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Chapter 7

# Waterways

Among the transportation agencies considered in this book, waterways are by far the oldest. In colonial times water surely played a far larger role than land transportation. Early accounts indicate that this was true both for passengers and for freight. Trade and travel between the colonies was almost exclusively by sea. The westward movement took advantage of lakes and rivers, soon supplemented by canals. As the nineteenth century advanced and the railroad came, the relative importance of waterways in the total transportation picture must have declined steadily. At what date this decline ceased it is impossible to say. All we know definitely is that between 1889 and 1939 waterway traffic grew at about the same rate as the traffic of all agencies combined. Its relative position in the total transportation picture scarcely changed in fifty years.[1] Yet the composition of total waterway traffic changed markedly.

## WATERWAYS IN 1939

Waterways (including ferries) had but half as many passengers as steam railroads, and less than one-fifth as much passenger revenue. A comparison based on freight traffic is somewhat more favorable to water transportation. Indeed the 410 billion ton-miles reported by us for waterway freight traffic in 1939 was substantially larger than the 335 billion furnished by steam railroads. However, waterways earned less than one-quarter the gross revenues collected by steam railroads (Chapter 1 above).

[1] However, if 'total transportation' is broadened to include private automobile travel, and traffic in trucks operated by owners of the freight carried, then we have to modify this statement. In that case, the share (of waterways in the total) declined between 1889 and 1939. (Freight carried in ships operated by owners of the freight is included in all our measures of waterway traffic, and cannot be segregated; private automobile and private freight traffic is not included in our measures of highway transportation.) For further discussion see Chapter 2 above.

Table 30

WATERWAYS: PASSENGER AND FREIGHT TRAFFIC, 1939[a]

Short tons, statute miles

| | PASSENGER TRAFFIC | | | | FREIGHT TRAFFIC | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Revenue passengers*[b] (mil.) | *Revenue passenger-miles*[c] (bil.) | *Average journey*[c] (miles) | *Passenger revenue*[d] ($ mil.) | *Revenue freight shipped*[e] (mil. s.t.) | *Revenue ton-miles*[e] (bil.) | *Average haul*[e] (miles) | *Freight revenue*[f] ($ mil.) | *Revenue per ton-mile* (cents) | *Total Transportation Revenue* ($ mil.) | % |
| Coastwise | 17.7 | n.a. | n.a. | 4.7 | 141 | 174 | 1,230 | 225 | 0.13 | 230 | 29 |
| Intercoastal | 0.009 | 0.050 | 5,900 | 1.6 | 8.37 | 51.9 | 6,200 | 82 | 0.157 | 84 | 11 |
| Great Lakes (domestic only) | 5.35 | 1.5 | n.a. | 9.6 | 113 | 69.0 | 609 | 74 | 0.107 | 84 | 11 |
| Inland | 12.7 | | n.a. | 8.5 | 329 | 19.9 | 61 | 82 | 0.4 | 90 | 11 |
| Noncontiguous | 0.131 | 0.218 | 1,660 | 10 | 6.13 | 15.7 | 2,560 | 80 | 0.5 | 90 | 11 |
| International, American-flag | 0.384 | 0.927 | 2,410 | 41.8 | 23.0 | 79.5 | 3,460 | 167 | 0.200 | 209 | 26 |
| Ferries | 223 | n.a. | n.a. | 7 | .... | .... | .... | .... | .... | 7 | 1 |
| TOTAL | 259 | n.a. | n.a. | 83 | 622 | 410 | 660 | 710 | 0.17 | 793 | 100 |
| International, foreign-flag | .745 | 2.314 | 3,110 | 93.9 | 80.7 | 360 | 4,460 | 575 | 0.160 | .... | .... |

n.a.: not available

[a] The various waterways are defined in note c to Table 3 above; see also text of this chapter.

[b] Regular and excursion passengers were 19.0 mil. for Atlantic, Gulf, and Pacific coasts and 5.41 mil. for Great Lakes (U. S. Army, Chief of Engineers, *Annual Report, 1940,* Part 2, p. 30). According to correspondence with the War Department these figures include 'all passengers embarking and disembarking at United States ports and those traveling on the waterways'. To obtain totals for coastwise and Great Lakes (domestic), we therefore deducted foreign and noncontiguous arrivals and departures (all flags) numbering 1.3 mil. and 0.06 mil. respectively (U. S. Maritime Commission Report 2610, 'Water-Borne Foreign and Noncontiguous Commerce and Passenger Traffic', for 1939). The extent to which the resulting totals include both arrivals and departures (i.e., double counting of passengers) in domestic traffic is not clear. Intercoastal passengers were extrapolated from the 1937 figure (22 thousand: see U. S. Maritime Commission Report 157, 'Water-Borne Passenger Traffic', for 1937) using passenger revenue (U. S. Board of Investigation and Research, *Comparison of Rail, Motor and Water Carrier Costs,* 79th Cong. 1st Sess. Senate Document 84, p. 209). Source for inland waterways and ferries was U. S. Army as above, and for noncontiguous and international, U. S. Maritime Commission Report 2610.

[c] For intercoastal, noncontiguous, and American-flag international, see Appendix Table H-2 and notes to that table. Intercoastal passenger-miles were extrapolated by means of passenger revenue (see note b above). Estimate for Great Lakes and inland waterways is by the ICC (see *55th Annual Report,* p. 9). For foreign-flag international, the same sources and methods were used as for American-flag.

[d] Data for coastwise, Great Lakes, and inland traffic based on unpublished estimates by the National Income Division, U. S. Bureau of Foreign and Domestic Commerce. For intercoastal, see note b above. American-flag and foreign-flag international, unpublished estimates by the Office of Business Economics, as above. Figure for noncontiguous assumes same revenue per passenger-mile as American-flag international. Ferries, *Survey of Current Business,* July 1947, National Income Supplement, Table 30.

[e] See Appendix Table H-1 and notes to that table. Figures for foreign-flag were obtained in the same way as figures for American-flag international.

[f] See discussion in text; also Table 31.

The seven kinds of waterway for which traffic and gross revenues can be estimated for 1939 are shown in Table 30. Only about one-tenth of all waterway revenues, according to our estimates, was contributed by passengers. Ferries, which carried four-fifths of all waterway passengers, furnished but one percent of gross revenues. The two largest divisions, in revenue terms, are coastwise and American-flag international shipping. The latter contributed roughly half waterway passenger revenues, but the former owes its importance almost entirely to freight traffic. The remaining divisions — Great Lakes, inland, intercoastal, and noncontiguous — are also freight rather than passenger carriers. The seven divisions vary greatly in other respects also, average haul of freight, for instance, running all the way from 61 miles for inland waterways to over 6,000 miles for intercoastal traffic. The average for all waterways — 660 miles — was almost twice the average haul for all railroad freight (Table 4 above).

Average revenue per ton-mile (.17 cents) for all waterway freight in 1939 was about one-sixth of the corresponding figure for steam railroads, and one twenty-fourth the figure for intercity trucking (Table 4). To be sure, as noted in Chapter 2, transportation by water is slower, as well as ordinarily more circuitous, than by land; there are longer handling delays and perhaps in some cases more risk of loss or damage. Yet a part of the differential must be attributed to the longer average haul; for equivalent distances the disparity would doubtless be smaller.

The remainder of this section describes how we estimated revenue per ton-mile in 1939, and explains some of the rather startling differences between the quotients obtained for different waterways.

*Coastwise Traffic.*[2] More than half our coastwise freight consists

[2] The U. S. Maritime Commission defines coastwise trade "as trade along the Atlantic, Gulf, and Pacific coasts, as well as trade between the continental United States ports and the noncontiguous American territories of Hawaii, Alaska and Puerto Rico" ('Economic Survey of Coastwise and Intercoastal Shipping,' U. S. Maritime Commission, 1939, p. 2). We exclude the traffic with noncontiguous territories from our definition of coastwise trade so as to permit comparisons with other domestic freight transport agencies. Following the Commission, we reserve the term 'intercoastal trade' to refer to traffic moving between the east and west coasts by way of the Panama Canal. Traffic moving between the Gulf and Atlantic coasts we include in 'coastwise' trade. The

Table 31

COMPOSITION OF COASTWISE FREIGHT TRAFFIC, 1939[a]
Short tons, statute miles

| | *Shipments* (mil. tons) | *Ton-miles* (bil.) | *Revenue per Ton-mile* (cents) | *Freight Revenue* ($ mil.) |
|---|---|---|---|---|
| Petroleum and petroleum products | 105 | 146 | 0.08 | 117 |
| Dry cargo | 37 | 28 | 0.38 | 108 |
| Common carrier | 13 | 10 | 0.66 | 69 |
| Contract and private | 23 | 18 | 0.22 | 39 |
| TOTAL | 141 | 174 | 0.13 | 225 |

[a] Tonnage shipped by coastal regions (U. S. Army, Chief of Engineers, *Annual Report*, Part 2) for 1939 was distributed between petroleum products and dry cargo, and the latter classified by type of carrier on the basis of the U. S. Maritime Commission's 'Economic Survey of Coastwise and Intercoastal Shipping' for 1937. Shipments by coastal regions, U. S. totals for which appear in the first column, were multiplied by average hauls for each region derived from Appendix Table H-3 to yield the ton-mile estimates in the second column. Derivation of the third column is described in the text and the fourth column follows immediately.

of petroleum shipments moving by tanker from the Gulf to Atlantic ports or along the Pacific coast. This accounts for its very low average revenue per ton-mile. Oil tankers are chiefly operated by the marine departments or transportation subsidiaries of large oil refining companies.[3] There is no common carrier tanker transport, but the transportation service of private oil carriers may be valued at the published rates for chartered tankers acting as contract carriers. These 'going charter rates' in 1939 averaged about 0.08 cents per ton-mile for crude and refined oil shipped from Gulf to North Atlantic ports not east of New York.[4]

statistics collected by the Army Engineers are also more comprehensive; they follow the legislative definition of coastwise trade, and include what we have called 'intercoastal' and 'noncontiguous' traffic: where necessary we adjusted such data to our definitions.

[3] The U. S. Maritime Commission found that 15 major oil companies own 84 percent of all oil tankers in operation (TNEC, *Hearings*, Part 14-A, p. 7730).

[4] 'Oil Price Handbook, 1939' (National Petroleum News), pp. 191-2. The rates here are given in terms of dollars per barrel, and were divided by 1,900 miles (taken as the average haul) and multiplied by suitable weight conversion factors to yield ton-mile rates. Tanker rates fluctuate rather widely and in 1939 were somewhat below the level in other years.

Among dry-cargo carriers in the coastwise trade we must distinguish between: (1) common carrier steamship lines operating over more or less regular routes in the transportation, at scheduled rates, of package and merchandise freight; and (2) private and so-called tramp or contract carriers. Ton-mile revenues for the former can be approximated from ICC figures ('Statistics of Carriers by Water', annual). Few of the latter report to the ICC; they are engaged in the transport of bulk commodities in cargo lots at rates far below those of common carriers. We have somewhat arbitrarily assumed ton-mile revenues for contract at one-third of corresponding revenues for common carriers.[5] The composition of coastwise freight traffic may be roughly estimated as in Table 31.

*Intercoastal Traffic.* All types of carriers (common, contract, and private) participate in intercoastal traffic, but in recent years common carriers have dominated the trade, and their rates have been reported regularly to the Maritime Commission.[6]

*Great Lakes.* Freight ton-miles between Great Lakes ports in 1939 were fewer than in the coastwise trade but many more than on rivers and canals. Revenue per ton-mile is estimated at little more than one-tenth of a cent.[7] Just as coastwise trade is dominated by petroleum, so traffic on the Great Lakes consists largely of other bulk commodities — wheat, iron ore and coal. A fairly long haul, combined with mechanized loading and unloading equipment, make their transportation very economical.

*Inland Waterways.* Revenues for river and canal traffic are estimated at 0.4 cents per ton-mile. This relatively high rate may

[5] See, for instance, Federal Coordinator of Transportation, *Freight Traffic Report* (1935), Vol. III, p. 152.

[6] See 'Economic Survey of Coastwise and Intercoastal Shipping.' In 1937 of 7 million short tons carried by all intercoastal vessels of 1,000 gross tons and over, common carriers accounted for nearly 6 million.

[7] The figure (.107 cents) relates to traffic passing through St. Mary's Falls Canal (Sault Ste. Marie), is due to U. S. Army Engineers, and will be found in the *Statistical Abstract of the United States.* The Canadian Bureau of Statistics in its *Report on the Grain Trade of Canada* (annual) gives a somewhat higher figure (.15 cents) for grain only shipped from Fort William – Port Arthur to Buffalo in Canadian as well as United States bottoms.

be explained in part by the shortness of the average haul. Mississippi traffic, which makes up the larger part of total river and canal traffic, is fairly well represented by that of the Federal Barge Lines, operated by the Inland Waterways Corporation, whose revenue receipts fluctuated between 3 and 4 mills per ton-mile in the late 1930's.[8]

The extent to which the rates charged by operators, especially on inland waterways, really measure the resources engaged has long been a source of controversy. Most investment in river and harbor improvements, which constitutes a significant portion of total waterway investment, has been financed by public agencies; and it has frequently been charged that unit cost figures of waterway operators do not adequately reflect the capital charges borne by government. Proponents of an expanded national waterway system, on the other hand, have claimed that waterway operators are sometimes saddled with "the cost of obsolete and superseded navigation works no longer used or useful" and with "the cost of uncompleted structures which cannot yet have aided present navigation."[9] In any case, the difficulty of distributing the cost of joint facilities between irrigation, flood control, power and navigation is obvious. This whole area of controversy was investigated by the Board of Investigation and Research appointed under the Transportation Act of 1940 with interesting but largely inconclusive results. For our present purpose the issues in question are secondary for, as elsewhere in this volume, we regard the charges actually paid (whether or not appropriate in a wider sense) as

[8] U. S. Army, Chief of Engineers, *Annual Report,* 1939, Part 2, p. 1447. Since such traffic is of a considerably longer haul than other river and canal traffic, we may have understated revenues for rivers and canals. On the other hand the Federal Barge Lines figure has indeed been characterized recently as a 'liberal' estimate merely for the line-haul cost of river transport (see Harold Kelso, 'Waterways Versus Railways,' *American Economic Review,* Sept. 1941, pp. 540-1). Yet in a study of contract carrier rates on the Mississippi system for eight basic commodities, the average unit revenue figure for all hauls was found to be 0.3 cents per ton-mile *(Transportation and National Policy,* National Resources Planning Board, 1942, p. 437). Presumably the rates to be imputed to private carriers, transporting especially coal, iron and steel along sections of the Mississippi River system, would be even lower. In the absence of more precise data we have used the figure of 0.4 cents per ton-mile.

[9] *Transportation and National Policy,* p. 454.

furnishing a suitable system of weights in combining our output indexes.[10]

*Noncontiguous Traffic.* The chief noncontiguous territories are of course Puerto Rico, Hawaii and Alaska. Trade between the United States and all such territories accounted for somewhat fewer ton-miles than did inland waterways in 1939 (Table 30). As data on revenues from this traffic appear to be completely lacking, we have used the same ton-mile rates, for dry cargo and tankers respectively, as in the coastwise trade.

Table 32

WATER-BORNE FREIGHT TRAFFIC BETWEEN THE UNITED STATES AND FOREIGN COUNTRIES, BY FLAG OF VESSEL, 1929, 1939, and 1946[a]

Short tons, statute miles

| | *American-flag* | *Foreign-flag* | *Total* | *Ratio: American-flag to Total* |
|---|---|---|---|---|
| | (billion ton-miles) | | | % |
| 1929 | 170 | 338 | 508 | 33 |
| 1939 | 80 | 360 | 440 | 18 |
| 1946 | 352 | 186 | 538 | 65 |

[a] Based upon receipts and shipments at United States ports (1929 and 1939, Maritime Commission; 1946, Bureau of the Census) and average hauls estimated by us; see Appendix H. Data for 1929 do not include Great Lakes traffic.

*International Traffic.* In 1939 ton-miles in American-flag vessels engaged in foreign trade exceeded traffic on the Great Lakes, but amounted to only about half the ton-mileage transported in the coastwise trade (Table 30). American- and foreign-flag carriers are of course in direct competition, and, as may be seen from Table 32, the recent history of American carriers has been chequered. The wartime expansion of the American merchant marine is measured by the fact that less than one-fifth of the ton-miles between the United States and foreign countries were carried in American-flag vessels in 1939, but two-thirds were so carried in 1946. Revenues have been estimated by the Maritime

[10] For a justification of this general procedure, see Appendix A.

Commission; they work out at 0.200 cents per ton-mile for American-flag and 0.160 cents for foreign-flag vessels.[11]

### THE GROWTH OF WATERWAY TRAFFIC

Between 1889 and 1939 combined passenger and freight traffic grew six-fold (Table 5 and Chart 2 above). Passenger-miles multiplied two-and-a-half times, freight ton-miles sevenfold (Tables 7 and 8 above, and Chart 20). These ratios compare with a twofold growth in railroad passenger and a fivefold growth in railroad freight traffic. As in the case of railroads, growth was concentrated in the period before 1920. Ocean waterway, like railroad, passenger-miles showed a declining trend between 1920 and 1940.[12]

In Table 33 and Chart 21 the waterway freight traffic index is decomposed into its six constituents. Of course percentagewise intercoastal and noncontiguous traffic grew fastest. For in 1889 there was no Panama Canal; trade with Alaska was small and unimportant, and Hawaii and Puerto Rico were not yet under the American flag. Leaving these two minor — though fast-growing — components on one side, we see that the rapid rise in total waterway freight traffic is due primarily to the growth of the coastwise trade, which rose more than tenfold. This growth reflects especially the movement of petroleum by tanker from Gulf to Atlantic ports, and to a lesser extent from the southern to the northern Pacific Coast. The iron ore movement resulting from the opening of the Mesabi Range in 1893 caused the Great Lakes component to rise rapidly during the first three decades of our period, but further growth between 1920 and 1940 was slight. Over the entire five decades 1889-1939 ton-miles on the Great Lakes grew at about the same rate as all waterway freight traffic — roughly sixfold. The remaining components — Inland and American-flag international traffic — each grew about fourfold,

[11] I have to thank the Maritime Commission for an unpublished tabulation. Total revenues were estimated by applying average freight rates on principal trade routes to American and foreign cargo carryings. The Commission's figures were then divided by our own ton-mile estimates.

[12] Waterway passenger-miles cover only intercoastal, noncontiguous and American-flag international traffic, and are not available for years since 1940.

but their movement during the half century was quite dissimilar. Inland traffic was at about the same level in 1920 as in 1889, and then shot up partly, as with the coastwise trade, because of oil shipments. International traffic, on the other hand, grew tenfold between 1889 and the early 1920's and thereafter declined steadily until our participation in World War II: in 1946 it was four times the 1939 level.

The uncharacteristic behavior of our international traffic has already received comment in Chapter 2 (see especially Table 10). As indicated, waterway freight traffic grew sevenfold between 1889 and 1939; but if international traffic is excluded the growth is nearly ninefold. On the other hand international traffic in American vessels jumped sharply as a consequence of World War II; between 1889 and 1946, therefore, waterway freight ton-miles grew more than twelvefold if international traffic is included, but only ninefold if it is excluded.

The remainder of this section contains some notes on the composition of each major kind of waterway freight traffic. The following section will offer measures of productivity change for waterway traffic as a whole.

*Coastwise and Intercoastal Freight Traffic.* To a striking degree the expansion of the coastwise trade in recent decades reflects the movement of petroleum in tankers: in 1939 such traffic accounted for more than four-fifths of all coastwise ton-miles. Movement is principally from West Gulf[13] to Middle Atlantic ports. In addition to petroleum, West Gulf shipments include sulfur, copper, asphalt, flour, cotton, soda and chemicals.

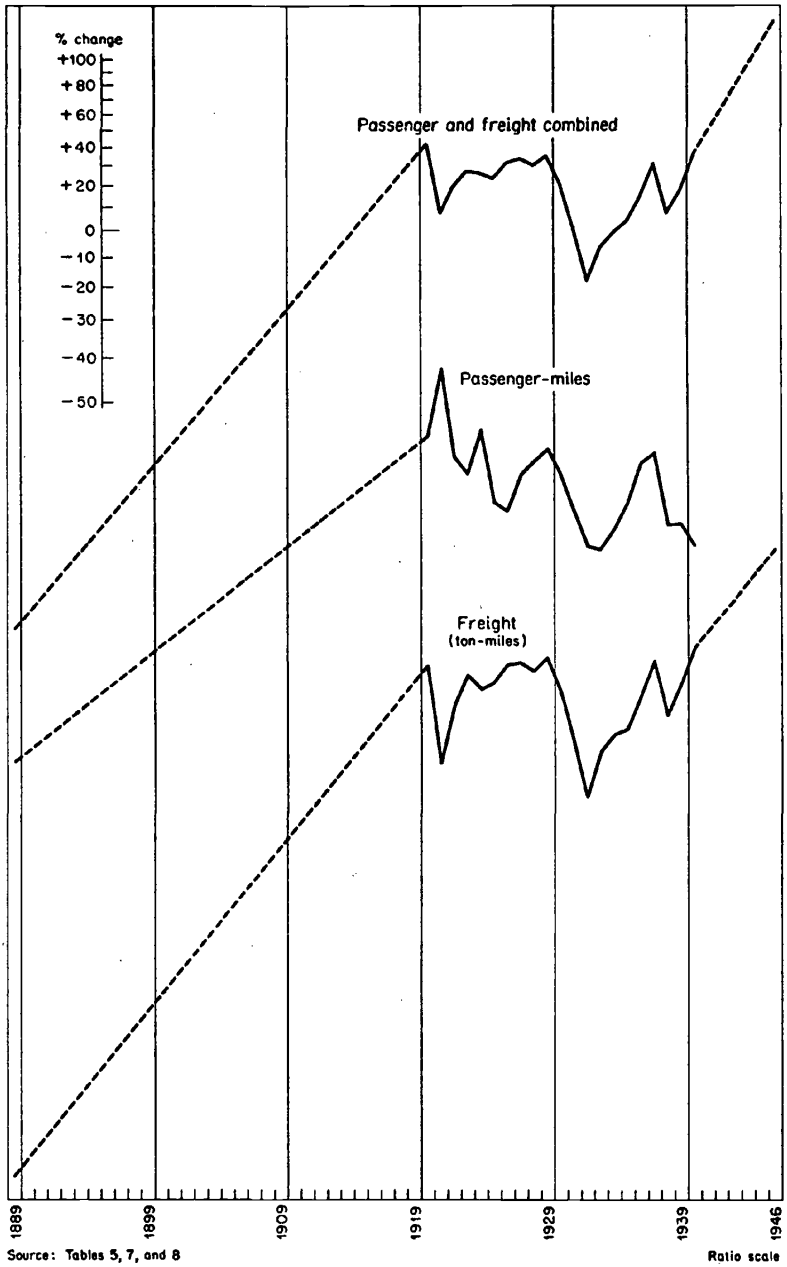
In point of shipments the next most important coastal region is the Middle Atlantic: from here there is much relatively short haul coal traffic from Hampton Roads to northern ports, especially New England. Products of oil refineries in the Middle Atlantic region also move up and down the coast.

Other shipments were of phosphate and paper products from

[13] In Maritime Commission statistics the West Gulf region extends from New Orleans west; East Gulf ports include Mobile and ports east thereof. The South Atlantic region extends to the North Carolina-Virginia line, and the Middle Atlantic region thence to the New York-Connecticut line.

Chart 20

## WATERWAYS: PASSENGER, FREIGHT, AND COMBINED TRAFFIC




Source: Tables 5, 7, and 8

Ratio scale

Table 33

WATERWAYS: INDEXES OF TRAFFIC, 1889 AND 1920-1946[a]

1929 : 100

| | PASSENGER-MILES | | | FREIGHT TON-MILES | | | | | | *All Waterways, Passenger & Freight Traffic Combined*[b] |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Inter-coastal* | *Noncon-tiguous* | *Inter-national, American-flag* | *Coast-wise* | *Inter-coastal* | *Great Lakes (domestic)* | *Inland* | *Noncon-tiguous* | *Inter-national, American-flag* | |
| 1889 | | 28 | | 14.6 | 2.6 | 16.5 | 53 | 11 | | 14.6 |
| 1920 | | 104 | | 36.8 | 29.4 | 82.7 | 58 | 93 | 165 | 104 |
| 1921 | | 139 | | 31.6 | 40.0 | 39.6 | 54 | 97 | 107 | 79 |
| 1922 | | 97 | | 45.7 | 68.4 | 64.6 | 52 | 91 | 118 | 89 |
| 1923 | | 90 | | 60.9 | 118.0 | 91.2 | 71 | 85 | 103 | 94 |
| 1924 | | 108 | | 65.1 | 95.2 | 68.4 | 80 | 90 | 108 | 93 |
| 1925 | | 80 | | 85.8 | 81.5 | 86.4 | 97.2 | 102 | 98 | 91 |
| 1926 | | 78 | | 87.7 | 95.6 | 93.5 | 110.2 | 105 | 104 | 97 |
| 1927 | | 90 | | 96.3 | 98.7 | 85.2 | 103.5 | 104 | 104.0 | 99 |
| 1928 | 84.4 | 74.9 | 100.5 | 97.0 | 88.9 | 86.8 | 106.4 | 109.4 | 97.2 | 95.9 |
| 1929 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1930 | 92.4 | 72.8 | 92.8 | 96.3 | 85.7 | 77.8 | 104.9 | 104.2 | 86.9 | 89.4 |
| 1931 | 80.9 | 59.0 | 80.3 | 97.3 | 69.0 | 48.9 | 106.6 | 100.0 | 65.6 | 73.9 |
| 1932 | 74.0 | 44.4 | 70.9 | 90.6 | 54.3 | 22.8 | 91.3 | 97.8 | 50.4 | 60.4 |
| 1933 | 89.6 | 43.5 | 68.7 | 109.2 | 72.2 | 45.7 | 118.2 | 97.4 | 51.0 | 69.1 |
| 1934 | 108.7 | 57.0 | 71.8 | 110.3 | 80.5 | 47.8 | 108.8 | 104.8 | 57.0 | 73.6 |
| 1935 | 119.1 | 69.6 | 79.0 | 116.2 | 68.1 | 55.0 | 154.8 | 111.9 | 56.5 | 76.7 |
| 1936 | 96.9 | 74.3 | 98.6 | 143.3 | 63.4 | 79.6 | 177.7 | 121.2 | 55.5 | 85.0 |
| 1937 | 98.4 | 79.2 | 102.7 | 169.3 | 65.0 | 96.7 | 195.0 | 135.5 | 65.1 | 97.0 |
| 1938 | .... | 82.1 | 73.5 | 159.5 | 55.2 | 47.6 | 205 | 117.4 | 48.6 | 79.1 |
| 1939 | .... | 87.3 | 74.8 | 172.4 | 70.5 | 77.7 | 230 | 128.4 | 45.9 | 87.3 |
| 1940 | .... | 95.4 | 65.1 | 181.0 | 63.4 | 98.7 | 259 | 143.9 | 68.2 | 100.9 |
| 1941 | .... | .... | .... | .... | .... | 117.3 | 310 | .... | .... | .... |
| 1942 | .... | .... | .... | .... | .... | 126.6 | 305 | .... | .... | .... |
| 1943 | .... | .... | .... | .... | .... | 166.9 | 304 | .... | .... | .... |
| 1944 | ... | .... | .... | .... | .... | 119.0 | 362 | .... | .... | .... |
| 1945 | .... | .... | .... | .... | .... | 115.0 | 343 | .... | .... | .... |
| 1946 | .... | .... | .... | 120.5 | | 98.1 | 323 | 212 | 203 | 171.9 |

[a] The waterways to which the columns refer are defined in note c to Table 3 above; see also text of this chapter. Figures are based on data in Appendix H, except as follows. Passenger-miles for years before 1928 were extrapolated on basis of arrivals plus departures at United States ports in vessels of all flags (August Maffry, 'Overseas Travel and Travel Expenditures', U. S. Bureau of Foreign and Domestic Commerce, Economic Series 4, 1939, Tables 3, 4, and 5) adjusted by changes in the ratio of American-flag to all entrances and clearances (*Statistical Abstract of the United States*).

[b] Components weighted by average revenue. 1946 linked to 1940 on basis of freight traffic only. This index is the same as that shown on a 1939 base in Table 5. Indexes for total passenger and freight traffic respectively are given in Tables 7 and 9.

the East Gulf region; of citrus fruit, forest products and naval stores from South Atlantic ports. Shipments from New England, of pristine shipping fame, now yield less than 1 percent of all ton-miles in the coastwise trade.

On the Pacific Coast petroleum is again the leading commodity moved, although northern ports ship appreciable amounts of lumber, paper products, flour and grain. San Francicso distributes some manufactured products by coastal waterway.

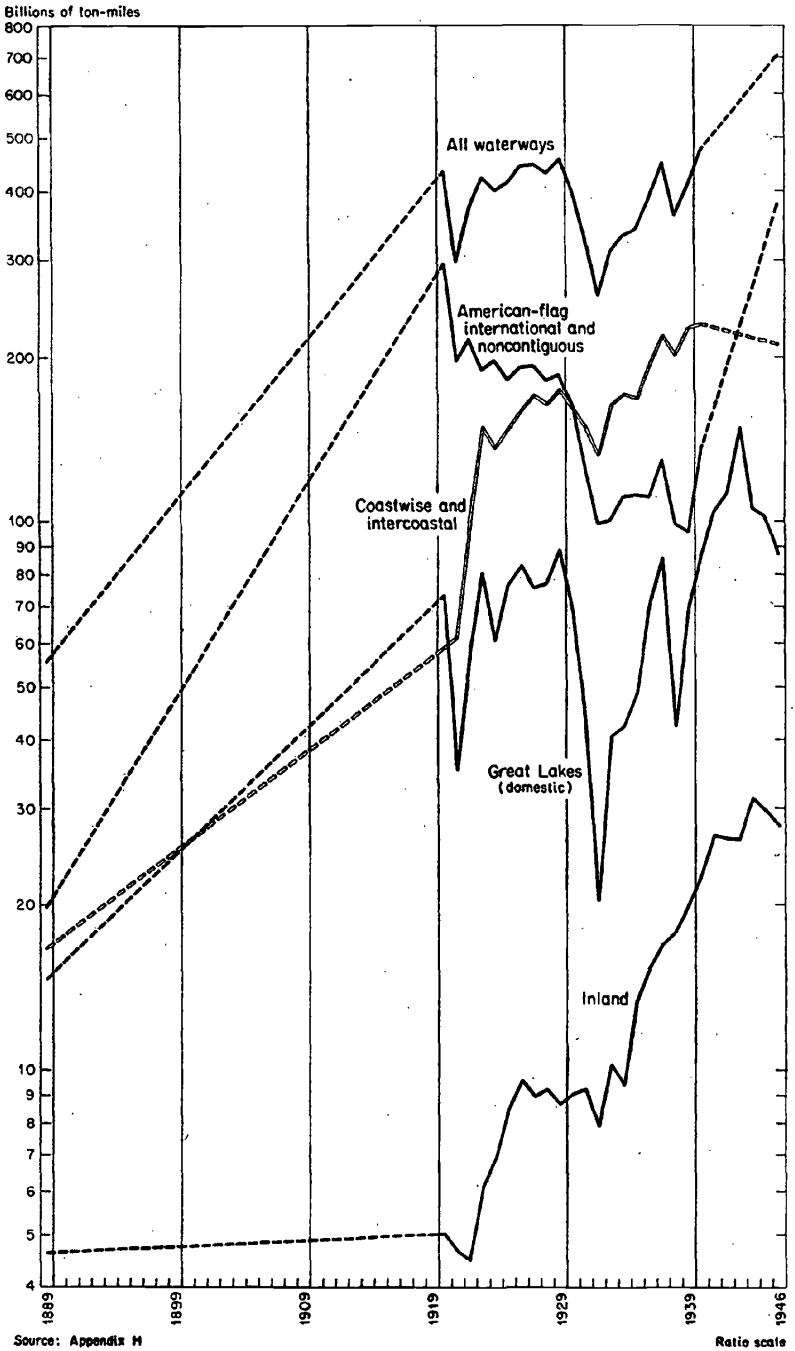
In the intercoastal trade in 1939 east-bound shipments included lumber, paper stock and manufactures from the Pacific Northwest; and petroleum products and canned fruits from California. Minor commodities were wheat flour, and wheat (from the Pacific Northwest), vegetables, fruits, canned fish and sugar. Of the west-bound traffic iron and steel products (mainly from the Middle Atlantic region) made up the greatest part. Other west-bound products were pigments, chemicals and manufactures, vegetables and products, refined petroleum and paper stock and manufactures.

*Freight Traffic on the Great Lakes.* The Great Lakes constitute one of the world's outstanding natural waterways, having a combined length of over 1,000 miles and a water surface area more than twice the size of the state of Pennsylvania. They are bordered by areas extremely rich in natural and industrial resources. Ice formation in the winter generally limits the navigation season to 8 or 9 months of the year. Although commonly classified as an inland waterway, transportation facilities and equipment on the Great Lakes are somewhat akin to those of ocean transport. However, the extremely heavy bulk freight traffic that moves through the Lakes during the limited season has given rise to a highly specialized type of bulk freighter that makes up the greater part of the present day Great Lakes fleet. These vessels are built with power plant and crew quarters at the stern and bow, all the intermediate space being unobstructed cargo hold, with no division into bulkheads or compartments. Many freighters are equipped with self-unloading devices, but the docks of the larger Lake ports have extensive specialized equipment for loading and unloading bulk freight, especially grain and iron ore.[14]

[14] U. S. Army, Corps of Engineers, *Transportation on the Great Lakes,* 1937.

Chart 21

## WATERWAY FREIGHT TRAFFIC



In 1939, 124 million tons of freight moved between United States ports on the Great Lakes for a total of 69 billion ton-miles, placing the Great Lakes system after the railroads and coastal shipping. This total includes, besides port-to-port traffic, other domestic traffic, such as internal movements on the canals and waterways entering the Great Lakes; and local receipts of sand, gravel and marine products. That most Lake traffic is made up of bulk commodities may be seen from the 1939 shipment figures: iron ore (45 million short tons), soft and hard coal (40 million short tons), grain (11 million short tons) and stone (12 million short tons).[15]

The average haul of lakewise traffic declined from 740 miles in 1920 to 570 miles in 1940. The decline may be attributed in part to the reduced share of relatively long haul iron ore traffic, and the increased relative importance of such short haul freight commodities as limestone. The average haul of Lake shipments also exhibits a marked cyclical movement, because of the extreme cyclical sensitivity of the long haul iron ore shipments which make up the bulk of total Lake traffic.

In the movement of iron ore from the mines to the Upper Lake docks, most of which are owned and operated by the rail carriers, much specialized equipment is employed, including bottom-dump hopper cars designed to discharge specified grades of ore into designated ore pockets at the ore docks. The ore is loaded by force of gravity from the docks, large concrete and steel structures perhaps 2,000 feet long, into the holds of the bulk freighters below. Shipments from the Upper Lake ports (mainly Duluth and Superior) begin in early spring and continue to late fall, when ice impedes navigation. By the close of the season the receiving docks (mainly at Lake Erie ports, although some ore goes to the Gary-Chicago area) have accumulated reserves which are drawn upon throughout the remaining winter months. Unloading equipment at the receiving docks has undergone extensive technological improvements since the turn of the century

[15] Data are from the 1940 Annual Report of the Lake Carriers Association (p. 39); they include traffic of Canadian ports, which account for the greater part of total grain shipments.

and today can handle 5 to 17 tons of ore at one operation, and can discharge a 10,000-ton vessel in 3 or 4 hours. The ore is then carried to interior blast furnaces in standard gondola and hopper cars; the rail hauls are relatively short, ranging below 100 miles.[16]

Eastbound bulk shipments of iron ore on the Great Lakes are conveniently offset by westbound movements of bituminous coal from the Appalachian mining districts of West Virginia, Pennsylvania, Kentucky and Tennessee. The coal moves to Lake Erie ports and thence by water to Duluth, Superior, Milwaukee and Chicago. The Lake coal is stored at Upper Lake ports for winter distribution to northern Michigan, Wisconsin and Minnesota; in the surrounding regions it comes into competition with all-rail coal from the midwestern coal regions of Illinois, Indiana and western Kentucky. Total Lake shipments of coal in 1939 had quadrupled since the beginning of the century.

After iron ore and coal come grain shipments. Like iron ore, grain moves from west to east. During the navigation season grain is shipped east principally by water: use of the more expensive all-rail route is made chiefly while the Lakes are closed to navigation. For 1939 total grain tonnage originated by rail in the United States amounted to some 40 million; in the same year nearly 6 million tons of grain were transported by all waterway routes, of which the larger part (131 million bushels or more than 4 million tons) was shipped by bulk freighter from Duluth, Superior, Chicago and Milwaukee.[17] Buffalo is the chief receiving center of Lake shipments of grain. While a good deal of wheat is consumed by Buffalo flour mills, most of the grain receipts are transferred to rail or water carriers for movement to points further east; some grain is transported by barge over the New York State Barge Canal and Hudson River. Great Lakes shipments of Canadian grain have increased rapidly since the beginning of the present century, but in 1939 grain movements in American-flag

[16] The foregoing description and much of the following discussion closely parallels the material presented in *Transportation on the Great Lakes,* pp. 257-305.

[17] Since the rail shipments include movement from the interior to lakeside these figures overstate the importance of rail transportation.

vessels from United States ports were about the same size as they had been forty years earlier.

Other bulk commodities moving in Great Lakes trade include lumber, stone, sand and gravel, and petroleum products. Limestone for the steel industry is handled by specialized loading and unloading equipment similar to that used for iron ore and coal traffic; as with iron ore, shipments tend to fluctuate with activity in the steel industry. Depletion of timber resources in the Great Lakes region has reduced lumber traffic; shipments of petroleum products have on the other hand risen steadily.

*Inland Waterways.* Unlike other waterways treated here, river and canal transportation relies heavily on barge and tugboat. According to the Census of 1926, for instance, 94 percent of the gross tonnage of vessels operating upon the Mississippi system and other inland waterways consisted of unrigged craft, that is, vessels without sails or mechanical power for independent propulsion. Extremely short haul in character, river and canal traffic made up nearly half the total tonnage shipped by water in 1939, but only 5 percent of all waterway ton-miles. About two-thirds of the traffic (in ton-miles) moves along the Mississippi River and its tributaries; the remainder consists mostly of relatively small amounts of traffic moving on numerous other rivers, canals and connecting channels.

On the Mississippi system shipments consist mainly of grain, coal, stone, sand and gravel, iron and steel, petroleum, and other bulk commodities. For instance steel mills in the Pittsburgh area ship iron and steel by water as far south as New Orleans. They have thus been able cheaply to reach rising markets, especially for steel pipe in southern and southwestern oil fields. Petroleum products move from the refining area around Baton Rouge northward, and also to New Orleans for reshipment by sea. The growth of the oil movement on inland waterways parallels that in the coastwise trade discussed above. Oil products have become a large component of Ohio river traffic, and in recent years have displaced grain as the leading commodity moving through the New York State Barge Canal.[18] Heavy, though short haul, shipments of coal

[18] Federal Coordinator of Transportation, *Public Aids to Transportation,* Vol. III, pp. 67, 113.

on the Monongahela River enjoy the distinction of being loaded directly from the mine tipple; here is one of the few instances, other than the movement of lumber and sand and gravel, in which river transportation need not be 'fed' by other transport agencies. Southbound grain traffic on the Mississippi revived after World War I, in part through facilities of the federally operated common carrier barge service which is said to have diverted to Gulf ports grain shipments that formerly moved to the Atlantic seaboard by rail.[19] Bauxite, sugar and cotton are other commodities that move over the Mississippi system.

Freight traffic on other rivers and canals is mostly of a bulky and short-haul character, consisting, especially on the smaller waterways, mainly of lumber and sand and gravel. Indeed, sand is often dredged from the very river over which it moves short distances to its destination. In 1939 rivers of the Atlantic coast contributed about 10 percent of inland waterway ton-mileage: the principal routes are the Hudson, Delaware, Potomac and Connecticut rivers. About 3 percent moved over Gulf coast rivers (other than the Mississippi system), especially the Mobile, Warrior and Black Warrior rivers. Some 6 percent was contributed by rivers of the Pacific coast, especially the Columbia and Willamette.

The sharp expansion of inland waterway traffic, which dates only from 1920 (Chart 21), is undoubtedly in part the outcome of federal policy. The transfer of freight traffic from waterways to the spreading railroads during the decades following the Civil War must have had every air of a permanent shift. To be sure, coal traffic along the Ohio and Mississippi rivers had a short-lived revival toward 1900, but even this movement was brought to an end by the opening of the Southern coal fields in Alabama. Public interest in waterways and their revival — by deliberate stimulation, if necessary — dates roughly from the decision taken in Albany in 1903 to enlarge the Erie Canal. Large scale appropriations for river and harbor improvements began shortly thereafter.[20] The Inland Waterway Commission, appointed by Theodore Roosevelt, predicted in 1912 a future shortage of railroad facilities. In fact, the federal government took over the operation

[19] *Transportation on the Great Lakes,* 1937, p. 117.

[20] In 1910-35 total expenditures reached $2.3 billion compared with $0.7 billion prior to 1910. See Federal Coordinator of Transportation, *op. cit.,* p. 12.

of barge traffic on the New York State Barge Canal and the Mississippi and Warrior rivers during World War I, and to some extent has been in the business ever since. The Inland Waterways Corporation, a federal agency, carries an appreciable fraction of all freight traffic moving over the Mississippi system.

*The Noncontiguous Trade.* Nearly the whole of our noncontiguous trade is with the three territories Puerto Rico, Hawaii and Alaska. (Although the Philippine Islands were technically a dependent territory during most of our period, for the sake of comparability United States-Philippine trade has throughout been included with international traffic, of which it now forms a part.) Two-thirds of all noncontiguous ton-miles are carried between the United States and Hawaii, the most distant territory. Traffic with Puerto Rico is next largest (one-quarter) and with Alaska third in size (one-tenth of the total). Traffic with all three territories has grown slowly but rather steadily. Imports from Hawaii are dominated by sugar and fruit, especially in cans; from Puerto Rico sugar and from Alaska canned fish and copper ore are the main imports. In return are shipped to all three territories a wide range of manufactured goods.

*International Traffic.* As we have seen, the fraction of American waterborne foreign trade carried in American-flag vessels has fluctuated widely from one period to another. Although an accurate comparison between American- and foreign-flag traffic cannot be made until the 1920's, it may be supposed that in the early days of the Republic at least half the total was carried in American bottoms. As the nineteenth century advanced, relatively rosier prospects in other lines of economic endeavor prevented the merchant marine from expanding as rapidly as the rest of the economy grew, and led to the concentration in the protected coastwise and intercoastal trades of most of what ocean shipping survived. At any rate, data on entrances and clearances at American ports by flag of vessel suggest that one-fifth to one-quarter of the nation's waterborne foreign trade was carried in American vessels at the opening of our period in 1889, and that by the time the Census of 1906 was taken the fraction may have fallen to one-eighth.

Shipping subsidies have undoubtedly played a part in the latter day revival of the American merchant marine. Yet, as may be seen plainly from Chart 21, the outstanding factor influencing the volume of freight traffic has been the incidence of two World Wars. A sheer absence of statistics in World War I and wartime secretiveness on the part of government in World War II prevent us from measuring the peaks of wartime traffic movement. But in outline the picture is clear enough. In the years immediately following World War I, with relief shipments to Europe running high and the merchant fleets of many European competitors still paralyzed, our merchant marine furnished more than ten times as many ton-miles between United States ports and foreign countries than in 1889. During the 1920's one-third of our foreign trade was carried in American vessels (Table 32). Thereafter American participation in international freight traffic declined steadily until the proportion stood at one-sixth in 1939. World War II boosted the carrying power and performance of the American merchant marine and decimated the merchant fleets of some of our competitors. As a result American vessels carried two-thirds of our waterborne foreign trade in 1946.

International passenger traffic tells a rather different story. The American-flag share of total waterborne passenger-miles between the United States and foreign countries rose from 20 percent in 1929 to 29 percent in 1939. In the latter year one passenger in three used an American ship; but the average journey was somewhat shorter on American than on foreign vessels (Table 30). For 1946 no data have been published. As with freight traffic, foreign-flag revenues per passenger-mile were substantially below American.

Though American freighters ply all over the world, roughly half the traffic is with western hemisphere countries and half with other parts of the World (Table 34). The distribution in terms of tons of freight received and shipped through United States ports differs somewhat from the distribution in terms of ton-miles. Because of variations in the average length of haul, trade with Canada via the Great Lakes forms 15 percent of receipts and

shipments but only 2 percent of ton-miles. Contrariwise, trade with Asia accounts for less than 10 percent of receipts and shipments but more than 20 percent of ton-miles.

Table 34

WATERWAYS: AMERICAN-FLAG INTERNATIONAL FREIGHT TRAFFIC, BY CONTINENTAL REGIONS, 1939*

Short tons, statute miles

| *Traffic between the U. S. and:* | *Receipts plus Shipments* (mil. tons) | *Ton-miles* (bil.) | *Average Haul* (miles) | % DISTRIBUTION *Receipts plus Shipments* | % DISTRIBUTION *Ton-miles* |
|---|---|---|---|---|---|
| Canada, via Great Lakes | 3.4 | 1.5 | 420 | 15.0 | 1.8 |
| Americas, ocean-borne | 12.8 | 34.0 | 2,700 | 55.7 | 42.8 |
| Europe | 4.3 | 22.0 | 5,100 | 18.8 | 27.6 |
| Africa | .6 | 4.2 | 7,400 | 2.5 | 5.3 |
| Australasia | .1 | 1.3 | 9,700 | .6 | 1.6 |
| Asia | 1.7 | 16.6 | 9,600 | 7.5 | 20.8 |
| TOTAL | 23.0 | 79.5 | 3,500 | 100.0 | 100.0 |

* See Appendix Table H-6.

Besides the data on which these figures are based, the Maritime Commission prior to World War II issued elaborate tabulations by commodities. These show — as might be expected — that shipments from United States ports were predominantly manufactured goods and agricultural raw materials, while receipts included a wide range of raw products and (chiefly from Europe) some manufactures. Although not as important as in the coastwise trade, the movement of petroleum and petroleum products in tankers accounted for more than a quarter of all receipts and shipments in 1939, but for only about one-sixth of total ton-miles.

### EMPLOYMENT AND PRODUCTIVITY

A perusal of Appendix Table H-7 and its notes will convince the reader that the employment data for waterways are very rough in character. Despite numerous census enquiries, the best series we could construct for years prior to 1929 takes account of vessel employment only and does not include stevedores or other harbor

employees. Moreover attempts to distribute total employment among our six different waterways, and ferries, proved unsuccessful.

Table 35

ALL WATERWAYS: OUTPUT, EMPLOYMENT, AND PRODUCTIVITY, 1889-1946

1929 : 100

| | *Output*[a] | *No. of Workers*[b] | *Output per Worker* |
|---|---|---|---|
| 1889 | 14.6 | 77 | 19 |
| 1920 | 104 | 141 | 74 |
| 1926 | 97 | 108 | 90 |
| 1927 | 99 | 106 | 93 |
| 1928 | 95.9 | 106 | 90 |
| 1929 | 100.0 | 100 | 100 |
| 1930 | 89.4 | 95 | 94 |
| 1931 | 73.9 | 86 | 86 |
| 1932 | 60.4 | 78 | 77 |
| 1933 | 69.1 | 81 | 85 |
| 1934 | 73.6 | 87 | 85 |
| 1935 | 76.7 | 89 | 86 |
| 1936 | 85.0 | 85 | 100 |
| 1937 | 97.0 | 90 | 108 |
| 1938 | 79.1 | 80 | 99 |
| 1939 | 87.3 | 84 | 104 |
| 1940 | 100.9 | 85 | 119 |
| 1946[c] | 171.9 | 120 | 143 |

[a] See Table 33.

[b] See Appendix Table H-7.

[c] Change in output between 1940 and 1946 is based on freight traffic only. For this reason the increases in output and productivity in 1946 compared with 1940 and earlier years are probably overstated. If passenger traffic is assumed to be zero in 1946, the output index becomes 162.2 and output per worker 135. Therefore it would seem that any overstatement cannot be large.

Employment increased about 80 percent between 1889 and 1920, fell back by the middle 'thirties roughly to the earlier level, but rose again by about 40 percent between 1939 and 1946[21] (Table 35 and Chart 22). These fluctuations were roughly parallel with changes in output, and output per worker rose rather

[21] Peak employment in 1945 was 176 percent of the 1939 level: see Appendix Table H-7. Unfortunately we do not have complete output data for 1941-45.

steadily. In fact the index, which represents combined passenger- and ton-miles per worker, grew roughly fourfold between 1889 and 1920, and doubled between 1920 and 1946. Between 1889 and 1939[22] output per worker increased at an average rate of 2.9 percent per annum — a rate which considerably exceeds the 2.2 percent yearly computed for transportation as a whole (Table 13). Undoubtedly this result reflects the increasing importance of bulk cargoes, especially petroleum moved by tanker and iron ore — that is, a shift in the character of output toward freight that can be moved in very large masses and can be loaded and unloaded mechanically. However, our employment index prior to 1929 is based on vessel employment only. Therefore, increased mechanization in loading and unloading is not reflected in our index of productivity prior to that year. Because of the trend toward mechanization of port equipment, and the shift toward bulk cargo — both tendencies began well before 1929 — our data may even understate the rise in output per worker in water transportation.

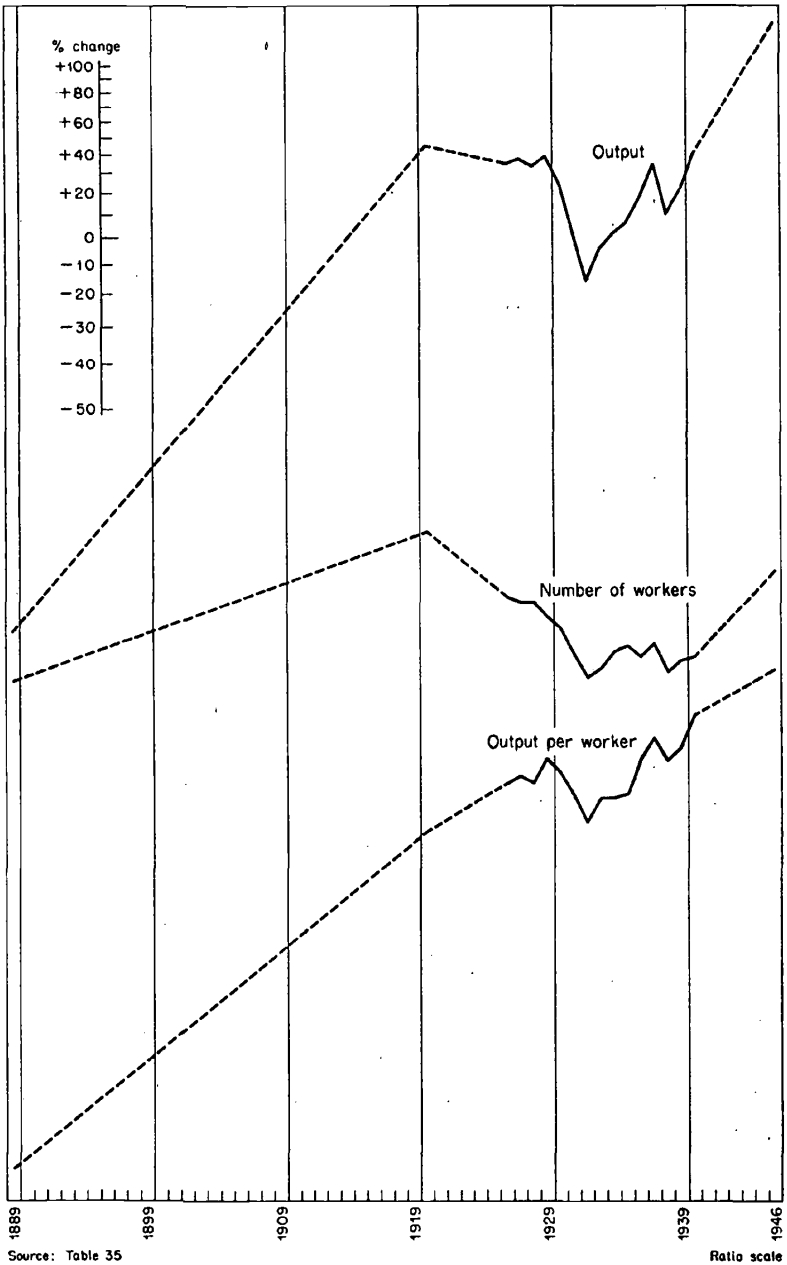
THE AMOUNT OF EQUIPMENT

For waterways as a whole output increased somewhat more rapidly than the gross tonnage of all vessels employed (Table 36). Gross tonnage per worker, in fact, rose nearly as fast as output per worker, and such influences as the trend toward bulk carriage of iron ore and petroleum doubtless are reflected in both quotients. Output and tonnage of vessels (but not employment) can be divided between domestic and international traffic. The contrast is striking. For combined coastwise, intercoastal, Great Lakes, and inland traffic, output rose far more rapidly than tonnage of vessels; these figures include iron ore and other bulk traffic on the Great Lakes, and the coastwise tanker trade. On the other hand for noncontiguous and American-flag international traffic, output rose at about the same rate as, or less rapidly than, vessel tonnage; no such shift toward bulk shipment is apparent.

Gross tonnage per worker rose more rapidly than gross tonnage per vessel. We may regard the rise in tonnage per worker as

[22] 1939 is chosen for the comparison rather than 1946 because, owing to the absence of passenger-traffic data, output and output per worker for the latter year may be overstated. See note c to Table 34.

Chart 22
## WATERWAYS:
## OUTPUT, EMPLOYMENT, AND PRODUCTIVITY




Source: Table 35

Ratio scale

Table 36

WATERWAYS: OUTPUT, EMPLOYMENT, AND GROSS TONNAGE OF VESSELS, 1889-1946[a]

1889 : 100

| | *1889* | *1920* | *1929* | *1939* | *1946* |
|---|---|---|---|---|---|
| *Coastwise, Intercoastal, Great Lakes, and Inland* | | | | | |
| Output | 100 | 325 | 670 | 816 | 965 |
| Gross tonnage of vessels employed | 100 | 187 | 279 | 331 | 257 |
| Output ÷ gross tonnage | 100 | 174 | 240 | 247 | 375 |
| *Noncontiguous and American-flag international* | | | | | |
| Output | 100 | 1,028 | 696 | 423 | 1,346 |
| Gross tonnage of vessels employed | 100 | 1,070 | 744 | 357 | 3,204 |
| Output ÷ gross tonnage | 100 | 96 | 94 | 118 | 42 |
| *All waterways* | | | | | |
| Output | 100 | 714 | 684 | 598 | 1,177 |
| Gross tonnage of vessels employed | 100 | 375 | 379 | 337 | 888 |
| Output ÷ gross tonnage | 100 | 190 | 180 | 177 | 133 |
| Number of workers | 100 | 183 | 130 | 109 | 156 |
| Gross tonnage per worker | 100 | 205 | 292 | 309 | 569 |
| Output per worker | 100 | 390 | 526 | 549 | 754 |

[a] For output and employment, based on Appendix H. For coastwise, Great Lakes and inland waterways, output is measured in ton-miles; for intercoastal noncontiguous, and American-flag international, both ton-miles and passenger miles are included; in combining the data, 1939 unit revenues were used as weights. Gross tonnage figures are from the *Statistical Abstract*, and measure the entire cubic capacity of a vessel's hull at the rate of one ton per 100 cubic feet.

compounded of growth in the average size of vessels, together with economies in the labor needed to operate a vessel of given size. But the size of vessels grew less rapidly in coastwise, intercoastal, Great Lakes and inland trade than in noncontiguous and international. It therefore seems likely that, if we had employment data for the domestic and international segments separately, the contrast in the behavior of output per worker would be less sharp than that shown in Table 36 for the output/gross tonnage quotient. Probably output per worker rose substantially in both divisions of the industry shown in the table, though somewhat more rapidly in the first than in the second.