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The opening of the Panama Railroad early in 1855 caused most of the traffic between the seaboard to abandon the long route around South America, but a considerable number of sailing vessels were annually dispatched between the two seaboard by way of Cape Horn, and a small amount of steam tonnage made use of the Magellan route.

The superiority of steamers over sailing vessels for handling most classes of freight, even for such a long route as that between the two seaboard of the United States around South America, became evident during the 1890's and caused the company which was then operating the principal line of sailing vessels between our two seaboard by way of Cape Horn to sell its sailing vessels and to inaugurate, in 1899, the American-Hawaiian line of steamers run by way of the Straits of Magellan. Early in 1907 the American-Hawaiian line shifted to the route via the Isthmus of Tehuantepec, and since that date practically all of the shipping moving between our two seaboard around South America has consisted of chartered sailing vessels and steamers that handle such bulky cargoes as can be economically shipped by that circuitous route.

2. The Panama route between our two seaboard was opened for traffic at the close of 1848, at the time of the rush to the California gold fields. With the completion of the railroad from Colon to Panama, early in 1855, most of the traffic between our two seaboard moved by way of Panama; and this continued to be the principal highway for transcontinental traffic until 1869, when the connection of the Missouri River with the Pacific coast by the Union and Central Pacific Railroads established the first rail line across the United States. The traffic by way of Panama rapidly fell off after 1869; and, though varying from year to year, remained comparatively small until 1911, when there was a sudden increase in the volume of traffic by water between our two seaboard.

Several causes account for the relative unimportance of the Panama route since 1869. The transcontinental

railroads, until recently, have maintained a relentless competitive warfare against the Panama route. The through rail rates between the Atlantic and Pacific seaboard are lower than the rates for shorter hauls to and from the intermediate points in the Rocky Mountain territory; and, until the Government regulation of railroads became effective, the railroad companies quoted shippers such rates as were necessary to keep traffic from taking the Panama route. Moreover, the transcontinental railroads were able to restrict the use of the Panama route through their close relations with the Pacific Mail Steamship Company, which has, for most of the time, been the only regular line between the west-coast ports of the United States and Panama. For a period of 20 years, ending in 1893, the railroads, through the Transcontinental Association, paid the Pacific Mail Steamship Company a fixed monthly sum, or rental, for the freight space available in its steamers, and thus completely controlled the Pacific Mail as a competitor. From 1900 to the present, the Southern Pacific Company has owned a majority of the stock of the Pacific Mail Steamship Company. The history of the relations of the Pacific Mail to the transcontinental railroads and to the Panama Railroad need not be presented in this account of the traffic and rates by the various routes connecting the two seaboard of the United States.\* It is sufficient to state that

\* For the history of the relations of the Panama Railroad to the Pacific Mail Steamship Company and for an account of the connection of the Pacific Mail with the transcontinental railroads, the following references may profitably be consulted:

(1) Opinion of the Interstate Commerce Commission in Railroad Commission of Nevada v. Southern Pacific Company et al. (June 22, 1911), 21 I. C. C. Reports, 329-384.

(2) Statement by Edward A. Drake, vice-president Panama Railroad, to the Committee on Interoceanic Canals, United States Senate, Feb. 11, 1910.

(3) Report of Joseph L. Bristow, special Panama Railroad commissioner, to the Secretary of War, June 24, 1905, upon the Policy to be Pursued in Management of the Panama Railroad Company (Government Printing Office, Washington), also report of Jan. 20, 1908, on the Advisability of the Establishment of a Pacific Steamship Line by the Isthmian Canal Commission (S. Doc. No. 409, 62d Cong., 2d sess.).

(4) Statement by R. P. Schwerin, vice-president and general manager Pacific Mail Steamship Company, to the Committee on Interoceanic Canals, United States Senate, on Senate bill 428, Mar. 10, 1910. Also statement by Mr. Schwerin before same committee, on House bill 21969 Mar. 1, 2, and 3, 1912.

(5) Statement by William R. Wheeler, representative of San Francisco Chamber of Commerce, to Senate Committee on Interoceanic Canals, on House bill 21969, May 27, 1912.

the transcontinental railroads by active competition and by artificial restraint have, until recently, kept the traffic via the Panama route comparatively small.

The development of traffic via Panama has been hampered, not only by the competition and restraint of the transcontinental railroads, but also by two other causes. While the French company was engaged in construction work on the Isthmus from 1882 to 1889, the use of the Panama Railroad by commercial freight was restricted by employment of the railroad for the transportation of materials and supplies used in construction work. Likewise, since 1904, the construction of the canal has limited the volume of commercial freight that could be handled across the Isthmus. The other cause that has checked the growth of traffic via Panama has been the competition of the Tehuantepec route, which, since the beginning of 1907, has afforded a shorter and better transportation route than the one by way of Panama for the traffic between the two seaboard of the United States. The volume of traffic handled via Panama between our two seaboard during recent years has been small and has tended to decline on account of the absorption of the Panama Railroad in Canal work.

3. The Tehuantepec route was opened for traffic early in 1907, when the American-Hawaiian Steamship Company took its steamers off the route via the Straits of Magellan and established regular line services on the Atlantic between New York and Puerto Mexico and on the Pacific between Salina Cruz and Hawaii and the west-coast ports of the United States. In 1906 it made an agreement with the Tehuantepec National Railway, which is owned by the Mexican Government, stipulating that the railway company should receive one-third of the through rate. This agreement also included a guaranty on the part of the Tehuantepec National Railway that the net earnings of the steamship company, per ship ton, should not be less than the earnings had been in 1904, when the steamship company was operating by way of the Straits of Magellan.

This guaranty, however, did not require the Tehuantepec National Railway to reduce its share of the gross receipts of the steamship company to less than 25 per cent. The American-Hawaiian line has been very successful. The fleet of the American-Hawaiian Steamship Company increased from 3 steamers in 1899 to 9 steamers in 1904, and to 17 in 1911. Five new steamers were ordered in 1911. The rapid growth in the traffic of the company has been made possible by the sugar tonnage from Hawaii to the eastern ports of the United States. The freight shipments westbound between our two seaboard are larger than those eastbound, but the exports of Hawaiian sugar have enabled the American-Hawaiian Steamship Company to run its steamers loaded in both directions. Indeed, the exports of sugar from Hawaii have been much larger than the American-Hawaiian Company could handle.

The through route between the two seaboard via the Southern Pacific Railroad from the Pacific coast to Galveston and New Orleans and from those cities to New York by the Southern Pacific Company's steamers (the Morgan Line) was established in 1883. The Sunset-Gulf route immediately began an active warfare against its competitors by rail and by water lines, and secured a large share of the traffic from coast to coast. The transcontinental railroads, other than the Southern Pacific, ran from the Mississippi and Missouri Rivers to the Pacific coast and were primarily interested in the development of traffic between the Middle West and the Pacific coast. The rates by the Sunset-Gulf route from New York to San Francisco were made the same as the rates by the transcontinental lines from St. Louis and Missouri River crossings to the Pacific. Gradually the rates by the through all-rail lines from the Atlantic to the Pacific were made the same as the rates from Chicago, St. Louis, and Missouri River crossings to the Pacific seaboard. This system of blanket rates was worked out by 1896, and has since prevailed on west bound traffic. The establishment of the same rates

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by the Sunset-Gulf route and by the all-rail lines between the two seaboards allied the Sunset-Gulf route with the all-rail lines as common competitors against the water routes around South America and via the Isthmuses of Panama and Tehuantepec. The control of the Pacific Mail Steamship Company by the transcontinental railroads since 1874, and the ownership of the Pacific Mail by the Southern Pacific from 1890 to the present, enabled the transcontinental railroads, as has been explained, to keep the traffic by the water routes within small proportions, until a few years ago, when the American-Hawaiian Steamship Company, and later the California-Atlantic, developed a relatively large tonnage coastwise via the Tehuantepec and Panama routes. This development of the coastwise business during the last few years has not been seriously opposed by the railroads, doubtless because of the rapid development of the rail tonnage consequent upon the industrial progress of the Intermountain and Pacific Coast States.

The volume of traffic handled between the Atlantic and Pacific ports of the United States by the several water routes has been constantly on the increase for a number of years, showing the rapidly growing need for the canal. The total tons of freight, not including Hawaiian sugar, rose from less than 500,000 tons in 1906 to over 800,000 tons in 1911. If the tonnage of Hawaiian sugar be included, the increase during the six years in total traffic was from 560,000 to 1,104,000 cargo tons. The increase during the four years ending in 1911 was steady and rapid. The decline during 1907 and 1908 is to be accounted for mainly by the San Francisco earthquake and fire.

An important feature is the separation of total traffic into that handled by regular steamship lines and that carried by individual vessels owned or chartered by the shippers. The traffic handled by the regular lines more than trebled during the six-year period, while that carried by individual vessels decreased more than 50 per cent. In 1911, 82.8 per cent of the entire traffic, other than

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Hawaiian sugar, was carried by the regular lines, whereas in 1906 only 42.1 per cent was shipped by the established steamship lines.

The volume and variety of the traffic between the two seaboard of the United States have so expanded as to render the services of established steamship lines having regular and frequent sailings more economical than the services of individual vessels carrying full cargoes of single commodities. The traffic manager of the American-Hawaiian line stated to the Interstate Commerce Commission, on January 16, 1907, that—

We carry practically everything. In the course of a year I think we have at least 90 per cent of the articles that may be named in the trans-continental tariffs and a great many articles not on any tariff that are continually offered and carried.

The traffic carried by way of the Panama route also includes a large variety of commodities. The west-bound freight tariff of the Panama Railroad Steamship Line requires 25 pages to enumerate the several articles upon which individual rates are quoted. The east-bound tariff of the California-Atlantic Steamship Company is a type-written document of 20 pages.

The freight carried between our two seaboard by way of Panama and Tehuantepec originates and terminates not only at the Atlantic and Pacific ports, but also at interior points. Manifests of the shipments by the American-Hawaiian line enumerate commodities shipped from eastern New York, eastern Pennsylvania, Massachusetts, New Jersey, Vermont, Connecticut, Rhode Island, Maine; also commodities from Syracuse and Buffalo, N. Y., from numerous cities in Ohio, from certain cities in Michigan, and from Chicago, Milwaukee, and St. Louis. These same manifests show that this freight is destined not only to Pacific coast ports, but to inland points, such as Sacramento, Stockton, The Dalles, Ore., Spokane and Everett, Wash., and Reno, Nev.

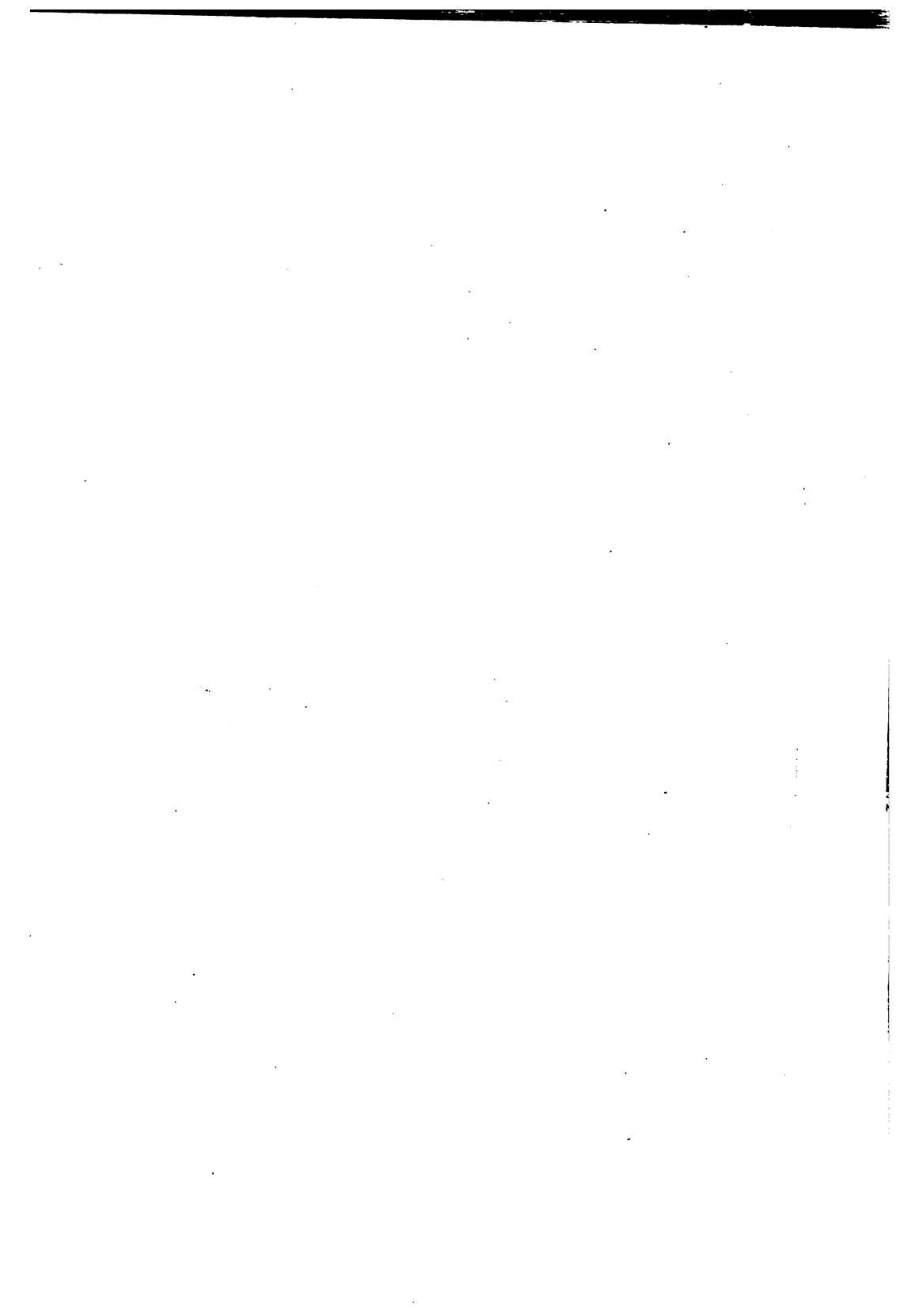
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Most of the bulk cargoes handled in vessels owned or chartered by shippers now move by the disadvantageous routes around Cape Horn or through the Straits of Magellan. The opening of the Panama Canal will make it possible for the individual ship to engage in intercoastal traffic under much better conditions. It is not probable, however, that the percentage of the total traffic handled by individual vessels will increase in the future. It is more probable that the percentage of the entire business handled by lines will increase. Most of the traffic from our Pacific to Atlantic ports carried in individual vessels owned or chartered by the shipper will necessarily consist of cargoes of grain, lumber, and sugar. The sugar traffic is already large and may be expected to become heavier. The shipments of grain from the west coast, especially from Puget Sound ports, to Europe through the canal will be large, but it is not probable that the grain from the northwestern part of the United States will find very much market at the Atlantic seaboard. That section of the United States will in all probability be supplied from the grain fields of the Middle West. Barley from the Pacific Coast States will be required in the Mississippi Valley and Atlantic coast sections of the United States, and may be shipped in vessel cargoes as charter traffic. However, such commodities as wheat, barley, wool, canned salmon, and others of a like character that might advantageously be shipped as full cargoes in chartered vessels will probably be carried eastbound mainly by line vessels, because of the fact that the tonnage of traffic westbound is normally heavier than the tonnage eastbound. Line vessels will seek these bulk commodities as supplemental cargoes eastbound and at low rates. As was stated above, the American-Hawaiian line has developed a profitable business by securing a heavy eastbound tonnage of Hawaiian sugar. In 1911 the Hawaiian line transported 295,800 tons westbound, but only 162,500 tons, other than sugar, eastbound.

The lumber shipments from the Pacific coast through









**THE WEST BREAKWATER, LOOKING SEAWARD FROM TORO POINT.**

The illustration shows a dredge at work placing rock on the face of the breakwater which is designed to form a safe harbor for ships entering the Canal from the Atlantic. Similar breakwaters protect the Pacific entrance.

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ocean carriers is impracticable and undesirable. If coastwise traffic through the canal were to be handled mainly by individual vessels owned or chartered by shippers, Government regulation would, indeed, be impracticable; but the service of steamship lines operating over established routes is not essentially different from the transportation service of the railroads. Moreover, when several steamship lines operate over the same route or over competing routes they have fixed schedules of rates established by agreement and their rate policy differs in no marked degree from that of competing railroads.

‡ The rates charged by steamship lines differ fundamentally from charter rates, which are highly competitive and fluctuate with the supply of and demand for chartered tonnage. Charter rates fluctuate according to business conditions and could not be and ought not to be subject to Government regulation. The rates of steamship lines, however, are not only made in conferences of the competing lines, but also in many cases are fixed with reference to the rates charged by the railroads with which the steamship lines must compete for traffic. It is thus at least doubtful whether it is good public policy not to regulate the rates and services of coastwise steamship lines. Whether such regulation is wise or unwise, it is at least not impracticable.

2. The question of exempting coastwise shipping from the payment of Panama Canal tolls should be decided with reference to the parties that would be benefited by that policy. If the tolls charged coastwise ships using the canal are added to the rate of freight paid by shippers, the remission of tolls will benefit the shippers and possibly, to some extent, the general public. On the other hand, if the freight rates are not any higher because of the tolls, the exemption of ships from the payment of tolls will not affect the freight rates, and the exemption of the payment of tolls will benefit the steamship company and not the shippers. Charter rates, as has just been stated, are highly competitive and the rates which a shipper must pay to

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secure the use of a vessel for a trip through the canal will undoubtedly be increased by the amount of tolls paid. Shippers using vessels which they own or charter will receive the benefit of the exemption of canal tolls. On the other hand, the rates charged by steamship lines, being regulated by agreements among competing companies and being fixed with reference to what the traffic will bear, will presumably be as high as traffic conditions warrant regardless of canal tolls. If the tolls are charged, the operating expenses of the steamship companies will be increased by the amount of the tolls and their net profits will be lessened by the same amount. In other words, free tolls will be a gratuity or a subsidy to the coastwise steamship lines. There are reasons for believing that the rates of the coastwise steamship lines, which will handle from four-fifths to nine-tenths of the water traffic between the two seaboard of the United States, will not be affected by the policy of the United States Government as regards free tolls.

Estimates of the comparative costs of shipment by the methods outlined above as against those via the Panama Canal all point to a saving of at least one-third in favor of the canal. The railroads charge about one-third of the through rate upon all freight carried between the coasts, and this on an average amounts to between \$3.00 and \$3.50 per cargo ton. Against this there will be merely the charge of \$1.20 per net vessel ton exacted for the use of the canal. Inasmuch as a vessel ton is equivalent to 100 cubic feet of space, while a cargo ton is only equivalent to 40 cubic feet of space, these terms must not be confused. As a rule, freight vessels can transport more than two tons of cargo for each net ton of rating, an average of about two tons of freight capacity for each vessel ton. On this basis the tolls as fixed for the canal at present will only amount to about sixty cents per cargo ton, and the saving should be from \$2.40 to \$2.90 on each ton of cargo as against the railway transfer method.

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There are many commodities which will be shipped via the canal which would not bear the double handling made necessary by the old method, either by reason of their fragile nature or the expense of double handling. Among the latter are lumber, coal, ore and such materials which are handled in bulk. This latter consideration will be of the utmost importance in connection with the great ore and nitrate deposits of the western coast of South America.

### REDUCTIONS IN SHIPPING RATES

The matter of ascertaining the amount of reduction in costs made possible by the use of the canal is not difficult to determine. When, however, we attempt to investigate the matter of a reduction of charges a more difficult situation confronts us. While the freight rates charged by transcontinental railroads have been a great factor in creating a powerful demand for a canal, in the hope that water competition would result in reducing present rates, it is extremely doubtful if these reductions will bear a true proportion to reductions in costs, although the idea is prevalent throughout the country that such will be the case.

Our industrial history has shown very clearly that it is impossible to compel keen competition. Our railroad companies have pools, conferences, mergers, road understandings and agreements to such an extent that competitive rates do not exist, and the Interstate Commerce Commission is the only means open to the shipper of compelling a reasonable relationship between costs of transportation and rates. The rule of thumb by which railroad rates are fixed is the phrase, "all that the traffic will bear," and it seems likely that this method will also be followed in fixing the steamship rates through the canal, and the rates maintained by the same methods as have been followed in the case of the railroads. All of the great European transport lines are bonded together in rate agreements, and it is probable that the coastwise steamship lines using the Canal will be

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operated under similar conditions, and the rates between the Atlantic and Pacific coasts will be the same by all rival lines. Of course there will be outside competition by means of privately owned or chartered vessels, but inasmuch as few shippers are able to forward in cargo lots this competition will amount to but a small percentage of the total volume of trade, practically all of which will be handled by the regular transport companies. These rates may be modified, of course, by extending the power of the Interstate Commerce Commission, or some similar body to their regulation, but it is probable that the same conditions which obtain in connection with the transcontinental railroads will reappear in connection with the Canal.

### RAILROAD COMPETITION

From this arises the question of competition between the transcontinental railroads and the intercoastal steamship lines. It has been thought that the railroads would be compelled to reduce their rates to a competitive basis with the freight rates charged via the Canal, and it was with the idea of compelling such competition that railway-owned ships were forbidden the use of the waterway. Two sets of conditions are to be apprehended: the first, that rate conferences between the steamship and railroad companies will operate to maintain a non-competitive rate schedule between them; or, in other words, that both will continue to charge as much as the traffic will bear. The second condition is that only about ten per cent of the railroad traffic is billed through from coast to coast, and if the roads should reduce the rate on this class of traffic they would be compelled to adjust the rates to all intermediate points on a similar basis and thus cut heavily into their revenues. On this account it is altogether likely that the railroads will prefer to sacrifice the ten per cent of volume rather than revise all the existing rates on such a basis. Summing up the situation, we must not anticipate a heavy reduction in costs of transportation

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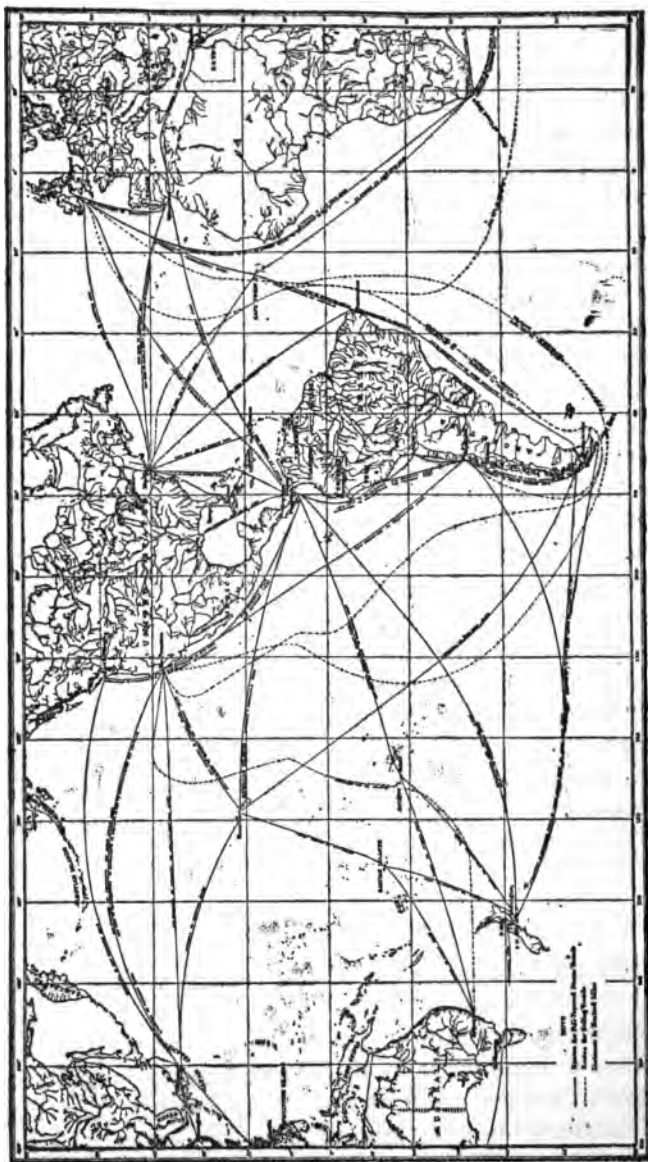
between the coasts either by ship or railroad. Certain reductions, however, are bound to come, for the reasons that competition cannot be entirely eliminated, and the insistent demands of the public for rates which bear a reasonable relation to the costs of service must be taken into consideration in fixing rates; and there are certain commodities upon which the reduction is sure to be material, and a large number on which some reduction will certainly be made in order to fill the ships which will naturally enter into this business.

The most direct way of estimating what the people of the United States and of the world at large are to gain by the opening of the Panama Canal is to estimate the tonnage which will pass through the canal, and to divide this tonnage among the several classes of trade. It has been estimated that the traffic between the coasts of the United States will amount to only about one-tenth of the ships which pass through the canal, our trade with foreign ports will amount to about one-third, and that one-half of the traffic will be ships which do not touch the ports of the United States at any point, but simply use the canal as a short cut between the Atlantic and the Pacific.

To understand the relation of the now existing trade routes, and those which will come into being with the Panama Canal, a study of a route map is necessary which shows comparative distances on all of the principal trade routes. (*See page 226.*)

### RESULTS FAR REACHING

It is difficult to foresee all of the results which will be obtained by the operation of the Canal, for the reason that they are so numerous and so far-reaching. It is probable that in course of time trade, political and banking conditions will be revolutionized to a degree unforeseen. The first effect will naturally be the tightening of the commercial ties between the eastern and western sections of the United



**TRADE ROUTES AND DISTANCES BY EXISTING LINES AND BY THE PANAMA CANAL.**

(See table on opposite page.)



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States, due to the greatly increased facilities for transportation between them. With the increase in commercial relations will naturally come a greater community of interests, not only commercial, but political and social, and a closer welding of East and West.

### DISTANCES IN NAUTICAL MILES

#### SAVED FROM NEW YORK VIA THE PANAMA CANAL ON TRADE ROUTES

San Francisco:	
Magellan.....	13,135
Panama.....	5,262
	<hr/>
Saved.....	7,873
Guayaquil:	
Magellan.....	10,215
Panama.....	2,810
	<hr/>
Saved.....	7,405
Callao:	
Magellan.....	9,613
Panama.....	3,363
	<hr/>
Saved.....	6,250
Iquique:	
Magellan.....	9,143
Panama.....	4,004
	<hr/>
Saved.....	5,139
Valparaiso:	
Magellan.....	8,880
Panama.....	4,633
	<hr/>
Saved.....	3,747
Honolulu:	
Magellan.....	18,312
Panama.....	6,700
	<hr/>
Saved.....	6,612

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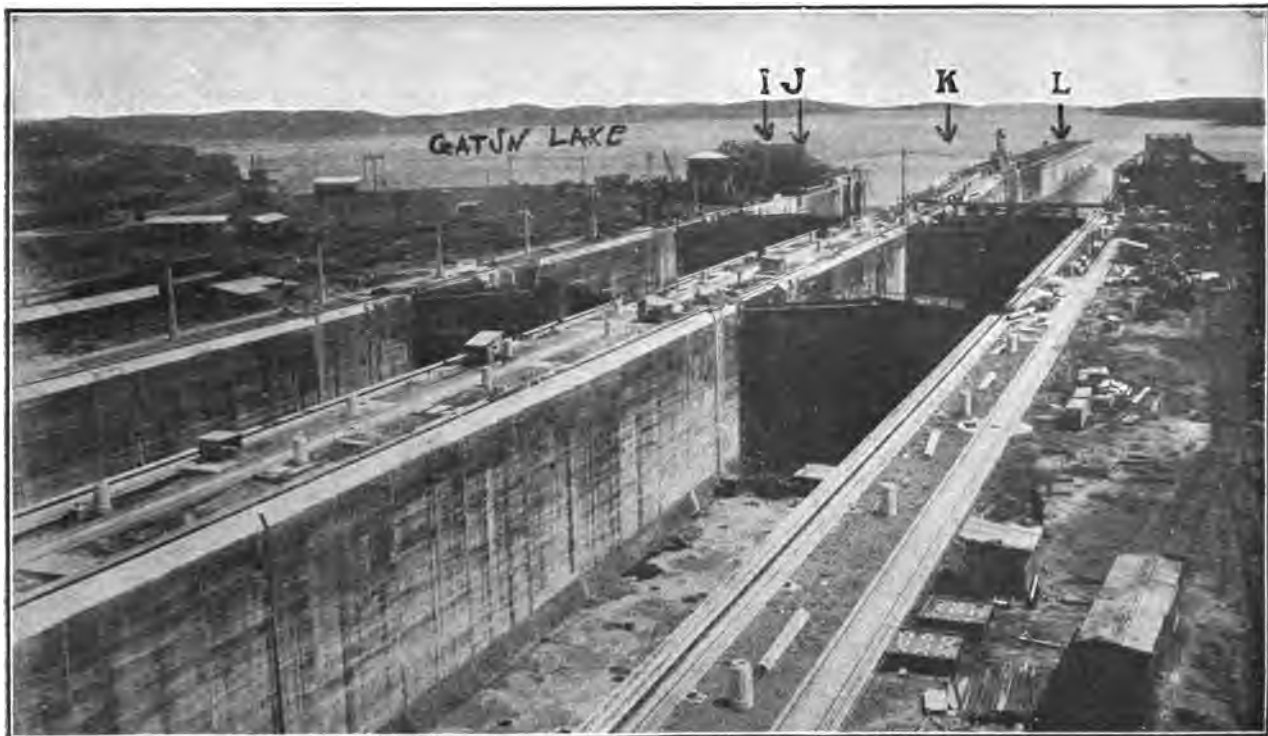
<b>Manila:</b>	
Suez.....	11,589
*Panama.....	11,548
Saved.....	41
 <b>Yokohama:</b>	
Suez.....	13,079
*Panama.....	9,798
Saved.....	3,281
 <b>Hongkong:</b>	
Suez.....	11,628
*Panama.....	11,383
Saved.....	245
 <b>Melbourne:</b>	
Magellan.....	12,852
Panama.....	10,030
Saved.....	2,822

### THE CANAL AND THE COMMERCE OF AMERICA

The establishment of a waterway between the two great oceans of the globe will more widely affect the commerce of the world than any single work or event in its history. President Hayes, in 1879, declared that "an interoceanic canal across the American Isthmus will essentially change the geographic relations between the Atlantic and Pacific coasts of the United States and between the United States and the rest of the world." The Panama route will effect much greater economies of time and distance than those that are at present secured by the use of the Suez Canal.

Colquhoun, in his "Key to the Pacific," says: "It will bind together the remote sections of that immense country, assimilate its diverse interests, go far towards solving many

\* Via San Francisco and the Great Circle.



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#### GATUN LOCKS.

I. Steel emergency gate for protection of locks in event of accident. J. First lock gate from Gatun Lake, coming from Pacific side. K. Gatun Lake and Canal channel. Lake now 45 feet above sea level. Will be raised to 87 feet during coming rainy season. L. Guide wall where vessels are taken in tow by the motors.



difficult problems, and make the United States still more united. . . . No greater impulse to commerce can be given than this complement to the Suez Canal. It will benefit America in an infinitely greater degree than Europe. . . . It will give an immense impetus to United States manufactures, especially cotton and iron, and will greatly stimulate the shipbuilding industry and the naval power of the United States."

Whilst the Panama Canal must prove an universal boon it will doubtless work to the detriment of some countries and certain industries, at least until after adjustment of the new trade relations. America will always be the greatest beneficiary of the advantages accruing from the use of the waterway and we will briefly consider a few of the changes in conditions that have been brought about by the completion of the enterprise to which so large an amount of American energy, intellect and capital has been devoted.

#### EFFECT OF THE CANAL ON THE COMMERCE OF THE SOUTH

No region in the United States can feel the immediate benefit of the new route to the same extent as the Southern States and the vast Valley of the Mississippi. The latter territory, the richest in all the world, one and a quarter million square miles in extent, intersected by five thousand miles of navigable waterway, with prolific soil and energetic people, finds new markets and a new outlet for its varied products no longer dependent upon expensive railway transportation. Chicago is nearly the same distance from New Orleans as from New York, but St. Paul, Omaha, Dubuque, Evansville and Denver are nearer to the former point than to the latter. It is quite probable that the present generation will see ocean steamships coming down from Duluth, through the Great Lakes, an inland canal, and the Mississippi River, to the Gulf of Mexico, and passing on to Pacific and Asian ports.

The new gateway to the Pacific will give a tremendous

impetus to the industries of the South. Its raw cotton, which for a decade has been making small gains, under difficult competition with the British East Indies and China, in the Japanese market, is relieved of an onerous handicap. The product of its mills, a coarse fabric, such as is especially adapted to the requirements of South American and Oriental consumers, must enjoy an enlarged demand under stimulating conditions. Heretofore almost all the cotton goods exported from this country to Asia has gone out through New York eastward by way of the Suez Canal.

Alabama coal will find a constant and extensive demand at Panama, which will become the greatest coaling port in the world. Birmingham, where iron can be produced more cheaply than at any other place on the earth, will find new markets in South America and Asian countries for its output. The steel, machinery, and various hardware of Tennessee and other Southern States, which have been reaching Australia and China during the past few years under the most disadvantageous conditions of shipment, can be sent through the Canal to these and other destinations at a cost which may defy competition. The large lumber and wood manufacturing industries of the South will be obviously benefited to a great extent by the creation of a short route to the western coasts of Central and South America.

#### GREAT BENEFITS TO OUR PACIFIC STATES

The immense saving in the journey from our eastern ports to the Pacific Coast will revolutionize the trade of the latter region. Von Schierbrand says:\* "It has been computed that on a single voyage of a 1,500-ton sailing vessel between Port Townsend, Seattle or San Francisco and Boston, New York or Philadelphia, the saving effected in wages, repairs, insurance, provisions, and freight charges, by reason of the Panama Canal will aggregate between

\*America, Asia and the Pacific. Wolf von Schierbrand. New York, 1904.

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\$8,000 and \$9,500." Many raw products of our Pacific Coast, which can not bear the cost of long railroad hauls, are made available to eastern markets at prices profitable to the producer and the manufacturer. This applies particularly to building lumber and furnishes a partial solution to the problem with which the rapidly disappearing forests of our middle and eastern states are confronting us. The economies effected in the transportation of the cereal and fruit products of California and other western regions may easily be imagined. Millions of pounds of fish were sent annually in ice across the continent, aside from the enormous quantities that went to Europe in English sailing vessels round Cape Horn. All this passes through the Canal.

The Canal is the means of enabling the people of the Pacific Coast to buy more cheaply and to secure better prices for their products. By breaking the monopolistic power of the railroads it will lead to the agricultural development of the unoccupied sections of this territory, to a vast increase in its population and to the creation of world-wide markets for its products.

### A BOON TO THE NORTHEASTERN TERRITORY

The industries of the northeastern section of the United States, that is to say the territory lying to the east of Pittsburg and to the north of the James River, consist mainly of the manufactures of iron and steel, machinery, tools, etc., and textiles, coal mining, and shipbuilding. The exports of manufactured cotton from this and other parts of the United States go principally to ports in Asia and Oceania, where their chief competitor is the product of the British mills. It is not necessary to expatiate upon the advantage which the short route will give to us in this trade. The countries of South America expend about \$80,000,000 annually in the purchase of cotton goods. At present, however, little more than five per cent of this

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large sum is paid for American cloth, but the facilities for shipping economically that will be created by the Canal must have, among other results, that of giving to the manufacturers of our Northeastern and Southern States a very large share of this desirable business.

It is hoped that by the use of a new type of steel river barge of large capacity and small draft the coal of Pennsylvania and the Southern mines may be shipped direct to Panama at a cost of one dollar per short ton. This would allow of its being sold at three dollars, a figure sufficiently low to preclude successful competition. The ability to supply cheap fuel would not only accrue to the benefit of our coal mining interests, but would, where other considerations balanced, decide shipmasters in favor of the Panama route, for the contract price of steam coal at Port Said is about six dollars and the current price about ten dollars per ton.

### OUR ADVANTAGE OVER FOREIGN COMPETITORS

The principal exporting competitors of the United States in the markets for the manufactures of iron and steel are Great Britain, Germany and Belgium. European producers can reach the west coast of South America, and the oriental countries in general, more readily than can our manufacturers, but the Canal will entirely subvert the condition in the favor of the latter. Few of our industries are likely to receive such an expansive impulse from that event as those dependent upon iron and steel for their material and the section which will benefit most in that respect is the coal and ore region of the South.

One of the most certain consequences of the increased American trade due to the waterway between the Atlantic and Pacific oceans will be the great extension of the merchant marine and the expansion of the shipbuilding industry of the country. The Canal will have the effect of largely increasing the coasting trade of the United States



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and all the vessels engaged in it must be built in American yards. Aside from this the increased foreign trade under conditions that will make the shipping business once more profitable, must lead to the construction of a large additional number of American vessels, and the considerable benefiting of American shipbuilders, who find great difficulty in competing with those of Europe on account of our higher wage scales.

A large shipbuilder responded to an inquiry by the Isthmian Canal Commission with the following statement: "In my judgment the opening of the Isthmian Canal and the development of its traffic would stimulate American shipbuilding to the extent of an increased demand for vessels to be used in trade affected by said canal. As a rule increased demand develops increased sources of supply and the cost of product is invariably reduced in proportion of increased business to fixed expenses of any manufacturing establishment, and therefore the canal would in this case tend to enable shipbuilders to construct ships more economically and more surely to compete with foreign builders."

The foregoing are only a few illustrative examples of the benefits to certain portions of the United States conferred by the Panama Canal. Anything approaching a comprehensive statement of the matter would fill a large volume.

### THE EFFECT ON OUR FOREIGN COMMERCE

But to gain a full view of all that will be accomplished it is necessary to go farther afield. Up to within the last few years the American people have been so largely occupied with the development of the enormous natural resources of this country they have had little time or necessity for the development of foreign trade, and the commerce of the world at large is carried on by European nations. This state of affairs cannot exist indefinitely, however, and our foreign trade is now growing very rapidly. In spite of this present great total, however, the

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effect of the Panama Canal will be to multiply it enormously. For instance, our percentage of the great trade with the western coast of South America is extremely small. The shipments from southern Chile of nitrate, copper and iron ores, etc., amount to an enormous tonnage each year. Of this the United States gets less than one-fifth. Grain shipments from western South America are also heavy, and practically all of this goes to Europe. With the Canal open the United States will be so much nearer than Europe that a large portion of this trade should eventually be diverted to the eastern coast of the United States, where our great manufacturing plants are located. The same conditions apply to Australia and New Zealand, with which we will be on a par with Europe so far as distance is concerned by the use of the canal, and our Atlantic coast will be 4,000 miles nearer Australia by Panama than by Suez. New York will be 5,000 miles nearer New Zealand by Panama than around the Cape of Good Hope.

Our traffic with the Far East, China and Japan, will likewise be greatly benefited by the new route, although not to such a great extent, as both China and the Philippines will be equally distant from New York via both the Panama Canal and the Suez Canal. From the standpoint of a reduction of distance the Panama Canal will undoubtedly benefit us to a very great extent.

The other considerations of costs of fuel, supplies, facility for repairs, etc., have been taken care of by the establishment of the great supply stations at Panama.

### THE EFFECT ON OUR SHIPPING INTERESTS

The question of American shipping has been a sore point for many years. In fact, the American flag has almost disappeared from the world's merchant marine. There have been various causes for this, chief among them the high cost of labor, which has put the cost of building ships in the United States up to a prohibitive figure and made

## THE RESULTS OF OPENING THE CANAL 235

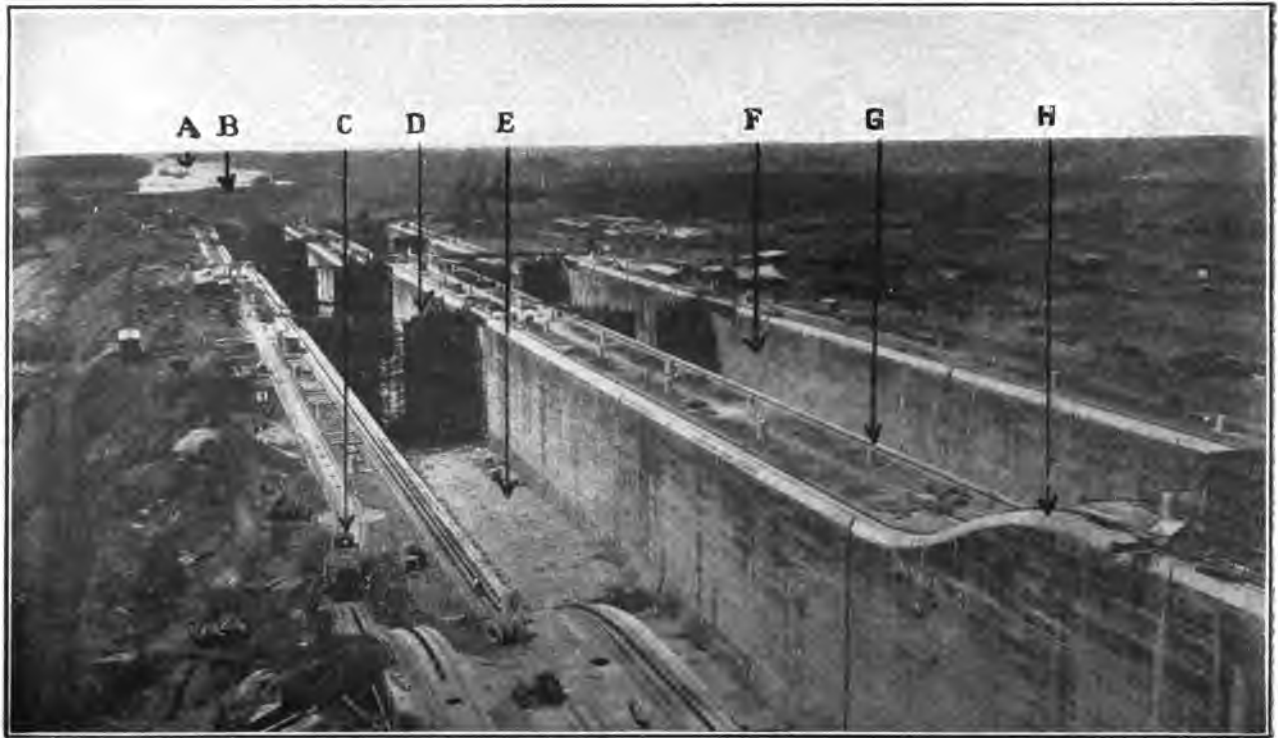
it far cheaper to buy ships abroad and operate them under a foreign flag than to build here. Recent legislation admitting foreign built ships to American registry, together with the admission of necessary parts free of duty, looks to the remedy of this matter, and we shall probably see an enormous increase in the American registry within the next few years. Ships, however, which are engaged purely in the coastwise trade must still be built in the United States to obtain the privilege of American registry.

### WILL THE CANAL PAY

The question of whether or not the Canal would pay has been one which has agitated the American people for some time. The maximum rate which has been authorized by Congress for canal tolls is \$1.25 per ton on freight, and \$1.50 per passenger, although these rates may be reduced by the President in case they are higher than necessary to produce the amount required for operation and maintenance, which will amount to about \$4,000,000 annually. If we take into account the interest upon the investment at the rates at which the Canal bonds have been placed, the tolls must produce another \$10,000,000 per year, or a total of \$14,000,000 annually for the Canal to be self-supporting. It is not likely from the outlook that the Canal will pay for some years to come.







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#### GATUN LOCKS.

A. Completed sea level section of canal, seven miles long, from Atlantic Ocean to Gatun Locks, where by a series of three locks vessels are raised to Gatun Lake 85 feet above sea level. B. Small area of land to be dredged away as soon as Gatun Locks are completed. C. Electric towing motor, four of which will tow each vessel entirely through the locks. They run on cog rail along the lock walls. D. Lock gate under construction. E. Floor of first lock from Atlantic side. Note holes in floor for admitting the water. F. Lock for vessels coming from Pacific side. G. Base on which concrete posts will be erected for electric lights. A row of lights on all sides of the locks will make operation at night as safe as day. H. Incline from locks of different levels up and down which the towing motors run on cog rails.

## **APPENDICES**





## APPENDIX I\*

### GREAT CANALS OF THE WORLD

Ship canals connecting great bodies of water, and of sufficient dimensions to accommodate the great modern vessels plying upon such waters, are of comparatively recent production and few in number. The one great example of works of this character which has been a sufficient length of time in existence and operation to supply satisfactory data as to cost of maintenance and operation and practical value to the commerce of the world is the Suez Canal, and for this the available statistics begin with the year 1870, while its new and enlarged dimensions only date from the year 1896. For the Sault Ste. Marie Canal, connecting Lake Superior with Lake Huron, statistics date from 1855. Statistics of the Welland Canal date from 1867, though the canal in its enlarged form has been in operation only since 1900. The other great ship canals of the world are of much more recent construction, and data regarding their operation therefore cover a comparatively brief term, and in some cases are scarcely at present available in detail.

The artificial waterways which may properly be termed ship canals are nine in number, viz.:

- (1) The Suez Canal, begun in 1859 and completed in 1869.
- (2) The Cronstadt and St. Petersburg Canal, begun in 1877 and completed in 1890.
- (3) The Corinth Canal, begun in 1884 and completed in 1893.

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\* The following matter is largely quoted from the monograph under this title issued by the Department of Commerce and Labor, Washington, D. C.

- (4) The Manchester Ship Canal, completed in 1894.
- (5) The Kaiser Wilhelm Canal, connecting the Baltic and North Seas, completed in 1895.
- (6) The Elbe and Trave Canal, connecting the North Sea and Baltic, opened in 1900.
- (7) The Welland Canal, connecting Lake Erie with Lake Ontario.
- (8 and 9) The two canals, United States and Canadian, respectively, connecting Lake Superior with Lake Huron.

#### THE SUEZ CANAL

The Suez Canal is usually considered the most important example of ship canals, though the number of vessels passing through it annually does not equal that passing through the canals connecting Lake Superior with the chain of Great Lakes at the south. In length, however, it exceeds any of the other great ship canals, its total length being 90 miles, of which about two-thirds is through shallow lakes. Work on the canal was begun on April 25, 1859. Political, labor and financial troubles delayed the completion of the enterprise, however, and the formal opening of the canal was not until November, 1869.

The material excavated was usually sand, though in some cases strata of solid rock from 2 to 3 feet in thickness were encountered. The total excavation was about 80,000,000 cubic yards under the original plan, which gave a depth of 25 feet. In 1895 the canal was so enlarged as to give a depth of 31 feet, a width at the bottom of 108 feet and at the surface of 420 feet. The original cost was \$95,000,000, and for the canal in its present form slightly in excess of \$120,000,000.

By the concessions of 1854 and 1856 the tolls were to be the same for all nations, preferential treatment of any kind being forbidden, and the canal and its ports were to be open to every merchant ship without distinction of nationality. The formal neutralization of the canal oc-

curred in 1888 by the Suez Canal Convention, but was not fully assented to until April 8, 1904.

The canal is without locks, being at sea level the entire distance. The length of time occupied in passing through the canal averages about eighteen hours. By the use of electric lights throughout the entire length of the canal passages are made with nearly equal facility by night or day. The use of these lights, the growth in canal dimensions, the increase in the number and size of passing stations or "lay-bys" and the straightening of curves have reduced the average time required to pass through the canal from 48 hours 58 minutes in 1870 to 17 hours 1 minute in 1911.

The canal has accommodated the following traffic service since its opening:

	VESSELS.	GROSS TONNAGE.
1870 .....	486	654,915
1875 .....	1,494	2,940,708
1880 .....	2,026	4,344,519
1890 .....	3,389	9,749,129
1895 .....	3,434	11,833,637
1900 .....	3,541	13,699,237
1905 .....	4,116	13,134,105
1910 .....	4,533	16,581,898

The tolls charged are 6 $\frac{3}{4}$  francs per ton for vessels carrying cargo, and 4 $\frac{1}{4}$  francs for vessels in ballast. Steam vessels passing through the canal are propelled by their own power.

THE CRONSTADT AND ST. PETERSBURG CANAL

The canal connecting the Bay of Cronstadt with St. Petersburg is described as a work of great strategic and commercial importance to Russia. The canal and sailing course in the Bay of Cronstadt are about 16 miles long, the canal proper being about 6 miles and the bay channel about 10 miles, and they together extend from Cronstadt, on the Gulf of Finland, to St. Petersburg. The canal was opened in 1890 with a navigable depth of 20 $\frac{1}{2}$  feet, the original depth having been about 9 feet; the width

ranges from 220 to 350 feet. The total cost is estimated at about \$10,000,000.

#### THE CORINTH CANAL

The next of the great ship canals connecting bodies of salt water in the order of date of construction is the Corinth Canal, which connects the Gulf of Corinth with the Gulf of Ægina. The canal reduces the distance from Adriatic ports about 175 miles and from Mediterranean ports about 100 miles. Its length is about 4 miles, a part of which was cut through granite soft rock and the remainder through soil. There are no locks. The width of the canal is 72 feet at bottom and the depth  $26\frac{1}{2}$  feet. The work was begun in 1884 and completed in 1893 at a cost of about \$5,000,000. The average tolls are 18 cents per ton and 20 cents per passenger.

#### THE MANCHESTER SHIP CANAL

The Manchester Ship Canal, which connects Manchester, England, with the Mersey River, Liverpool, and the Atlantic Ocean, was opened for traffic January 1, 1894. The length of the canal is  $35\frac{1}{2}$  miles, the total rise from the water level to Manchester being 60 feet, which is divided between four sets of locks, giving an average to each of 15 feet. The minimum width is 120 feet at the bottom and average 175 feet at the water level; the minimum depth 26 feet, and the time required for navigating the canal from five to eight hours. The total amount of excavation in the canal and docks was about 45,000,000 cubic yards, of which about one-fourth was sandstone rock. The lock gates are operated by hydraulic power; railways and bridges crossing the route of the canal have been raised to give a height of 75 feet to vessels traversing the canal, and an ordinary canal whose route it crosses is carried over it by a springing aqueduct composed of an iron caisson resting upon a pivot pier. The total cost of the canal is given at \$75,000,000. The revenue in 1911, according to

the Statesman's Year-Book. was £580,841, and the working expenses, £305,977.

#### THE KAISER WILHELM CANAL

Two canals connect the Baltic and North seas through Germany, the first, known as the Kaiser Wilhelm Canal, having been completed in 1895 and constructed largely for military and naval purposes, but proving also of great value to general mercantile traffic. Work upon the Kaiser Wilhelm Canal was begun in 1887, and completed, as before indicated, in 1895. The length of the canal is 61 miles, the terminus in the Baltic Sea being at the harbor of Kiel. The depth is  $29\frac{1}{2}$  feet, the width at the bottom 72 feet, and the minimum width at the surface 190 feet. The route lies chiefly through marshes and shallow lakes and along river valleys. The total excavation amounted to about 100,000,000 cubic yards, and the cost to about \$40,000,000. The saving is 200 miles in the Kattegat passage, and the time of transit occupies from eight to ten hours.

#### THE ELBE AND TRAVE CANAL

A smaller canal known as the Elbe and Trave Canal, with a length of about 41 miles and a depth of about 10 feet, was opened by the Emperor of Germany, June 16, 1900.

It was under construction for five years, and cost about \$5,831,000, of which Prussia contributed \$1,785,000 and the old Hanse town of Lubeck \$4,046,000. This canal is the second to join the North Sea and the Baltic, following the Kaiser Wilhelm Canal (or Kiel Canal), built at a cost of \$37,128,000. The breadth of the Elbe and Trave Canal is 72 feet; breadth of the locks, 46 feet; length of locks, 261 feet; depth of locks, 8 feet 2 inches. It is crossed by 29 bridges, erected at a cost of \$1,000,000. There are seven locks, five being between Lubeck and the Mollner

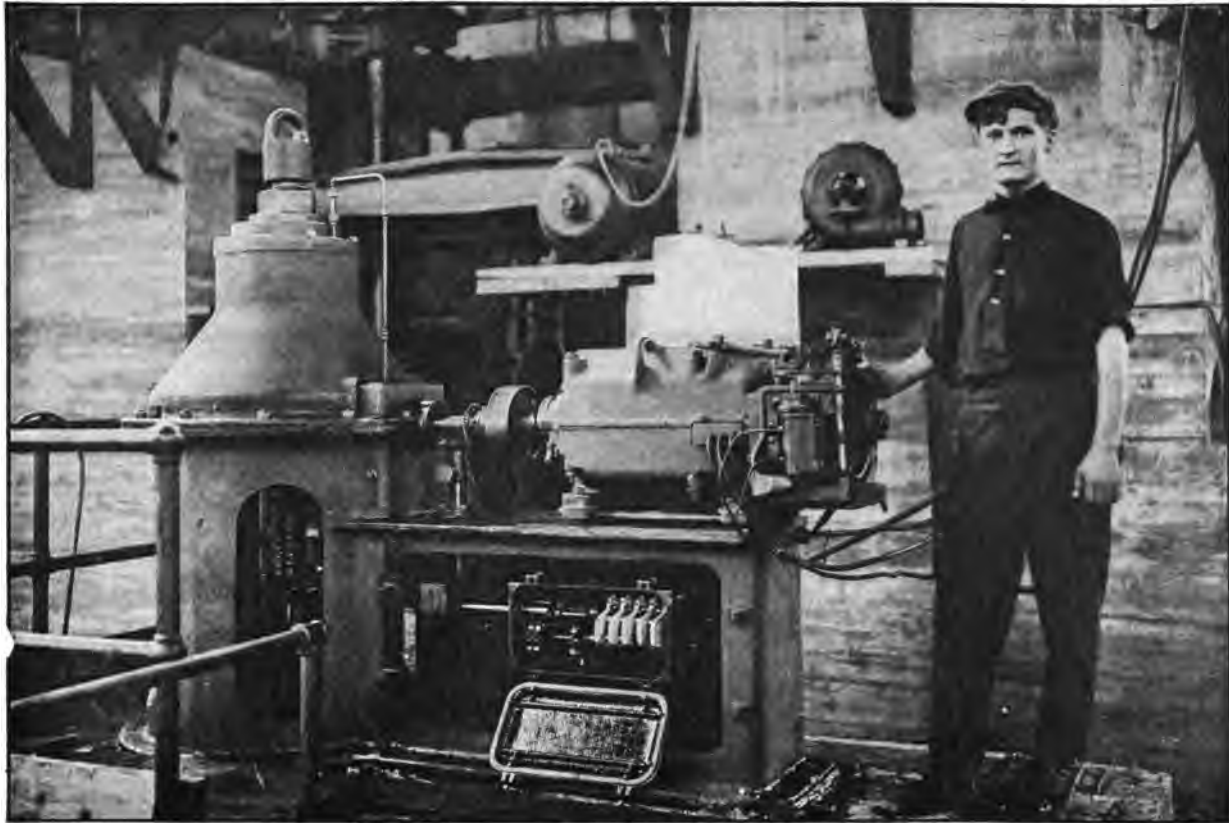
See (the summit point of the canal) and two between Mollner See and Lauenburg-on-the-Elbe. The canal is able to accommodate vessels up to 800 tons burden; and the passage from Lubeck to Lauenburg occupies 18 to 21 hours. The first year it was open (June, 1900, to June, 1901) a total of 115,000 tons passed through the canal.

#### ELECTRIC TOWING

At this point it may be noted that the Germans began experiments during 1900 with electric towing on the Finow Canal between Berlin and Stettin. A track of 1-meter gauge was laid along the bank of the canal, having one 9-pound and one 18-pound rail laid partly on cross-ties and partly on concrete blocks. The larger rail served for the return current, and had bolted to it a rack which geared with a spur wheel on the locomotive. The locomotive was 6 feet 10 inches by 4 feet 10 inches, mounted on four wheels, with a wheel base of 3 feet 6 inches, and weighing 2 tons. It was fitted with a 12-horsepower motor, current for which was furnished by a 9-kilowatt dynamo, driven by a 15-horsepower engine. The current was 500 volts, transmitted by a wire carried on wooden poles 23 feet high and about 120 feet apart. The boats were about 132 feet long and 15 feet 6 inches beam, and carried from 150 to 175 tons on a draft of 4 feet 9 inches.

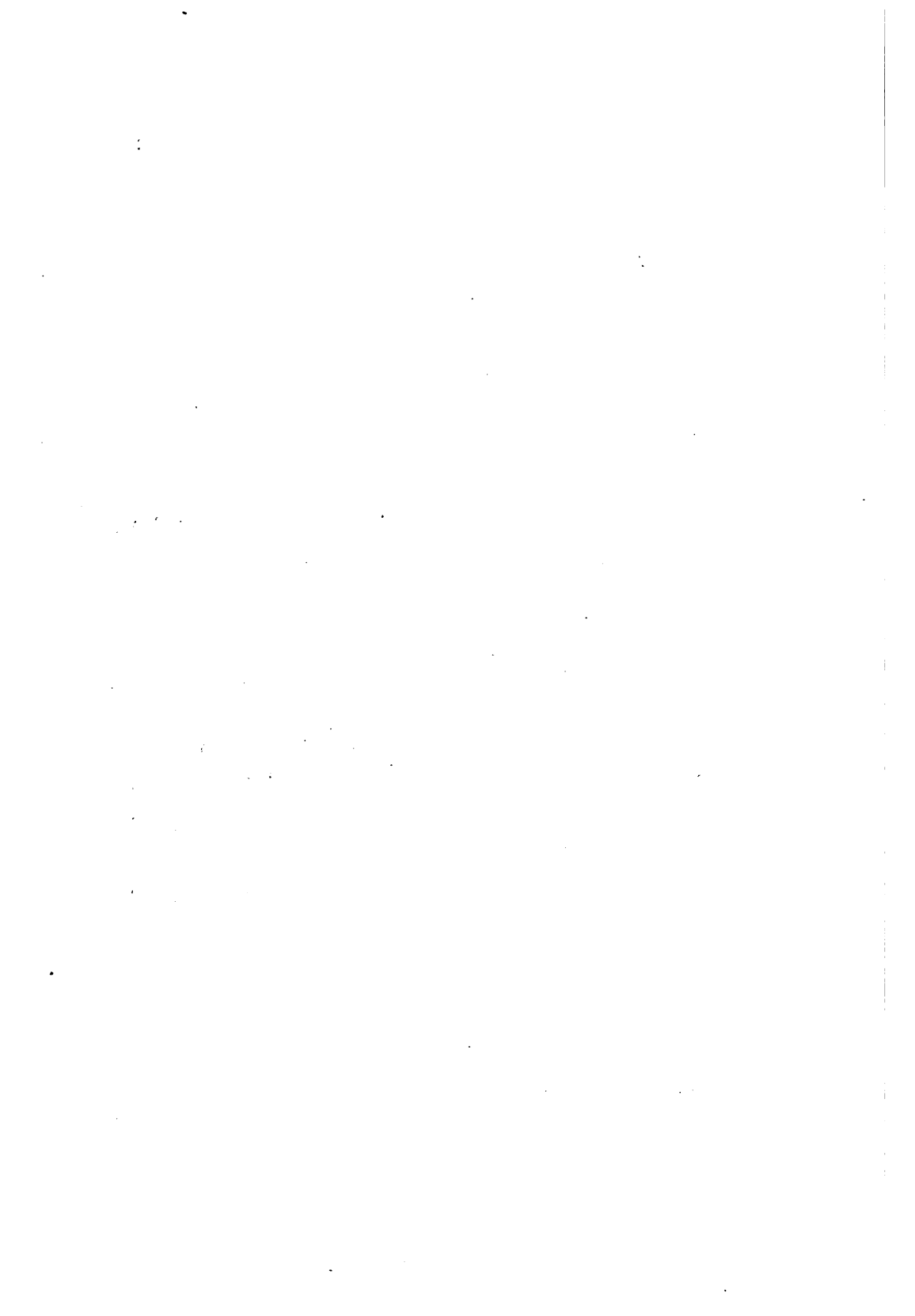
#### SHIP CANALS CONNECTING THE GREAT LAKES OF NORTH AMERICA

Three ship canals intended to give continuous passage to vessels from the head of Lake Superior to Lake Ontario and the St. Lawrence River are the Welland Canal, originally constructed in 1833 and enlarged in 1871 and 1900; the St. Mary's Falls Canal at Sault Ste. Marie, Mich., opened in 1855 and enlarged in 1881 and 1896, and the Canadian Canal at St. Mary's River, opened in 1895. In point of importance, measured at least by their present use,



**A CYLINDRICAL VALVE MACHINE, MOTOR AND LIMIT SWITCH.**

This machine is one of many which are used to regulate the flow of water to the locks. All valves are controlled from a central operating station on each of the three sets of locks. The limit switch automatically shuts off the power and stops the motor when the valve is entirely open or shut.





the canals at the St. Mary's River by far surpass that of the Welland Canal, the number of vessels passing through the canals at the St. Mary's River being eight times as great as the number passing through the Welland, and the tonnage of the former nearly forty times as great as that of the latter. One of the important products of the Lake Superior region, iron ore, is chiefly used in the section contiguous to Lake Erie, and a large proportion of the grain coming from Lake Superior passes from Buffalo to the Atlantic coast by way of the Erie Canal and railroads centering at Buffalo. The most important article in the westward shipments through the Sault Ste. Marie canals, coal, originates in the territory contiguous to Lake Erie. These conditions largely account for the fact that the number and tonnage of vessels passing the St. Mary's River canals so greatly exceed those of the Welland Canal.

The Welland Canal connects Dalhousie on Lake Ontario and Port Colburne on Lake Erie on the Canadian side of the river. It was constructed in 1833 and enlarged in 1871 and again in 1900. The length of the canal is 27 miles, the number of locks 25, the total rise of lockage 327 feet, and the total cost about \$26,000,000. The canal will accommodate vessels of 14 feet draught.

#### THE SAULT STE. MARIE CANALS

The canals at Sault Ste. Marie, Michigan, and Ontario are located adjacent to the falls of the St. Mary's River, which connects Lake Superior with Lake Huron, and lower or raise vessels from one level to the other, a height of 17 to 20 feet. The canal belonging to the United States was begun in 1853 by the State of Michigan and opened in 1855, the length of the canal being 5,674 feet, and provided with two tandem locks, each being 350 feet in length and 70 feet wide, and allowing passage of vessels drawing 12 feet, the original cost being \$1,000,000; the final, \$4,000,000. The United States Government, by consent of the State, began

in 1870 to enlarge the canal, and by 1881 had increased its length to 1.6 miles, its width to an average of 160 feet, and its depth to 16 feet; also had built the Weitzel lock, 515 feet long and 80 feet wide, 60 feet at gate openings, with a depth of 17 feet on the sills, which was located 100 feet south of the State locks. The State relinquished all control of the canal in March, 1882. In 1887 the State locks were torn down and replaced by a single lock known as the Poe, 800 feet long, 100 feet wide, with a depth of 22 feet of water on the sills. This lock was put in commission in 1896. The canal was also deepened to 25 feet. In 1908 began the widening of the canal above the locks and the construction of a new lock 1,350 feet long between gates and having a draught of  $24\frac{1}{2}$  feet at extreme low water. The Canadian canal,  $1\frac{1}{8}$  miles long, 150 feet wide, and 22 feet deep, with lock 900 feet long, 60 feet wide, with 22 feet on the miter sills, was built on the north side of the river during the years 1888 to 1895 at a cost of \$7,900,000. The commerce passing through the canals is larger than that of any other canal in the world; the total tonnage of the American canal in 1910 was 49,856,123, while that of the Suez Canal was only 23,054,901.

#### LAKE BORGNE CANAL

The Lake Borgne, Louisiana, Canal was formally opened in August of 1901. It affords continuous water communication with lakes Maurepas, Pontchartrain, and Borgne, the Mississippi Sound, Mobile, and the Alabama and Warrior rivers, and the entire Mississippi River system, and has an important bearing as a regulator of freight rates between these sections. The effects of the canal may be briefly summed up as: Shortening the distance between New Orleans and the Gulf points east of the Mississippi; bringing shipments from the Gulf coast direct to the levees at New Orleans; saving the trans-shipment of through freights, with a consequent reduction in freight rates; enabling sea-

going vessels, drawing 10 to 12 feet of water, to come within 20 miles of New Orleans, saving all such craft the cost of tonnage, and shortening, by 60 miles, direct water communication between New Orleans and the deep water of the Gulf. In addition to these effects may be enumerated the cheapening of coal for consumption at New Orleans. Coal had hitherto been floated down the rivers from Pittsburgh, a distance of 2,100 miles. The canal opened up the coal fields in the interior of Alabama for New Orleans consumption and reduced coal prices considerably, giving an additional advantage to domestic industries and to steamers purchasing bunker coal. The canal is 7 miles long and from 150 to 200 feet in width. Bayou Dupre forms a portion of the canal. The lock chamber is 200 feet long, 50 feet wide, and 25 feet deep, and connects the canal with the Mississippi River.

#### THE CHICAGO SANITARY AND SHIP CANAL

The Chicago Sanitary and Ship Canal connects Lake Michigan at Chicago with the Illinois River at Lockport, a distance of 34 miles. It was cut for the purpose of giving to the city of Chicago proper drainage facilities by reversing the movement of water, which formerly flowed into Lake Michigan through the Chicago River, and turning a current from Lake Michigan through the Chicago River to the Illinois River at Lockport and thence down the Illinois River to the Mississippi. The canal, which is practically a sewer, is flushed with water from Lake Michigan, and its waters are pure within a flow of 150 miles. Its capacity, not fully utilized at first, is 600,000 cubic feet per minute, sufficient to renew the water of the Chicago River daily. Indeed it has been proved that the Illinois is purer than the Mississippi at their junction.

The minimum depth of the canal is 22 feet, its width at bottom 160 feet, and the width at the top from 162 to 290 feet, according to the class of material through which

it is cut. The work was begun September 3, 1892, and completed and the water turned into the channel January 2, 1900. The flow of water from Lake Michigan toward the Gulf is now at the rate of 360,000 cubic feet per minute, and the channel is estimated to be capable of carrying nearly twice that amount. The total excavation in its construction included 28,500,000 cubic yards of glacial drift and 12,910,000 cubic yards of solid rock, an aggregate of 41,410,000 cubic yards. In addition to this the construction of a new channel for the Desplaines River became necessary in order to permit the canal to follow the bed of that river, and the material excavated in that work amounted to 2,068,659 cubic yards, making a grand total displacement in the work of 43,478,659 cubic yards of material which, according to a statement issued by the trustees of the sanitary district of Chicago, would, if deposited in Lake Michigan in 40 feet of water, form an island 1 mile square with its surface 12 feet above the water line.

All bridges along the canal are movable structures. The total cost of construction, including interest account, aggregated \$34,000,000, of which \$21,379,675 was for excavation and about \$3,000,000 for rights of way and \$4,000,000 for building railroad and highway bridges over the canal.

The Illinois and Michigan Canal, which formerly carried off most of the waste of the city, is used by small craft, and the new drainage canal also may be used for shipping in view of the federal government's improvements of the rivers connecting it with the Mississippi for the construction of a ship canal for large vessels. The canal also made possible the development of enormous hydraulic power for the use of the city.

#### THE HENNEPIN CANAL

The Illinois and Michigan Canal has been supplemented by the Illinois and Mississippi Canal, more commonly

known as the "Hennepin." It completes a navigable waterway from the Mississippi River to Lake Michigan. The first appropriation for the project was made in 1890; work was begun in 1892 and the canal formally opened, October 24, 1907.

Starting at the great bend of the Illinois River,  $1\frac{3}{4}$  miles above Hennepin, this barge canal follows the Bureau Creek valley to the mouth of Queen River on the Rock River, and then proceeds by the Rock River and a canal around its rapids at Milan to its mouth at Rock Island in the Mississippi River. The canal is 80 feet in width at the water line, 52 feet in width at the bottom, and seven feet in depth. The greater part of the water comes from the Rock River, which is dammed by a dam nearly 1,500 feet long between Sterling and Rock Falls, Illinois.

#### OTHER CANALS

In addition to the ship canals previously mentioned, there are a number of other important waterways worthy of mention. The great North Holland Canal, cut in 1845 from Amsterdam to Helder, a distance of 51 miles, to avoid the shoals of the Zuyder Zee, has a depth of 20 feet, a width of 125 feet at the surface, and carries vessels of 1,300 tons burden, and is described as "the chief cause of the great prosperity of Amsterdam."

The Caledonian Canal, which connects the Atlantic Ocean and North Sea through the north of Scotland, is 17 feet in depth, 50 feet in width at the bottom, and 120 feet at the surface, with a surface elevation at the highest point of 94 feet above sea level. The canal proper is 250 miles long, and the distance between the terminals over 300 miles. It saves about 400 miles of coasting voyage round the north of Great Britain through the stormy Pentland Firth. The cost has been stated at \$7,000,000, including repairs; and the annual income is between \$35,000 and \$40,000.