926–33*

Fiscal year—	Annual appropriations, Bureau of Mines	Departmental allotments [1]	Funds transferred from other agencies [2]	Total funds available for expenditure	Unexpended balance	Total expenditures	Expenditures exclusive of service items [3]
1926	$1,875,010.00	$81,220.00	$510,501.15	$2,466,731.15	$28,891.78	2,437,839.37	$1,841,150.80
1927	1,914,400.00	94,443.39	325,000.00	2,333,843.39	44,871.29	2,288,972.10	1,926,910.12
1928	3,025,150.00	113,266.45	328,000.00	3,466,416.45	[4] 736,235.62	2,730,180.83	1,997,270.66
1929	2,725,118.00	103,000.00	205,500.00	[4] 3,753,094.67	[5] 152,701.34	3,600,393.33	2,280,960.68
1930	2,274,670.00	123,300.00	166,200.00	[5] 2,684,386.38	[6] 135,714.93	2,548,671.45	2,216,995.72
1931	2,745,060.00	120,680.91	166,500.00	[6] 3,134,595.10	[7] 195,534.37	2,939,060.73	2,304,121.45
1932	2,278,765.00	137,866.48	194,500.00	[7] 2,770,712.18	[8] 344,340.92	2,426,371.26	2,197,055.86
1933	1,860,325.00	75,100.00	221,808.42	[8] 2,398,947.38	[9] 490,936.42	1,908,010.96	1,705,472.04
Total	18,698,498.00	848,877.23	2,118,009.57	23,008,726.70	2,129,226.67	20,879,500.03	16,469,937.33
1934	[10] 1,514,300.00	47,500.00	124,000.00	[9] 1,483,211.72	----------	----------	[11] 1,206,444.00

[1] Includes printing and binding, stationery, and contingent funds.
[2] Includes proceeds from sales of residue gas.
[3] Service items include Government fuel yards, helium, and other investigations and services for other departments.
[4] Includes $719,476.67 unexpended balance reappropriated.
[5] Includes $120,216.38 unexpended balance reappropriated.
[6] Includes $102,354.19 unexpended balance reappropriated.
[7] Includes $159,580.70 unexpended balance reappropriated.
[8] Includes $241,713.96 unexpended balance reappropriated.
[9] Includes $184,590.79 unexpended balance reappropriated.
[10] Withdrawals from appropriations to Bureau limited by Department to $1,124,000.00.
[11] Estimated.

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TABLE 2.—*Bureau of Mines expenditures, fiscal year 1933*

Branch or division	General expenses	Investigating mine accidents	Mining investigations in Alaska	Operating mine rescue cars and stations	Testing fuel	Mineral-mining investigations	Oil and gas investigations	Expenses, mining-experiment stations	Care, etc., buildings and grounds, Pittsburgh
Office of the Director	$12,199.59								
Office of the Assistant to the Director	8,556.25								
Administrative branch:									
Office-administration division	12,425.82	$4,854.77		$6,497.07	$26.77	$3,803.79	$5,606.06	$7,130.11	$440.00
Information division	34,095.35	13,762.83		12,647.63	6,872.52	2,245.11	2,311.67	1,320.96	
Total	46,521.17	18,617.60		19,144.70	6,899.29	6,048.90	7,917.73	8,451.07	440.00
Office of chief mining engineer		37,776.98							
Technologic branch:									
Experiment-stations division		100,693.46		7,150.47	43,176.95	2,069.84		70,745.42	63,316.79
Explosives division		52,589.51							
Helium division									
Mechanical division		47,818.82	$8,419.98		89,538.00	76.32			
Metallurgical division						47,161.27		101,584.71	
Mining division		24,239.89		238.55		63,381.46	232.26		
Petroleum and natural-gas division							156,609.48		
Total		225,341.68	8,419.98	7,389.02	132,714.95	112,688.89	156,841.74	172,330.13	63,316.79
Economics branch:									
Coal division									
Common-metals division									
Mineral-statistics division									
Office of principal mineralogist									
Petroleum-economics division									
Rare metals and nonmetals division									
Total									
Health and safety branch:									
Demographical division		27,153.87		153.00					
Health division		53,374.31							
Safety division		17,059.09		247,140.14					
Total		97,587.27		247,293.14					
Total appropriations	75,060.00	421,190.00	9,350.00	301,375.00	155,000.00	130,420.00	183,200.00	200,000.00	70,000.00
Total expenditures	67,277.01	379,323.53	8,419.98	273,826.86	139,614.24	118,737.79	164,759.47	180,781.20	63,756.79
Unexpended balance	7,782.99	41,866.47	930.02	27,548.14	15,385.76	11,682.21	18,440.53	19,218.80	6,243.21

Branch or division	Maintenance and operation, Government fuel yards	Helium investigations	Economics of mineral industries	Helium plants	Helium production	Gas production	Printing and binding	Department contingent	Total
Office of the Director									$12,199.59
Office of the Assistant to the Director									8,556.25
Administrative branch:									
Office administration division		$2,271.56	$10,455.28		$5,639.26		$10,357.65	$22,517.20	92,025.34
Information division							287.99		73,544.06
Total		2,271.56	10,455.28		5,639.26		10,645.64	22,517.20	165,569.40
Office of chief mining engineer							570.52		38,347.50
Technologic branch:									
Experiment-stations division							2,532.84		289,685.77
Explosives division							494.97		53,084.48
Helium division		38,130.99		$7,123.17	118,505.45	$25,368.49			189,128.10
Mechanical division							1,099.71		146,952.83
Metallurgical division									148,745.98
Mining division							1,161.62		89,253.78
Petroleum and natural-gas division							1,985.37		158,594.85
Total		38,130.99		7,123.17	118,505.45	25,368.49	7,274.51		1,075,445.79
Economics branch:									
Coal division	(1)		55,737.89						55,737.89
Common-metals division			26,244.32						26,244.32
Mineral-statistics division			74,721.43				23,232.11		97,953.54
Office of principal mineralogist			6,628.41						6,628.41
Petroleum-economics division			35,342.87						35,342.87
Rare metals and nonmetals division			33,162.35				734.87		33,897.22
Total			231,837.27				23,966.98		255,804.25
Health and safety branch:									
Demographical division							3,254.95		30,561.82
Health division							566.57		53,940.88
Safety division							3,386.25		267,585.48
Total							7,207.77		352,088.18
Total appropriations	(1)	44,500.00	270,230.00	241,713.96	184,000.00	37,808.42	52,000.00	23,100.00	2,398,947.38
Total expenditures		40,402.55	242,292.55	7,123.17	124,144.71	25,368.49	49,665.42	22,517.20	1,908,010.96
Unexpended balance		4,097.45	27,937.45	234,590.79	59,855.29	12,439.93	2,334.58	582.80	490,936.42

[1] Revolving fund.

TECHNOLOGIC BRANCH

MECHANICAL DIVISION

Electricity in mines.—Service intended to promote the design of electrical machinery, for use in gassy mines, that will reduce hazards of ignition by shock and gas, has been continued throughout the year. The possible ignition of mine gas by static electricity has been studied and a manuscript embodying the results prepared.

Use of coal.—Fundamental information on the process of combustion in a fuel bed with underfeed firing, and on the effect of preheating the air supply, has been obtained from studies of coal utilization. Both investigations will aid the rational design of coal-burning equipment and smokeless devices. Methods have been developed for measuring and comparing certain burning characteristics of various coals (which have hitherto been expressed in such general terms as free, medium, and slow burning) and the ability of a fresh fire to pick up the load.

Fuel-economy service.—Eight departments of the Federal Government have applied the Bureau's studies of the quality and efficient use of coal to their own needs. Nearly 200 plants have received the attention of the Bureau's consulting fuel-economy service, and the recommendations made have saved some $300,000 in investment and over $15,000 in yearly expense.

Fuel inspection.—Many Government organizations ask the Bureau's advice in selecting coal offered on specification, since its records of the quality of coal delivered on contract grow more extensive each year.

Fuel analyses.—About 9,000 coal analyses were added during the year to the 170,000 already on file. A publication on Montana coals was the eighteenth State report describing coal fields and deposits visited by Bureau engineers and containing analyses of coal samples collected for test at Bureau experiment stations.

Constitution and carbonizing properties of North American coals.—The low- and high-temperature coking properties and the microstructure of typical North American coals have been determined by a new method developed in cooperation with The American Gas Association. The following coals have been discussed in Bureau technical papers: Pittsburgh bed, Pennsylvania; Davis bed, Maryland; Chilton and Taggart beds, West Virginia; Elkhorn bed, Kentucky; Mary Lee and Black Creek beds, Alabama; No. 6 bed, Illinois; and Michel mine, British Columbia. Seventeen different types of spores have been identified and described in the foregoing coal beds, thus supplying data for correlating beds in questionable geological horizons.

The effect of carbonizing temperature on the composition of tar and light oils has been established, and a commercially promising method of extracting tar, acids, and phenols from tar with ether has been developed. These compounds are useful for producing synthetic resins of the "bakelite" type.

Classification of coal.—Such physical properties of coal as friability, tendency to disintegrate by weathering, agglutinating or caking index, and chlorine content have been ascertained by tests in cooper-

ation with the American Standards Association. A number of typical American coals have been so tested.

Thermal chemistry of hydrocarbons.—Experimental and theoretical studies of reaction kinetics and equilibria of hydrocarbon compounds in coal gas and natural gas have resulted in (1) the development of mathematical methods for computing thermodynamic functions from spectroscopic data and the application of this method to acetylene, ethylene, ethane, and methane; (2) the disclosure of the yields of acetylene and of ethylene obtainable by the pyrolosis of mixtures of methane and steam and of methane and carbon dioxide at various temperatures and pressures; and (3) the disclosure of conditions affecting the catalytic polymerization of acetylene to benzene and the polymerization of ethylene to lubricating oils. These basic studies indicate the possibility of commercially producing ethyl alcohol from higher hydrocarbons of waste natural gas at an estimated manufacturing cost of 14 cents a gallon and of lubricating oil at 13 cents a gallon.

Solubility of methane in coal.—Coals ranging in rank from lignite to anthracite were exposed to methane at pressures up to 100 atmospheres. The amount of methane dissolved in the coals increased with pressure and the methane-holding capacity of the coals with rank; hence, anthracite and semibituminous coal mines are apt to be much more gassy than low-rank bituminous mines.

Conclusions.—All fuel consumers are at liberty to make use of the impartial and accurate data on the coals of the United States assembled by the Bureau of Mines. This information doubtless will be in much greater demand when the coal industry establishes a uniform relationship between prices and classes of coal. The data now being collected on the carbonizing properties of coal will promote the manufacture of smokeless fuels and tend to reduce concentrations of smoke and soot in city atmospheres. Research on the basic chemistry of natural gas will hasten the commercial development of processes for utilizing some now being blown to waste.

MINING DIVISION

Mining and milling methods and costs; metallic ores.—With the aid of some 300 managers of representative metal and nonmetal mines and mills in North America, a series of information circulars has been prepared during the past 4 years on methods and costs of mining and milling and on important problems in mining practice. Of these, about 250 have been published; 50 are still to be issued. A valuable bulletin on cost accounting, necessary as a background for these 300 circulars on mining costs, was prepared with the assistance of the American Society of Certified Accountants and leading mine-accounting specialists; many mining companies contributed data, time, and help.

Publications during the year included bulletins on gold-mining and on shaft-sinking methods and costs, 5 summary circulars covering special aspects of mining, 10 circulars on mining and 2 on milling at individual mines, and 6 reports on the cost of equipping and developing small gold mines (a subject upon which nothing had been published).

Manuscripts for bulletins on the following subjects were submitted for publication: Modern placer-mining methods; copper-mining practice in the United States; methods and costs of milling copper ores; methods and costs of mining and milling lead and zinc; tungsten mining and milling methods; underground scraping practice in metal mines; and engineering factors in the ventilation of metal mines.

Nonmetallic mining.—Operating costs and technical details of the mining methods used at 3 crushed-stone quarries, 1 clay pit, 1 gypsum mine, and 7 sand and gravel pits were presented in information circulars. Two others discussed the technical problems involved in prospecting and developing sand and gravel deposits. These papers, plus the 27 already published, comprise the only technical library so compiled as to make information on cost records and the technique of nonmetallic mining directly available to interested operators.

Although nonmetallic-mineral production far surpasses metal production in quantity, and equals it in value, much less technical attention has been paid to nonmetallic-mining methods; the collection of these data and their interpretation attempt to remedy this condition.

Falls of roof and coal.—Four technical papers, five reports of investigations, and two information circulars on falls of roof in specified coal beds were published. These investigations, which embody definite recommendations to the individual mines studied, have resulted in marked reduction of coal-mining hazards, made possible more complete recovery of coal, and proved of recognized assistance to the operators.

Geophysical prospecting.—A comprehensive geophysical survey of 500 square miles, in and around the Government's Texas helium reserves, was completed to promote the development of such reserves. Machines for calibrating seismometers, together with control equipment, were completed and installed, and precision instruments of several types were designed and constructed. Geophysical observations were made in serpentine areas, to aid in finding a domestic supply of chromium. Two technical papers and 12 monthly abstracts of current geophysical literature were published.

Ventilation.—A comprehensive bulletin on metal-mine ventilation was completed. Ventilation studies were begun in the anthracite district and are being continued.

Conclusions.—Field work of the division personnel has made possible dissemination of data on mining conditions, methods of operation, factors affecting costs of production, and labor conditions in the principal mining districts. Itemized costs have been ascertained for such factors of expense in mining as breaking ore and coal, loading, haulage, hoisting, developing, stoping, blasting, timbering, power and general items; and in milling as crushing, grinding, conveying, classifying, gravity and flotation concentrating, filtering, drying, and tailing disposal. The reports also show the man-hours per ton at the various mines and mills, and the quantity of explosives, timber, electrical energy, and reagents and other mill supplies consumed per ton of ore treated.

Mere statistics would be misleading in any study of mineral production looking to control of output, wages, and prices; to reach equitable conclusions it is essential for the contributing elements to be known and understood as they affect production costs.

METALLURGICAL DIVISION

The study of possibilities of production of iron and steel by direct processes has advanced steadily. The year's accomplishments include the development of two methods for direct production of wrought iron from highly concentrated ores. Laboratory tests have been successful and commercial trials are under way.

The reduction of iron ores by natural gas, another phase of the program, was given continued attention, and work on the problem is virtually competed.

Direct reduction of ferberite tungsten ores to produce a material satisfactory for use in the manufacture of high-speed steel has been accomplished in the laboratory; it is hoped that this process will enable domestic ores to compete with foreign.

Ore-dressing technique has been advanced, particularly in separation by alternating magnetic fields. Chromite ores have been concentrated by this method with especially promising results.

Metallurgical fundamentals.—The high-temperature specific heats of metallurgically important substances are given in a bulletin presenting the results of continued work in the application of thermodynamic methods to metallurgical problems.

Metallurgy of copper.—A good way to improve the economics of copper smelting is to find some method of saving the sulphur and iron in copper ores. Flotation processes may yield a fine concentrate.

Methods have been devised for burning this concentrate to give high-sulphur gases and a product from which the copper and iron can be separated. A complete study of copper ferrites has been necessary in connection with this work. The existence of two forms of copper ferrites, revealed by their X-ray spectrograms, has been an interesting discovery.

Metallurgy of lead and zinc.—The reduction of zinc ores by natural gas and lead smelting in the blast furnace have been investigated further.

Metallurgy of rare and precious metals.—Many gold ores cannot be directly cyanided, but must be roasted; however, the gold is frequently so contaminated in this process that good recoveries are not obtained. A number of difficult treatment problems have already yielded to study, and, in view of the current importance of gold metallurgy, this work is being actively pursued.

Metallurgy of iron and steel.—Nonuniformities in gas distribution, temperature, and smelting in blast furnaces can be traced to irregularities in the size of the feed. The usual methods of agglomeration, such as sintering and briquetting, are being studied, as well as the use of glomerules developed by the Bureau. In this latter method, the charge of fine ore is moistened and caused to ball so individual glomerules are one fourth to three fourths inch in diameter. When heated above 1,000° C., these glomerules attain mechanical strength and yet remain easily reducible.

Ore dressing.—The Bureau has pioneered in the flotation of nonsulphide minerals. Methods are now available for the flotation of virtually all important nonsulphide minerals, and much has been accomplished in separation of these minerals. At present, particular emphasis is being placed on the tungsten and chromium minerals, as well as kyanite and other nonmetallics.

The importance of efficient crushing and grinding in order to free valuable minerals from worthless gangue can hardly be overstated. The relation of power to surface produced and the efficiency of various types of ballmills are being carefully studied. Radically new methods of ore preparation are also being developed, with especial emphasis on explosive shattering, in which the ore is subjected to an explosion of superheated steam.

Special studies.—The magnetic properties of minerals, and changes which can be brought about by heat treatment, have been investigated, and many minerals not heretofore susceptible to magnetic concentration have been so conditioned that they may be separated by alternating magnetic fields. The action of these alternating fields on minerals is another subject being followed with interest.

Conclusions.—Conservation of our natural resources is being promoted by continuance of work now under way. It is hoped that these investigations will reduce considerably foreign monopolies of processes or of raw materials.

PETROLEUM AND NATURAL-GAS DIVISION

Subsurface relationships of oil and gas.—Further national recognition was accorded research of the Bureau of Mines on performance of oil and gas wells when subsurface studies of east Texas wells and investigations of the liberation of gas naturally dissolved in crude oil were completed. Data for the published reports were obtained with special instruments developed by the Bureau for taking samples at the bottom of drill holes and for recording pressures and temperatures in wells. The field work was made possible by financial assistance from the operators.

The natural flowing life of individual wells can be predicted by this method while the reservoir pressure is above 755 pounds per square inch absolute; below this pressure, east Texas crude oil liberates its naturally dissolved gas. Selection of correct sizes of tubing is facilitated by the data in these reports.

By a new method the energy available in the reservoir fluid at various pressures was determined from the gas-liberation characteristics of bottom-hole samples of oil. Information was also reported for computing the quantity of gas that must be injected into a well to produce flow by gas lift when natural flow ceases. Compressibility data on east Texas oil showed the minor effect, as a propulsive force, of liquid expansion due to release of pressure.

A comprehensive thermodynamic analysis of flow in wells was completed. The mathematics of well flow has been condensed by curves and tables into a form usable by producers.

Fluid flow and recovery of oil and gas.—Recent laboratory tests, in which back pressures were held on the sand, demonstrated the beneficial effect of dissolved gas on oil recovery. The advantage

of gas over air, under back-pressure conditions, is due to the reduction of surface tension and decreased viscosity of the oil caused by gas going into solution. For the combination of sand, oil, and gas, 60 to 65 percent of the original oil in the sand was the limit of recovery for field operations, an important fact to operators using this method of production.

Continuing the study of the flow of fluids through porous media, 33 tests, using air as the flowing medium, were completed. The results confirm earlier data. In addition, 44 tests of gaseous flow through cores of consolidated sands from oil-producing horizons were made. In general, analyzed results indicate flow relationships conforming to those obtained in the study of unconsolidated sands.

Analysis of data from a series of accelerated oxidation tests, lasting 182 days, is expected to answer practical operating questions regarding possible changes in the characteristics of crude oil if air is used to stimulate production.

Production and transportation of natural gas.—Advancing the science of controlling and gaging natural-gas wells, 959 back-pressure tests have been made on 577 natural-gas wells. Of these, 88 percent show a straight-line relationship between pressure conditions in the well and delivery from it. Tests by the Bureau's method, with high back pressures and relatively low rates of flow, can be applied to determine (1) rate of flow under open-flow conditions; (2) availability of gas under any pressure condition; and (3) different producing characteristics of a well in relation to such factors as the presence of water and gasoline and the effects of caving and of shooting. Added knowledge has been gained in the use of critical and noncritical flow provers, pitot tubes, and choke-nipples for accurate measurement of gas deliveries.

The Pennsylvanian gas-producing formations of the Oklahoma City field were studied by the Bureau at the request of the Oklahoma City Chamber of Commerce. The ensuing report stated that these should be regarded merely as an auxiliary supply to augment the formation gas in the pre-Pennsylvanian oil-producing zones when the oil wells stop flowing naturally. This investigation should save the industry and the State a large investment on which returns would have been uncertain.

Tests of 29 lines, totaling 757 miles of pipe, ranging in size from 6 to 22 inches and in operating pressure from 30 to 600 pounds per square inch, were described in a comprehensive report on gas transportation. A method of determining viscosity of natural gas was developed, and a report issued on the deviation of natural gas from Boyle's law under pressure commonly used in transportation lines. The code of The American Gas Association will include these findings.

Corrosion caused by traces of hydrogen sulphide, water vapor, and oxygen, in gas lines operating under high pressures, prompted the development of a test method which, when applied to operating pipe lines, permits reasonable prediction of the economic life of a line under test conditions. The practices recommended should decrease rapid attack of metal by corrosive agencies.

Chemistry and refining.—Sulphur in petroleum continued to be the major investigation in chemistry and refining. A chemical method was developed for removing elementary sulphur from gasoline.

Rocky Mountain high-sulphur black oils were subjected to cracking and treating tests to determine their suitability as sources of motor fuel. A refiner in the area tested these experimental motor fuels for antiknock quality. The straight-run gasolines have a low octane rating. Cracked-gasoline ratings have not been reported.

Results of the Bureau's study of paraffin were prepared for publication. Comprehensive laboratory tests are combined with data obtained from refineries to show commercial methods of wax manufacture.

The properties of typical crude oils from the Eastern Hemisphere were tabulated in a bulletin representing the results of a continuing study of crude oils as material for the manufacture of commercial products. Additional samples from eastern United States sands were analyzed, and analyses of Texas crude oils by the Bureau of Mines method were compiled. Where possible, the characteristics of the oils were correlated with their source beds.

Conclusions.—Many uneconomical practices, based upon rule-of-thumb methods, have been eliminated in oil and gas fields because basic knowledge regarding reservoir conditions has been obtained and reported by the Bureau of Mines. The development of facts regarding the presence and removal of sulphur in petroleum has continued to aid refiners in manufacturing commercial products.

Work on oil and gas has been seriously crippled by termination of studies that had been developed to the point where definite results of practical value were assured. There is need for investigations of economic well spacing, performance of wells under production-control conditions, water encroachment, and economical withdrawal of oil and gas. Research into fractional distillation should be expanded to include methods of obtaining petroleum products without excessive refining costs. The Petroleum Experiment Station continued to operate under great handicaps because no adequate engineering laboratory has been provided.

EXPERIMENT STATIONS DIVISION

The Annual Report of the Director of the Bureau of Mines for the fiscal year 1932 describes in detail the type of activities carried on at each of the 11 field experiment stations.

NONMETALLIC MINERALS

During the year, research by the Bureau of Mines has made several definite contributions to domestic industry.

(1) It has laid the foundation for the establishment of a new American industry that will supply a commodity now imported. Laboratory and small-scale engineering tests indicate the probability that potassium sulphate can be made on a commercial scale more economically from polyhalite than from any other domestic raw material, and that the costs will be low enough to compete with sulphate now imported from Germany. (See recovery description below.)

(2) The possible extension of three industries to provide domestic substitutes for imported products has been shown. Certain domestic chalks and whitings have been found to be satisfactory substitutes

for those of foreign manufacture. From the kaolins of the Pacific Northwest, the Bureau has recovered quartz sand, formerly imported into that region for use in glass and pottery. Cleaning methods for Idaho and Washington clays have been developed; plant tests show that the resulting product is equivalent to material now imported from England.

(3) The Bureau has developed flotation procedures and reagent combinations, for the treatment of Alabama graphite, that will be less costly than former practice. This offers some possibilities for the revival of an Alabama graphite industry, inactive because of foreign competition.

Recovery of potassium sulphate from polyhalite.—Extensive deposits of polyhalite, a hydrated potassium-magnesium-calcium sulphate, were discovered by the Bureau in New Mexico and Texas during its 5-year drilling program initiated in 1926. Since this mineral had never been exploited, the Nonmetallic Minerals Experiment Station undertook to develop processes for the production of potassium salts and other industrial chemicals from it. During the past year prospects for the commercial utilization of polyhalite have improved markedly, due to the following important advances in the processes outlined in previous years:

1. Tests in small-scale engineering equipment have proved that common salt, occurring as an impurity, may be removed to any desired practical limit without much loss of potassium sulphate.

2. The time of calcination has been reduced from 30 minutes or more, previously considered necessary, to a maximum of 3 minutes.

3. The production of potassium sulphate through formation of syngenite, a hydrated potassium-calcium sulphate, has been improved by the development of a commercially attractive pressure method of decomposition which materially reduces costs.

4. Continuous operation of the reduction step in a process previously developed, has replaced batch treatment. The reducing agent is a mixture of hydrogen and carbon monoxide derived from natural gas.

Utilization of domestic chalks and whitings.—Paleontological and petrographic studies, as well as tests of samples from all known domestic formations of chalk and many American limestone and marble deposits, for color, oil absorption, workability, hydrogen-ion concentration, sedimentation, decoloration, particle size, chemical composition, and putty requirements, by the Northwest Experiment Station, indicate that at least seven American limestones compare favorably with European chalk. All American chalks studied were darker than the commercial European chalks, and no inexpensive method of improving the color was found.

Purification and utilization of quartz and mica from Pacific Northwest kaolins.—Quartz sands washed from eastern Washington and northwestern Idaho kaolins, subjected to laboratory and plant tests, were found satisfactory in glass and pottery, and, while useful, were not as suitable for foundry and blast sand as the tougher Belgium, Illinois, and New Jersey sands. Moscovite from the same source is useful in white fillers.

Purification of sandy micaceous kaolins by pneumatic methods.—Impurities in Washington kaolins could be reduced from 70 to 6

percent in a simple apparatus consisting of an impact pulverizer and air separator in operation at the Northwest Experiment Station. While the refined material was not as clean as that prepared by water washing, it was suitable for earthenware pottery and for kalsomine and other fillers; operating costs were less.

Kaolin and china clay in the Pacific Northwest.—Washington and Idaho kaolins or china clays can be satisfactorily purified by methods devised at the Northwest Experiment Station in cooperation with the University of Washington. Laboratory and factory tests have shown that the purified china clay is suitable for china, porcelain, and earthenware pottery, paper filler, superior refractories, and general filler purposes. The commercial development of these materials would avoid importation to the Pacific coast of English china and ball clay, valued at $116,176 in 1929.

Milling Alabama graphite ores.—A froth-flotation study as applied to Alabama graphite ores has been completed by the Southern Experiment Station. Proper control of the acidity of the flotation pulp would reduce the treatment to two stages, and would virtually eliminate the necessity for re-treating concentrate in a finishing mill, thus reducing substantially the cost of producing commercial graphite from these ores.

Cleaning fine coal by flotation.—Ferric and ferrous salts are the most effective flotation reagents found by the Northwest Experiment Station for cleaning fine sizes of high-sulphur coal. Cleaned-coal froths ordinarily maintain their stability for long periods and are troublesome to handle with usual washery pumping equipment. Cleaned-coal froths have been shown to break down completely if the frothing reagents are added only as required to maintain a working froth.

Conclusions.—Industrial recovery should be promoted by application of the year's research on nonmetallic-mineral problems. Several processes developed are applicable to essential, widely used products that would displace similar material now imported. The significance of new domestic industries as markets for machinery and raw materials for plant construction, and of the increased purchasing power from greater employment of American labor, is obvious. Two new coal-cleaning plants have already been put in operation, and others may be installed.

Utilization of the byproducts from polyhalite treatment for potash has been studied only to a slight extent. Thorough research on the production of such industrial chemicals as sodium sulphate, magnesium sulphate, magnesium chloride, and other salts from wastes would aid in solving the problem of polyhalite utilization and at the same time assist the various industries using these chemicals.

EXPLOSIVES DIVISION

Permissible explosives.—In 1907, the year before the Government began to test explosives, the fatality rate in coal mining was 1.687 per thousand men employed, due to the large number of deaths caused by explosives and explosions. Only about 1 percent of the explosives then used were of the short-flame (permissible) type, the remainder being black blasting powder. In 1929, the record coal-

producing year, the fatality rate was reduced to 0.432 per thousand, due in large measure to cooperative efforts of the Explosives Division of the Bureau and the coal-mine operators. Fully 50 percent of the coal mined in 1929 was blasted with explosives classed by the Bureau as permissible.

During the fiscal year 1933, 18 explosives were added to the Bureau's active permissible list, and 17 explosives were transferred from the active to the inactive list, leaving 135 permissible explosives and 5 models of blasting devices on the active list. Eight of the explosives submitted failed to pass the tests. Nine field samples of permissible explosives have been checked to determine whether they conform to the specified requirements.

Effect of moisture.—The effect of the absorption of moisture on the explosive properties of permissible explosives, when stored in coal mines, was tested. It was found that, even under most favorable conditions, storage should be limited to the shortest possible period.

Investigations of the duplicability of gallery tests showed that moisture has no appreciable effect on the ease of ignition of mixtures of natural gas and air.

Tests of fuse and detonants.—The chemical, physical, and explosive properties of three initiating compounds have been tested during the year as part of a continuing program to ascertain the relative ability of various detonants to cause complete detonation of explosives, particularly permissible explosives. The properties and characteristics of various brands of fuse obtained in open market were also determined.

Assistance to other organizations.—Three inspections at explosives plants were made on behalf of the Panama Canal Commission in connection with their acceptance of explosives for use in the Canal Zone.

The danger of using black powder, and the relative safety of permissible explosives, in the presence of gas and/or coal dust were illustrated by several demonstrations during the year.

As a special phase of suitability tests, the relative ignitibility of 33 industrial explosives, submitted for use in the United States Forest Service by nine manufacturers, was determined. The Bureau's explosives engineers designed and constructed an ignitibility device with which to make these tests.

Pressure waves.—The ignition of a gas mixture by an explosive is a process influenced by the pressure wave the explosive sends out. This wave, which is reflected from the walls, roof, and floor of the working place, increases the pressure and temperature of the gas mixture, hence the safety of an explosive when fired into an inflammable-gas mixture also depends upon the size of the chamber in which it is fired. The Schlieren method of photography is being used to measure the speed and relative position of the pressure wave sent by permissible explosives.

Limits of inflammability of gases.—The limits of inflammability of combustible gases, and mixtures of gases, found in mines, manholes, and many industrial processes, have been determined in the explosives-chemical laboratory. Correlation of the results of many

such determinations has aided the development of a method of calculating the inflammability of gaseous mixtures from chemical analyses. Several successful applications to practical field problems have proved this method of calculation. A study has also been made of the mechanism of the initiation of gas explosions.

Conclusions.—Black blasting powder, dynamite, liquid oxygen, and other explosives of special types have caused countless explosions. Such explosives will not pass the Bureau's tests for permissibility and will readily ignite firedamp and coal dust. Discontinuance of the work of the explosives division would undoubtedly lead to disastrous explosions in coal mines, caused by use of long-flame explosives and black powder. The economic losses caused thereby would be many times larger than the cost of maintaining the permissibility tests.

HELIUM DIVISION

Production record.—The Amarillo helium plant, which produces all lifting gas used in Government airships, established two new records during the year—an average purity of 98.20 percent and an average recovery of 90.12 percent, attained in processing a natural gas containing 1.8 percent of helium. Continuing research in the cryogenic laboratory gave information of great importance on the conservation, production, and purification of helium.

The output of the Amarillo plant in 11 operating months of the fiscal year 1933 was 14,749,960 cubic feet of helium, which fully supplied the Army and Navy. This plant, with the 50,000 acres of gas lands, wells, and pipe line acquired by the Government, represents less than one fourth of the total capital investment in helium properties. It has used less than one seventh of the funds that have been spent in helium-plant operation. Nevertheless, in about 4 years of operation it has produced 52 million cubic feet of helium—nearly one half of all helium ever recovered in the world—and has barely commenced its useful life.

OFFICE OF CHIEF MINING ENGINEER

Outstanding features were the increased acceptance by the coal-mining industry of Experimental-Mine findings on coal-dust-explosion prevention and establishment of regular exchange of information on mine-safety problems with European testing stations. Under agreement with research stations of Great Britain, France, Belgium, and Germany quarterly reports were interchanged, supplemented by correspondence on specific studies, such as safety in multiple shot firing in coal mines.

Mine safety board.—New decisions were made on ventilation, supporting roof, guarding mine openings, barrier pillars, electric-wire protection, and checking men in and out of mines. A report embodies 25 decisions.

Experimental Mine investigations.—Tests of four Kentucky coals and three from the Pocahontas field, W. Va., determined the relative explosibility of the dusts therefrom. The results gave definite data concerning the rock dusting required. The relative power of different sources to initiate dust explosions were studied. Tests of dif-

ferent concentrations of coal dust in air developed analogies to gas-air explosions, such as a lower limit of concentration for flame propagation and a point of maximum explosibility. Bulletin 364, Laboratory Testing of the Inflammability of Coal and Other Dusts, was issued; Bulletin 369, Explosion Tests of Pittsburgh Coal Dust, 1925–32, is in press. Other research related to the compressibility and bearing strength of coal as a buttress for ventilation stoppings and hydraulic dams; a report thereon was issued as Technical Paper 527.

Special duties.—Data on subsidence of the surface from mining adjacent to the Experimental Mine, and on subsidence of a concrete-lined shaft near Uniontown, Pa., were reported in papers prepared for the American Institute of Mining and Metallurgical Engineers. Other work related to gases from coal, bumps, and other ground movement, steel roof supports, and mining petroleum by underground methods; the latter was covered in Bulletin 351.

ECONOMICS BRANCH

COAL DIVISION

Service to coal industry.—Prompt reports that follow supply and demand, and detailed annual publications that trace the underlying changes in the industry, providing a background for the current service, are among the features of an information service maintained by the division for coal producers, distributors, and consumers.

The annual reports are based on a canvass of each producing unit of the coal, coke, and fuel-briquetting industries. To reduce the cost of the current statistical studies, however, they have been collected, wherever possible, through trade agencies. In 1932–33 this policy was extended with further saving to the Government. A cooperative arrangement was made with the National Association of Purchasing Agents for it to collect and summarize current data on coal stocks and consumption from manufacturing consumers, and forward detailed returns to the Bureau. These returns are then consolidated with others collected directly by Government agencies, and a joint report certified by statisticians of the Bureau and the association is prepared. The system has been satisfactory, improving the accuracy of results, reducing the cost to the Government, and freeing industry from the burden of overlapping questionnaires. It has also accelerated collection, so that monthly reports of stocks and consumption of industries are published before the end of the following month.

Cooperative agreements were also made with railroad-traffic associations for publication of current analyses of the origin and destination of west-bound coal from the Appalachians and from Illinois, Indiana, and western Kentucky. This record will be widely used by shippers, buyers, and carriers of coal.

In all, 21,395 individual services were rendered during the year by mail, telephone, and personal interviews, exclusive of the distribution of regular publications to established mailing lists.

Economies in publication.—Large economies were effected in publication costs by combining reports and condensing tables to utilize

available space more efficiently. Editions were reduced, and the assistance of the coal-trade associations was obtained in reprinting extra copies. The Monthly Coal-Market Summary, formerly distributed direct by the Bureau, is now issued through the coal-trade journals. These and other economies have reduced printing costs from $8,000 to $2,000 a year, a saving of 75 percent, and the service has been improved.

Special investigations.—Special investigations covered by reports during the year include the following: County analysis of fuel consumption and power production by public-utility power plants, showing the regional competition of coal, fuel oil, natural gas, and water power in the generation of electricity; distribution of Pennsylvania anthracite; use and distribution of New Mexico coals; progress of mechanization in bituminous-coal mines; and use of underground loading machines in the anthracite industry.

Government fuel yards.—The Government fuel yards purchase and distribute fuel to all Federal and District Government buildings and establishments (except the Washington Navy Yard) in the District of Columbia, and to such institutions outside the District as can be economically reached. The establishment maintains its own garage and 46 heavy duty and light delivery trucks; its coal-handling plant has a storage capacity of more than 13,000 tons of coal. During the fiscal year there were delivered, to more than 500 points, 254,999 gross tons of coal, 278 tons of coke, 110,148 barrels of fuel oil, 21,188 bushels of charcoal, and 505 cords of wood. In addition, materials were hauled and motor vehicles repaired for other branches of the Government. The total value of fuel delivered and service performed was $1,348,129.42. The trucks traveled 205,303 miles, with an average round-trip haul of 6.96 miles. The fuel yards operate under a revolving fund maintained by sales of fuel and reimbursement for service performed.

Conclusions.—Until recently the demand for the division's services has come almost entirely from business men interested in guiding detailed operations of individual firms. In the last year new concern for reorganization of industry and advance planning is manifest, and the division receives many calls for information on problems connected with orderly control of production. Business statisticians seek to measure the rate of industrial change and to forecast supply and demand. In all such work the division's service is limited to finding and certifying the facts that may be established by the statistical record or derived immediately therefrom.

MINERAL STATISTICS DIVISION

Advances in 1933.—Statistics on minerals are needed more promptly than in the past. In response to this need, and despite reductions in personnel, the mineral statistics division accomplished earlier release of annual figures and maintenance of current statistical services.

In consequence the preliminary annual reviews for 1932 on most important commercial minerals were published within 3 months after the end of that year, closely followed by final statistics on the various mineral products. On June 15 the new Minerals Yearbook, com-

prising 61 chapters, 819 printed pages, and 90 illustrations, was sent to the printer. Completion of this report—which includes economic and technical discussions as well as statistics on all important commercial minerals—within 6 months after the end of the year represented a gain of more than 12 months over preceding years in preparation of the annual volume on mineral resources.

Through 108 annual statistical surveys of metallic minerals and important nonmetallic minerals, except mineral fuels, this division compiles essentially the only market information available regarding supply, demand, and utilization of specific mineral products. It prepares about 60 studies for publication in the Minerals Yearbook, compiles statistics on world production, enters into cooperative agreements for statistical studies with certain State geologists and mine inspectors, and maintains field offices at Denver, Colo., Salt Lake City, Utah, San Francisco, Calif., and Joplin, Mo., both for collection of data and for direct service to the mining industry. The field offices also prepare for publication 14 annual reports covering metal mining in all important producing areas.

PETROLEUM-ECONOMICS DIVISION

Production data on special naphthas, such as painters' and cleaners' naphthas and rubber solvent, all previously reported under the general heading of gasoline, were added to the monthly petroleum statement in 1932, increasing its scope. Information covering receipts of crude oil on the Atlantic seaboard, according to fields of origin, was also added during the year; shipments of crude oil to East-coast refineries constitute the largest movement in this country.

Study of automobile travel was continued, as related to gasoline supply and demand. This investigation covers trends, seasonal variations, and distribution of automotive traffic. The main problem is to determine the extent to which the increased use of motor vehicles has influenced the demand for gasoline.

A list of the 20 producers of liquefied petroleum gases in the United States was compiled and issued.

Service work.—The division assisted the Federal Oil Conservation Board in preparing reports on the conservation of oil and gas; it furnished advice concerning Government purchases of petroleum products and natural gas, definite savings in such purchases being accomplished. Similar assistance was rendered other Government agencies.

Annual reports.—Some changes were made during the past year in the division's annual reports. In other years the petroleum chapter of Mineral Resources of the United States and a bulletin entitled "Petroleum Refinery Statistics" have been issued separately, but beginning with 1931 the two publications have been combined as one Mineral Resources chapter, entitled "Crude Petroleum and Petroleum Products." Chapters on Natural Gas, Natural Gasoline, Carbon Black, and Asphalt and Related Bitumens were also prepared. The surveys of refineries and cracking plants were combined and issued as one report, Petroleum Refineries, Including Cracking Plants, in the United States. The report, Fuel Consumption at Refineries, was also issued.

Mineral market reports.—A survey covering liquefied petroleum gases in 1932 was issued as a mineral market report, as was the 1931 national survey of fuel-oil distribution. This group also included preliminary reports on petroleum, natural gas, natural gasoline, carbon black, and asphalt and related bitumens. Statements of production of crude oil and natural gasoline in foreign countries were also issued as mineral market reports.

Conclusions.—The increased production of natural gas, coupled with the continued expansion of distribution facilities, has increased public interest in developments, but the division has few employees and it is impossible to issue current figures on natural gas when and as desired by the industry. This commodity consequently remains the only important mineral fuel for which monthly figures on production and utilization are not available.

RARE METALS AND NONMETALS DIVISION

Basic economic data, including statistics on production and consumption of nonmetallic minerals, and various industrial barometers, constituting a background for studies of individual commodities, have been tabulated by the rare metals and nonmetals division and many charts prepared. To aid in shaping the future course of the nonmetallic-mineral industries, a 52-year history (1880–1931) was compiled and published. Other phases of this activity embraced studies of trends in the output of building materials of nonmetallic-mineral origin, compared with building contracts.

A special service to the aggregate industry has been established in the form of current quarterly estimates of production based on rail and water shipments, cement sales, and other indexes. An economic study of the cement industry, including a market analysis, has progressed. A comprehensive economic survey of the lime industry, dealing particularly with consuming industries and market trends, has been completed.

Reports.—Although printing funds were reduced greatly, the division continued to make available through various channels economic data regarding the commodities for which it is responsible. As published Bureau reports and articles accepted by the technical press were inadequate to meet the need, typewritten office memoranda were made to loan. Subjects covered by reports, memoranda, and press articles include stone, sand and gravel, light-weight aggregates, lime, arsenic, antimony, mercury, alkaline earths, amber, asbestos, greensand, and various other mineral commodities. Many information circulars prepared by the division are now out of stock, and, to meet the constant demand for the data, a small loan collection is available to interested persons.

With the completion of 20 additional digests of foreign mineral laws, the series is virtually finished, making information available on the mining codes and ancillary legislation of about 100 countries. Text was prepared for 13 Mineral Resources (1931) chapters and 10 Minerals Yearbook (1932–33) chapters.

COMMON METALS DIVISION

An unusual number of analytical memoranda and much other material for use by various units of the Bureau, other Government agencies, and members of the Congress were prepared by the division. Especial stress was laid upon studies of the monetary metals. Investigations of antimonial lead and litharge-glycerine cement were made for the War Department.

The Mineral Resources chapters on Copper, Lead, Zinc, Lead and Zinc Pigments, Tin, Bauxite and Aluminum, Manganese, Chrome, and Sulphur and Pyrites for 1931, and corresponding Minerals-Yearbook chapters for 1932–33 were both written in the past year. Information circulars on Chromite and Manganese were published.

A method was developed for estimating the production of sulphuric acid, including byproduct acid from smelters. Index figures for world mineral production were worked out as a basis for showing production relations of mineral commodities by quantity, value, and geographical distribution. Early records regarding copper stocks were compiled, and consumption of manganese in the chemical and battery industries was ascertained. The further development of data files containing fundamental material in regard to the common metals largely increased their value.

HEALTH AND SAFETY BRANCH

HEALTH DIVISION

Toxic gases and vapors.—The toxicity and health hazards of the vapors of methanol, benzol, butanone, pentanone, hexanone, n-butyl acetate, secondary amyl acetate, dichloroethyl ether, methyl cellosolve, and butyl carbitol were studied. Most of these chemicals represent new developments in the production of organic chemicals from coal and petroleum products, in some instances from what were heretofore waste gas. The information obtained was a basis for promoting safety in the manufacture, distribution, and use of these products.

Harmful dusts.—The tissue response produced by intraperitoneal injection of a wide variety of dusts into guinea pigs has been studied and a method developed to serve as a criterion of the harmful properties of dusts and the fundamentals of the reaction to dusts. A report of this work is being prepared.

A bacteriological study of pulmonary infection in pneumoconiosis was made in conjunction with other studies in silicosis. Three reports dealing with pulmonary infection in pneumoconiosis have been prepared: (1) Fuso-Spirochaetal Infection of the Lungs in Silicosis; (2) Symbiotic Requirements for the Causation of Fuso-Spirochaetal Disease; and (3) Experimental Reproduction of Fuso-Spirochaetal Lesions of the Lungs.

The importance and need of research pertaining to injury from industrial dusts are manifested in the increasingly wide occurrence of dust diseases; in the pending claims for compensation, estimated

to aggregate several million dollars, with conditions that will tend to foster continued filing of claims; in the lack of understanding and appreciation of the hazards by many workmen and industries; and in the compensation claims that harass the mining, metallurgical, and quarrying industries.

Owing to the decrease in funds available to the Bureau, investigations and research that apply directly to toxicology and health hazards from gases, vapors, and dusts were recessed at the end of the year.

Gas masks and respirators.—Owing to the many inefficient and therefore dangerous respirators available on the market, procedures for testing dust respirators are being developed, and a schedule of requirements for safe devices has been started. The Bureau's continued work on problems of respiratory protection against industrial gases, and its approval system, are important factors in raising standards and making available safer and more efficient devices.

Stream pollution.—Continued investigation of means for mitigating stream pollution by acid coal-mine drainage has confirmed the practicability of sealing worked-out or abandoned mines or similar sections of active mines to exclude air but not necessarily retain water. This has been demonstrated in the laboratory and in a group of mines placed at the Bureau's disposal for study by the courtesy of the owners. In many instances, acidity disappeared in a relatively short time, and the water became alkaline—a natural and desirable condition. In all instances, the acidity has been markedly reduced, and the reduction is progressing in all mines under observation. It is believed that a continuance of the observations will show conclusively that it is a practicable procedure for reducing the acid in domestic and industrial water supplies and consequently the corrosion and water-treatment problems and costs which have economic importance to many communities. It has been demonstrated that mine operators will benefit through reductions in the cost of replacing pump lines and pump equipment. Moreover, sealing worked-out and abandoned parts of the mines will reduce ventilation problems and costs, and in many instances promote safety from explosions. The suggested procedure could readily be applied to the hundreds of abandoned coal mines throughout the country, the ownership or responsibility of many of which is in doubt or lost, but which continue to contribute acid drainage, sometimes for as long as 50 years.

An investigation of metal-mine mill-tailings pollution of the Coeur d'Alene River and Lake (Idaho) was completed, and a report submitted to the attorney general of the State of Idaho. This work was undertaken at the request of a commission to ascertain facts relative to a controversy between the residential, agricultural, and mining interests.

Silicosis study.—Two reports on the Picher (Okla.) investigation (discontinued June 30, 1933) were published during the year as Bureau of Mines Technical Papers 545 and 552, Silicosis and Tuberculosis Among Miners of the Tri-State District of Oklahoma, Kansas, and Missouri—I and II. Three other reports on the work are ready for publication.

Analysis of mine gases.—During the year, 1,839 gas samples were received and analyzed. Of this number, 1,686 were from coal and

metal mines, collected and analyzed in connection with determining the cause of mine explosions, the control and extinguishing of mine fires, and the promotion of safe and hygienic working conditions.

SAFETY DIVISION

Safety records of 1931 and 1932.—A low record for mine accidents in both coal and metal mining was made in 1931, and the rate in 1932 was almost identical, although, in the past, periods of financial depression with recession of activity in mining have been almost invariably accompanied by sharp increases in such accidents. In 1931, 1,463 persons were killed in the coal mines of the United States, and tentative figures for 1932 give 1,166, to be compared with an average of 2,409 annually for the previous 25 years; the 1931 fatality rate of 3.31 persons killed per million tons of coal produced is the lowest in the present century, and that for 1932 appears to have been about the same.

Various factors in mining account for the excellent safety record in 1931, 1932, and the first half of 1933, but doubtless the activities of the Bureau of Mines in advancing health and safety in mining are having a vital influence. During the past 6 years, over 460,000 persons in the mining and allied industries have been given the Bureau of Mines course in first aid or mine rescue, and numbers of mining men believe that the first-aid-trained man is but one half to one eighth as likely to be injured as he who has not had this education in safety. Rock dusting, long advocated by the Bureau as a preventive of widespread explosions, is now responsible for the stoppage of many coal-mine explosions; the resultant annual saving of lives amounts to several hundred. Similarly, perhaps largely as a result of activities of the Bureau, many accidents that might have been caused by falls of roof, haulage, explosives, electricity, and other things, are now prevented; proof of this appears in data from individual mines, mining companies, and other organizations, and from State inspectors where cooperative safety activities and campaigns have been put into effect.

Safety training.—During the past fiscal year, the safety division, with its total field personnel of 25 engineers and 32 safety instructors, gave 74,501 courses in first aid or mine rescue to persons in the mineral industries in 578 communities in 36 States and Alaska. To date, the Bureau has given these courses to 755,650 persons in the mineral industries, more than half in the last 4 years.

To June 30, 1933, Bureau of Mines certificates had been issued to 1,037 mineral plants, indicating that all employees have received the first-aid course. During the past fiscal year, 231 of these 100-percent certificates were issued, covering the training of 38,852 persons.

The accident-prevention course for the instruction of bituminous-coal-mining officials in up-to-date methods is so extensive that several weeks are required for it, and necessarily the classes are relatively small. During the past year, this course was given to 958 mining officials; nearly 600 others took part of it. Since its start in the autumn of 1930, 4,411 bituminous-coal-mining officials have taken the full course.

First-aid instructors' certificates numbering 1,196 were issued to persons in 26 States and Alaska; Pennsylvania led with 625, Ken-

tucky was second with 161, Alabama third with 108, and West Virginia fourth with 97. The 55 members of the safety division of the Bureau giving first-aid training are yearly bringing the full course of first aid to between 70,000 and 100,000 persons in the mineral industries.

Holmes Safety Association.—At the March 6, 1933, meeting of the Joseph A. Holmes Safety Association, which is sponsored by the Bureau, and of which the Director serves as president, 2 gold, 5 silver, and 3 bronze medals, and 2 certificates, were awarded to individuals for deeds of heroism; for outstanding achievements in safety, certificates of merit were awarded to 18 individuals, 28 bituminous-coal mines, 3 anthracite mines, 18 metal mines, 2 petroleum companies, 1 smelter, 4 nonmetallic mineral mines, and 2 miscellaneous mining organizations.

The past year has been the most active in organizing community safety clubs as Holmes safety chapters; 40 new chapters were established in 8 States—24 in Pennsylvania, 6 in Iowa, 2 each in Indiana, Kentucky, Louisiana, and Virginia, and 1 each in West Virginia and Arkansas—a total of nearly 200 chapters now functioning actively, with membership approximately 60,000. During the year, Bureau field men made safety talks before about 250 Holmes-chapter meetings.

Aid at accidents.—In the past year, contacts were made by safety-division personnel with accidents in the mineral and allied industries as follows: 22 explosions in 10 States, 122 persons being killed and 34 injured; 27 fires in 14 States, 2 persons being killed and 5 injured; 54 miscellaneous accidents in 13 States, 62 persons being killed and 35 injured. Three major explosion disasters in bituminous-coal mines occurred in December, 1932, but the other 11 months of the year were free of them—the greatest period of immunity from major disasters in any fiscal year in the history of modern coal mining in the United States.

Safety inspections.—The safety inspections and reports on mines and other plants in the mineral industries continued; 229 reports, based upon safety examinations or inspections of mining properties, were made by safety-division field men during the year; 70 were transmitted to operators for their information, but no reports of this type are published. These examinations and reports covered 33 States and Alaska.

Safety meetings.—Attendance at safety meetings and general participation in the proceedings or discussions are part of the duty of the personnel of the safety division; usually these meetings are held at night and are attended after a full day in or around mines forwarding some phase of the Bureau's safety work. During the year, field men attended 639 safety meetings in 30 States and Alaska, at which about 112,000 persons were in attendance.

Special studies.—Numerous special safety and health studies were made, one of the most important being an investigation of illumination in 20 mines which revealed that in general the light available to miners, in spite of their hazardous work, is only about that obtainable from moonlight on the surface. The use of explosives in mines, the dustiness of mine air and its effect on health, conditions causing various accidents in mines, items that go into the cost of accident

occurrence in the mining industry, the use of protective clothing, and various other phases of safety in mining were studied. More than 50 papers were published.

Conclusions.—The drastic curtailment of safety-division funds in the fiscal year 1932–33 materially diminished the effectiveness of its work; nearly all the decrease had to be applied to the travel of field personnel, and without direct contact with workers in the mining and allied industries the opportunity for achieving results in accident prevention is seriously handicapped. One result is temporary abandonment of 8 of the 10 mine rescue cars; moreover, the safety workers are greatly reduced in number, and in ability to function effectively. Bureau of Mines accident-prevention activities have a vital influence on safety in mining, and any diminution of these functions soon will be reflected in serious recessions in the safety rates and safety records of American mines.

Perhaps the most important change that could be made to increase the effectiveness of the Bureau's safety work, provided it were given adequate personnel and money, would be the grant by the Congress of authority to enter mines to make safety investigations and to make the findings public; this would not include power to enforce recommendations.

DEMOGRAPHICAL DIVISION

Achievements.—The various statistical studies conducted by the demographical division disclosed facts of interest and importance:

1. The quarrying industry lowered its accident rate in 1932 from that in the previous year. Incomplete reports indicated reduced accident rates also for anthracite and bituminous-coal mining.
2. At least two comparatively large bituminous-coal mines operated without a lost-time injury to their employees.
3. Operators' reports to the Bureau indicate an increase in the use of rock dusting to prevent explosions in coal mines.
4. The coal-mining industry has been free of major explosions since December 23, 1932.

Coal mines.—As previously stated, during the calendar year 1931, there were 1,463 fatalities and 80,349 nonfatal injuries in coal mines, compared with 2,063 fatalities and 103,821 nonfatal injuries in the previous year. In 1931, for every million man-hours of employment in the coal mines of the country there were 2 fatalities and 100 nonfatal injuries, the latter ranging from 28 in Alaska to 153 in Utah.

Metal mines.—Studies of accidents at the same metal mines during 1931 and 1932 showed a reduction in the latter year of 35 percent in the number of accidents, but a 5-percent increase in the frequency of accidents per million man-hours of exposure. Each employee averaged 1,655 hours of employment during the year, or 32 hours per week on a basis of 52 weeks to the year.

Nonmetallic-mineral mines.—The mines of the United States producing nonmetallic minerals other than coal effected a reduction of 36 percent in the number of accidents, and of 3 percent in the accident rate.

Stone quarries.—Complete reports covering the stone-quarrying industry, which includes such allied industries as the manufacture of cement and lime, revealed a decrease of 18 percent in the number of

men and a reduction of 6 percent in the accident-frequency rate per million man-hours of exposure.

Metallurgical plants.—This type of plant usually has fewer fatalities and nonfatal injuries than any of the other above-mentioned industries. Exclusive of the steel industry, the records for identical metallurgical plants show a slight decrease (1 percent) in the frequency of accidents per million man-hours of exposure to accident hazard.

Coke ovens.—The accident rate for the coke industry was reduced 17 percent in the calendar year 1932.

Accident-prevention contest.—The eighth annual safety competition was conducted among more than 300 large mines and quarries in the United States with extremely gratifying results. Analytical studies of the company reports showed that 2 bituminous-coal mines, 3 metal mines, 13 nonmetal mines, and 82 quarries were operated throughout the year without a lost-time injury to any employee. Several other plants were operated with but few lost-time injuries, giving them favorable safety records.

Explosives used in the United States.—Statistics were collected to determine the quantity and kind of explosives used in the United States, and the quantity used for mining and for other purposes; the quantity of explosives manufactured for industrial use in 1932 was less than in any of the 21 years for which information is available.

Conclusions.—Accident statistics supply fundamental data needed in determining the factors involved in accident occurrence and make possible intelligent programs of prevention. Bureau of Mines statistics, prepared on a uniform and comparable basis for all States, are made available to the mining industry, State mining officials, compensation commissions, and insurance companies, and constitute a potent factor in the promotion of safety in the mineral industries.

ADMINISTRATIVE BRANCH

OFFICE-ADMINISTRATION DIVISION

Personnel.—On June 30, 1933, there were 739 full-time appointed employees on duty at the Bureau, and in addition there were 5 full-time cooks hired under field agreements. The appointed employees were distributed as shown in the following table.

	Classification and number of appointees				
	Professional	Subprofessional [1]	C.A.F.	Custodial [2]	Total
Washington	[3] 49	4	169	58	280
Pittsburgh	[4] 91	44	51	53	239
Field in general	[5] 119	28	42	31	220
Total	259	76	262	142	739

[1] Includes instrument makers, safety instructors, laboratory aids, assistants, etc.
[2] Includes motor-truck drivers, janitors, laborers, messengers, etc.
[3] Engineers, 22; chemists, 4; miscellaneous, 23; total, 49.
[4] Engineers, 46; chemists, 34; miscellaneous, 11; total, 91.
[5] Engineers, 56; chemists, 33; miscellaneous, 30; total, 119.

NOTE.—Total, engineers, 124; chemists, 71; miscellaneous, 64; grand total, 259.

In additon to the foregoing full-time employees, the following persons were engaged on a when-actually-employed basis: 74 laborers, etc., employed on field agreements; 9 consulting engineers, chemists, etc.; and 64 other employees holding classified, unclassified, or excepted appointments on a part-time basis, making a total of 891 employees, a decrease of 101 employees as compared with the number on duty on June 30, 1932.

Property.—The property records of the Bureau, as of June 30, 1933, show accounts as follows:

Automobiles and trucks	[1] $271,947.40
Canvas and leather goods	2,985.84
Drafting and engineering instruments	9,926.37
Electrical equipment	64,686.67
Hardware and tools	33,087.93
Household equipment	19,863.93
Laboratory apparatus	468,835.66
Medical equipment	8,355.61
Office furniture and equipment	[1] 296,372.80
Photographic apparatus	26,806.45
Machinery and power-plant equipment	[1] 1,287,223.16
Land, buildings, and improvements	[1] 1,842,860.21
Rescue cars and specialized apparatus	403,678.31
Grand total valuation	4,736,630.34

This property is in Washington and at various field stations and offices of the Bureau.

INFORMATION DIVISION

Publications.—During the past year, this division supervised the distribution of 285,500 copies of the Bureau's printed publications. In addition, approximately 100,000 copies were sold by the Superintendent of Documents.

Numerous brief press statements, announcing the issuance of new publications or describing current investigations, were furnished to the daily and technical press.

Exhibits.—The division prepared, installed, and supervised seven exhibits at expositions and conventions illustrating various Bureau activities.

Editorial.—During the past year, 8 bulletins, 24 technical papers, 1 economic paper, 57 mineral-resources separate chapters and 1 bound volume, 61 chapters for the new volume on mineral statistics entitled "Minerals Yearbook, 1932–33", and 5 miscellaneous papers—157 publications in all—were edited and sent to the Printer. Owing to lack of printing funds, however, only part of the Bureau's output could be issued in this manner; consequently, 154 papers were published in the technical and trade press, by technical societies, cooperating educational, State, and municipal institutions, and similar outside agencies.

The information division also edited 18 reports of investigations and 78 information circulars. These papers supply promptly to the mining industry and the general public the essential results of the Bureau's investigations, which are usually described in detail in later reports, or present salient facts on subjects of interest in a concise form suitable for use in replying to inquiries.

[1] Includes Government fuel yards equipment.

Motion pictures.—The Bureau has a large number of educational motion-picture films, which show where essential minerals are found and how they are extracted from the earth, refined, and manufactured into useful products. The prevention of accidents and the protection of human life have been given special attention, and several pictures deal specifically with this important subject. These films are prepared under the supervision of the information division and are made possible through the cooperation of industrial concerns which defray the entire cost of production. On June 30, 1933, the Bureau's library contained 988 sets of films, including 2,104 reels, aggregating 1,600,000 feet.

Circulation of the Bureau's films is centralized at the Pittsburgh Experiment Station; but there are 13 subdistribution centers throughout the country, selected with regard to accessibility. The films are loaned without cost, to schools, churches, clubs, civic organizations, and other responsible borrowers. During the year, films were shown on 34,638 occasions before an estimated audience of 2,996,000 persons.

GENERAL CONSIDERATIONS

Mining is the second largest industry, being exceeded only by agriculture. It is of basic importance, and since the Bureau is one of the few governmental agencies directly serving this industry, it is deserving of substantial financial and moral support at the seat of government. Appropriations for the Bureau of Mines have always been relatively small, yet the services rendered by this group are of immense value in increasing safety and efficiency, preventing waste, and fostering economic development in the mineral industries. It is hoped that a better understanding of the high aims and purposes of the Bureau may be brought about, and a realization of the good it is doing may come to those most concerned with its problems and most affected by its results.

Next to whole-hearted public support, a laboratory near headquarters is of most importance to the Bureau. Such a laboratory was authorized by the Congress in 1931, and the State of Maryland has fulfilled its part of the program by deeding to the United States a fine 20-acre tract on the campus of its university. It remains for the Federal Government to complete its share by providing funds for the erection of the building. The reasons were summarized in the Bureau's annual reports for the past 2 years. This is a most pressing need.

FEDERAL EMPLOYMENT STABILIZATION BOARD

The advance construction plans of the one hundred odd construction agencies of the Federal Government and the District of Columbia, covering the 6-year period 1935–40, were requested by the Board in accordance with the Stabilization Act of 1931.

The latter part of May, in contemplation of the National Industrial Recovery Act, these agencies were asked to supplement their 6-year plans with additional schedules from which an emergency public-works program could be quickly drafted. These supplementary schedules embraced more than 30,000 items, including reconditioning, and represented a potential outlay for Federal construction in excess of $1,000,000,000.

The Board immediately proceeded with a study and analysis of both the 6-year and supplemental plans and, due to its past experience in planning of Federal public works, an emergency program was readily developed and made available to the Public Works Administrator as soon as he was appointed.

It was the intent of Congress, as provided in the act, that advance planning should be sufficiently flexible to enable its application in times of emergency, thereby aiding in increasing employment and permitting the Government to avail itself of the opportunity for speedy, efficient, and economical construction during a depression period.

The emergency program, as constructed under the guidance of this Board, proved to be the only immediately substantial and serviceable medium available to the Public Works Administrator in the allocation of funds for Federal construction, as provided for in the National Industrial Recovery Act. Without the planning activities of the Board, this emergency program would have suffered several months' delay with consequential inertia in the construction industry and further direct and indirect unemployment in the building field.

In accordance with Executive Order No. 6174, dated June 16, 1933, D. H. Sawyer, Director of the Stabilization Board, was named by the President to exercise temporarily the office of Federal Emergency Administrator of Public Works. The facilities of the Board were immediately utilized and its emergency planning programs and part of its personnel now constitute the basic organization of the Federal Projects Unit of the Public Works Administration.

At the present time, the past 2 years' planning activities of the Board take on added significance, both in the public works and economic fields, and its experience and influence are being fully utilized by the Tennessee Valley Authority, Central Statistical Board, Planning Council, and the planning board of the Public Works Administration. Planning, in its many phases, plays a most important part in the execution of the President's recovery program, and the

Stabilization Board is and will continue to be in an excellent position to render assistance to the economic and planning units of the newly created emergency agencies.

The flow of direct and indirect employment in the expenditure of the construction dollar from normal annual appropriations has been closely observed and analyzed by the Board. The contemplated expenditure of the $3,000,000,000 in the construction field more than ever warrants careful scrutiny, analysis, and interpretation of construction data. The progress of the work undertaken, the volume of construction under way, the varying construction costs, contracts awarded, man-months of direct and indirect employment, shipment of building materials, monthly expenditures on construction, etc., are all pertinent factors which must be utilized to gage the effectiveness of the emergency public-works program. In handling these economic factors since the passing of the Stabilization Act, the Board has become thoroughly conversant with the technique incident to their compilation, has developed standard formulas of computation, and has cultivated many reliable sources for information of this character.

INTER-AMERICAN HIGH COMMISSION

Following is a summary report for the fiscal year 1932–33 of the activities of the United States Section, Inter-American High Commission, the chairmanship of which was held by succeeding Secretaries of Commerce from March 1921 to March 1933.

The reduced staff of the section was concerned with the preparation of manuscript for documentation for the Seventh International Conference of American States to convene at Montevideo, Uruguay, December 1933. Four studies under the subjects of Uniformity in Marine Insurance Law, General Average, Legal Personality of Foreign Corporations, and Comparison of Rome and Habana Conventions for the Protection of Literary and Artistic Work were prepared and submitted to the Pan American Union for the use of delegates to this meeting.

Congress made no appropriation of funds for the continuance of a separate staff to carry on the duties of this section during 1934, indicating that this work could be prosecuted effectively by the present personnel of the Department of State. Accordingly, during the latter half of the year the archives, files, and library were condensed and preparations were made to transfer them to the State Department. These records are now being moved and disposition of furniture and equipment is being made in accordance with instructions, or by approval, of that Department.

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