The World's Columbian Water Commerce Congress

CHICAGO, 1893

REPORT OF THE SECRETARY

INCEPTION AND ORGANIZATION

MINUTES OF THE MEETINGS

AND

LIST OF MEMBERS

BOSTON
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283 Washington Street

LIST OF PAPERS.

I. The methods and cost of transportation on rivers and canals.

(a) Cable haulage on canals and rivers (Lévy's system), by Professor William Watson, Ph.D., Mem. Amer. Soc. C. E., Fellow Am. Acad. Arts and Sci., Secretary of the Congress.—Difficulties in cable haulage—system adopted—tension of the cable—the supporting and guiding pulleys—the rotation of the cable—the tow rope joint and its details—hooking on and management of the boat—automatic starting—method of circuits. Illustrated with figures showing the cable and stop—the details of the saddle, the tow rope joint, and the guiding pulleys—with a photographic view showing the system in operation.

(b) Chain towage with magnetic adherence by L. Molinos, President, and A. de Bovet, Director of the Lower Seine and Oise Towage Co., Paris, France. Historical sketch—defects of the system hitherto in use—requisites for a proper system—M. de Bovet's experiments on magnetic adherence—description of the new chain tow boat Ampère—practical results obtained—various applications of the magnetic pulley. Illustrated (1) by a folding plate (Figs. 1–17) containing the plan, sections, and details of the Ampère and those of the magnetic pulley, (2) by a photographic view of the Ampère (demi-tone plate).

(c) Electric propulsion on canals, by O. Büsser, Oderberg-in-the-Mark, Prussia. Use of a portable motor—Büsser's system of electric chain towage—the motors—the chain—the power-house—description of Büsser's electric motor steering boat—estimates—cost of the plant—the annual expense of maintenance—conclusions. Illustrations—Plate I. represents the system of electric towage with details. Plate II. the electro motor steering boat applied to barges and rafts.

(d) NOTE.—The electric towage in use on the Burgundy Canal, France, by M. Galliot, Ingénieur des Ponts et Chaussées.

II. The importance of protecting canal banks in view of navigation at high speed.

NOTE.—by Professor J. Schlichting, President of the Central Union of Navigation, Berlin, Germany.

III. The advantages resulting from replacing chains of canal locks by hydraulic lifts.

Description of the hydraulic lift at Les Fontinettes, France, by Prof. William Watson.

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IV. The best form of canal and river barges in respect to capacity and cost of traction.

Experimental researches on the forms of canal and river boats, by F. B. de Mas, Ingénieur en Chef des Ponts et Chaussées—object of the researches—method employed—influence of the surface—influence of the form—conclusions—Illustrated by four plates showing the plans, elevations, sections, and waterlines of the various boats used in the experimental researches.

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(b.) Canadian waterways from the Great Lakes to the Atlantic, by Thomas C. Keefer, C.E., Ottawa, Canada. The second enlargement of the Welland Canal—the St. Lawrence route—the Chan-

plain and St. Lawrence canal—the Ottawa Valley canal—the Grangers Canal. Illustrated by a profile of the Lake Erie navigation between Lake Erie and tide water at Albany, and the St. Lawrence navigation between Lake Erie and tide water at Montreal. Diagram showing the canals on the St. Lawrence River between Montreal and Prescott.

(c) The proposed waterway from Lake Michigan to the Mississippi *via* the Illinois and Mississippi Canal. (Two papers.)—(1) Historical sketch, by Thomas J. Henderson, M. C. (2) The influence of the canal in reducing the cost of transportation, by Mr. Alonzo Bryson, Davenport, Iowa.

(d) The new and the enlarged waterways required to meet the demands of commerce in Russia, by E. F. de Hoerschelmann, Engineer of Lines of Communication, Kief, Russia. General survey of the waterways—detailed description of the Marie system—project of the Don and Volga canal—improvement of the Dnieper. Illustrated by a map especially prepared.

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(b) NOTE. On the comparative cost of transportation by rail and by water in Austria, by A. Schromm, Navigation Inspector, Counsellor of the Government at Vienna, Austria.

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Appendix. "Nicarauga, the Gateway to the Pacific," by the Nicaragua Canal Company, containing the geographical and physical features, illustrated by three large, colored or shaded, folding maps. (1) The general plan and profile of the Nicaragua canal on a large scale, extending from the Atlantic to the Pacific. (2) Panoramic view of the canal. (3) Chart of the world showing the distances saved by the canal.

(b) The Manchester ship canal, by Elijah Helm, Secretary of the Manchester Chamber of Commerce, with an introduction by Marshall Stevens, General Manager of the canal.—Nearest steamer port providing for a population of 8,000,000,—2,500,000 being within carting distance of the Manchester dock—dimensions and summary description of the canal—effect of the canal on the growth of Manchester—prospects—attitude of the ship owners—the cotton trade—reduction in the cost of transportation of staple commodities—estimates of the prospective traffic and revenue.

Ship Railways.

(a) The working of the first ship railway, by William Smith, Mem. Inst. C. E., Harbor Engineer, Aberdeen, Scotland. Leading principles on which ship railway cars must be built—description of the Edinburgh ship railway—hydraulic cushions—report of the special jury—mechanical and hydraulic principles—Mr. Kinipple's report on

the advantages of this system of transportation. Illustrated by figures representing the plan of the grounds—embarkations—midship section of a laden boat and an end of a pair of compound bogies—plan of the bogie and of the hydraulic cushions—view of the boat on the rails—diagram of docks and warehouses.

(b) The Chignecto ship railway, by H. G. C. Ketchum, Chief Engineer of the Chignecto Ship Railway, Amherst, Nova Scotia. Object —saving in distance, insurance, etc.—reasons for the adoption of the ship railway in place of a canal—description of the proposed railway with its appliances. Illustrated by plates: plan and longitudinal section of the Chignecto ship railway. Map of the country.

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(a) Improvement of the navigation of the Seine, by Professor William Watson, illustrated by a map of the tidal Seine. Recent improvements in the river from Paris to Rouen—embankment works for the improvement of the tidal Seine—land reclaimed—results—an account of Prof. Vernon-Harcourt's experimental researches with a model of the Seine estuary—description of the model and the arrangements for imitating the tidal and fresh water flow—results of working with Bagshot sand—introduction of the training walls—results obtained from five experiments each corresponding to a different scheme for introducing training walls into the estuary. Each experiment is illustrated by a separate drawing.

(b) The Mississippi River improvement below Cairo by C. B. Comstock, Colonel of Engineers, Chairman of the Mississippi River Commission. The maximum discharge at various points on the river—the Mississippi Commission—the closing of secondary branches —mattresses employed for protecting the banks—contraction of the river bed by the use of rows of piles—works at Plum Point Reach—the levee system. Accompanied by a map of Plum Point Reach with the works of improvement. (Two photographic views.) Plate I., Fascine mat under construction in Ashport Bend, Sept. 8, 1893. Plate II., Mat at Greenville, Mississippi (two demi-tone plates).

(c) NOTE.—Results of the improvement of the lower and outer Weser, by Ludwig Franzius, Director of Public Works, Bremen, Germany.

X. Harbor Equipment.

The port of Havre, by Baron Quinette de Rochemont, Inspecteur Général des Ponts et Chaussées, Paris, France. Geographical and hydrographical information — currents and tides — description of

the port—graving docks—floating docks—removal of the silt from the port—works in progress or projected—commercial and statistical information. Illustrated by a map.

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(a) The commerce of the Mississippi River, by George H. Morgan, Secretary of Merchant's Exchange, St. Louis. Historical sketch—traffic on the Mississippi and its tributaries.

(b) The commerce of the United States as related to that of other countries, by William W. Bates, Ex U. S. Commissioner of Navigation—The contrast between the present and the former position of the United States in respect to the foreign carrying trade—importance of a commercial marine—history and causes of its decline—$200,000,000 annually earned by foreign ships for carrying 92 per cent of value of our own ocean commerce.

(c) NOTE.—On the same subject by Ambrose Snow, President of the American Shipping League.

(d) The status and interests of water transportation, by Thomas J. Vivian, in charge of transportation statistics, United States Census. Statistics of the United States foreign trade—unrigged craft considered as a legitimate portion of our fleet—diminution in our foreign, and increase in our domestic carrying trade largely compensatory—extraordinary development of this domestic commerce—our entire fleet larger than that of Great Britain—the distances made in average trips cover many of those made by English vessels on foreign voyages.

XII. Harbor Improvement.

(a) NOTE.—On the subaqueous framework constructions in the Baltic Sea, by Th. Shmeleff, Chief Inspector, Réval, Russia.

(b) Pneumatic foundations at Genoa and Rochelle, (Description of Zschokke and Terrier's system) by Professor William Watson. Character of the foundation—caisson for blasting out the rocks—boring apparatus—great floating caisson for laying the flooring—processes adopted for the construction of the blocks—method of working in the great caisson—displacement of the caisson—junction of the blocks. Illustrated by sections of the caissons and a photographic view of them in operation with the method of joining the blocks (demi tone plate).

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ORGANIZATION OF THE CHICAGO INTERNATIONAL CONGRESSES.

In 1890, the directors of the World's Columbian Exposition decided to hold a series of International Congresses in connection with the Exposition, and for this purpose established a separate organization, viz.: "The Auxiliary of the World's Columbian Exposition to conduct these congresses." The organization was constituted as follows:

(1) A Central Administrative Bureau.

(2) A Local Committee of Arrangements for each congress, consisting of a comparatively small number of persons, with few exceptions, residing in or near Chicago.

(3) An Advisory Council, adjoined to each committee, constituting its non-resident but active branch, composed of persons eminent in the work involved, and selected from many parts of the world, co-operating with the Local Committee by individual correspondence.

(4) Honorary and corresponding members invited to give their advice and co-operation.

(5) Committees of Co-operation appointed by particular organizations, and invited to an active participation in the work of the Congress.

The appointment of all the Committees was vested in the President of the Auxiliary, and the executive administration of each congress was in charge of the Local Committee and the officers of the Auxiliary. The names of these officers were as follows: President, Charles C. Bonney; Vice President, Thomas B. Bryan; Treasurer, Lyman J. Gage; Secretaries, Benj. Butterworth, Clarence E. Young.

ORGANIZATION OF THE WATER COMMERCE CONGRESS.

The Committee of the Water Commerce Congress was appointed in the early part of 1892, and its first act was to issue the following address :—

To the Friends of Water Commerce, in All Countries:—

In connection with the Columbian Exposition at Chicago, in 1893, and auxiliary thereto, will be held a Water Commerce Congress, to which delegates from all civilized nations are cordially invited.

For many centuries interstate commerce and commerce between nations have chiefly been dependent on water transportation.

As the population of the world increases, and the enlightened policy of reciprocity becomes more prevalent, the interchange of commodities between nations and states will continue to increase. That facilities for cheapest conveyance should be adequate to all requirements is self-evident.

The nations being at peace, it is believed that the most important economic question before the civilized world is the cost of transport.

Many steps in the modes of conveyance, on water as well as on land, have been taken, and every step has been followed by a reduction in transport charges.

Canals have been built, rivers straightened and deepened, harbors excavated and made larger, and docks built; barges have given place to boats, boats to sailing vessels, sailing vessels to steamships, and small steam vessels to larger ones; and many improvements have been made in marine steam engines.

The expense incurred in making these improvements, considered in the abstract, is immense; but considered in comparison with the aggregate saving in the cost of transport it is surprisingly small.

In view of what has been accomplished in this and other countries in increasing the facilities for internal commerce by water, and the commerce between nations by the construction of interoceanic canals, together with those in process of construction and in contemplation during the last half century, it is proposed to hold at Chicago, during the Columbian Exposition of 1893, an *International Congress on Water Commerce*, in which may be discussed such general questions as interest all nations, as well as such as apply more particularly to the United States. As an illustration of the scope of this Congress, rather than as an attempt to lay out a program at this time, may be mentioned the following questions :—

1. The economy of recent improvements in sea-going steamers.

2. The improvements and changes required in ocean harbors to accommodate the increase in size of vessels.

3. The best methods of improving tidal harbors.

4. The most efficient and economical plant and equipment for harbors, tugs, barges, elevators, cranes, docks, piers, etc., etc.

5. The best method of interchanging traffic between water and rail transportation.

6. Interoceanic canal projects; their present status, the necessity for such, and the results to be expected.

7. The most economical methods of navigating great inland bodies of water.

8. The economical effects of changes recently made, or proposed, in the construction and operation of lake vessels.

9. Systems of slack-water navigation; their construction and operation.

10. The best methods of improving navigable rivers; their results in cheapening transportation.

11. The respective effects of waterways and railways upon each other, and the results to the public.

12. Inland canals; their present position, usefulness, and economy.

13. Methods of cheapening transportation on canals. Self-moving vessels, various methods of towing, etc., etc.

14. Additional facilities in water transportation required in Europe, South America, or other parts of the world.

15. The projected enlargement of the Welland Canal and improvement of the River St. Lawrence.

16. What is the most economical size of vessels in the several systems of navigation?

17. What new motive power, if any, is likely to supersede steam in navigation?

Proposed ship canals in the United States:—

a. Between Lakes Huron and Ontario.

b. Between Lake Michigan and the Mississippi.

c. Between the Lakes and the Hudson River.

d. Across the Peninsula of Florida.

e. In other parts of the country.

f. What river or harbor improvements, and what canals are required in the Southern States, or on the Pacific Coast?

These, and kindred subjects which may be suggested, may be brought before the Congress, by the preparation of papers to be read and discussed at its meetings, and such further action be taken as may be deemed most expedient.

Within the memory of many there was a time when it was believed that inland transportation by rail would generally supersede transport by canals and canalized rivers, if not by lakes.

It is true that the time has passed for the construction of small canals for local purposes, but we believe that the time will never come when it will not be deemed expedient to construct artificial channels to connect large bodies of water naturally navigable, so that navigation may be continuous. The St. Mary's Falls Canal, connecting Lakes Superior and Huron, whose borders to-day are for the most part a wilderness, gives passage to a tonnage so marvelous that it seems to border upon the fabulous.

In 1870 the amount of registered freight which passed through the St. Mary's Falls Canal was 690,826 tons; in 1890 it was 8,454,435 tons.

The Suez Canal revolutionized the ocean commerce of Asia and the East India Islands with Europe and America. And when the Nicaragua Canal shall have been completed, it will become the commercial highway between the eastern coast of Asia, the East India Islands, the western coast of North and South America, and the western coast of Europe and the eastern coast of North and South America. Who can approximately estimate the probable commerce that will pass from the great oceans through this artificial channel, this great connecting water highway?

This is not the place to multiply examples. It is enough to indicate the results of great enterprises in making available important material advantages by artificial means.

Bradstreet's Report for 1889 says that during 234 days of that year ten (10) millions more tonnage passed through the Detroit River than the aggregate of the entrances and clearances of all the seaports of the United States; and three millions more than the combined foreign and coastwise shipping of Liverpool and London.

The saving in cost of transport by water is no less remarkable than the increase of water commerce. The statistician of the Interstate Commerce Commission says the entire cost of lake transportation in 1890 was $23,177,540.70, and that if the same freight had been carried at railroad rates the cost would have been $143,079,283.51. This shows a saving of nearly $120,000,000 in transport charges during the year 1890.

It is the object of this address to elicit from persons interested, in all parts of the world, such suggestions as will promote the highest utility and success of the proposed Water Commerce Congress. All those to whom this address is sent, and others interested, who hear of it, are therefore cordially invited, at their earliest convenience, to

favor the undersigned committee with suggestions of subjects to be considered in the proposed Congress, also with the names of persons especially qualified to present such subjects, and any other recommendations which they deem conducive to the end in view.

While the local arrangements of the proposed Congress are necessarily in charge of the Local Committee, which is composed of persons residing in or near the place where the Congress is to be held, the plans of the World's Congress Auxiliary provide that every such committee shall have the benefit of the advice and co-operation of an Advisory Council, composed of persons eminent in the department, and selected from all parts of the world. Proposals of names suitable for the Advisory Council of the proposed Water Commerce Congress are, therefore, also respectfully solicited. In addition to this Advisory Council a Committee of Co-operation may be appointed by any existing organization which may desire to promote the success of the proposed Congress. Such a Committee of Co-operation will constitute the means of communication between the organization and the World's Congress Auxiliary.

The Committee earnestly desire the benefit of such suggestions before proceeding to arrange a programme for the proposed Congress. Communications in relation to the subject may be addressed to the Chairman of the Committee.

JOHN C. DORE, *Chairman*, E. L. CORTHELL, *Vice Chairman*,
GEORGE F. STONE, O. CHANUTE,
MURRAY NELSON, D. E. RICHARDSON,
BENZETTE WILLIAMS, THOMAS G. CROSBY,

Committee of the World's Congress Auxiliary on a Water Commerce Congress.

WORLD'S CONGRESS HEADQUARTERS,
CHICAGO, April, 1892.

Later, the President added the name of William Watson to act as Secretary of this Committee.

In July, the President of the Auxiliary, at the urgent request of two members of the Local Committee, commissioned its Chairman, the Hon. John C. Dore, to proceed to Paris, to solicit the co-operation of the Fifth International Inland Navigation Congress, which was about to

convene.* Mr. Dore accepted this commission, and the manner in which he fulfilled his task is shown by the following extract from the minutes of the Paris Congress:—

Extracts from the minutes of the proceedings of the Fifth International Congress on Inland Navigation, Paris, July 29, 1892.

THE CHAIRMAN: Gentlemen, you are aware that next year there will be an International Exhibition at Chicago. The Hon. John C. Dore, Delegate from Chicago to the Paris Congress, wishes to invite us to be present on that occasion. He will now address the meeting.

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*These members were Mr. Elmer L. Corthell and Mr. Octave Chanute, who sent to Mr. Dore, on July 1, 1892, written memoranda as suggestions concerning the proposed Congress. Mr. Corthell wrote as follows:

"I find that this European Congress has held its sessions, at one time, in two consecutive years, and they may be induced to become a part of our Congress next year. If they are willing to do so, an organizing Committee should be selected largely from the United States."

Then follows a list of names suggested for such a Committee. "If the Congress, as such, cannot accept an invitation to hold its Congress as a part of ours, then to fully inform it of the scope of our Congress, and invite its individual members to attend and to contribute papers."

Mr. Chanute wrote as follows:

"The principal objects of International conferences upon a commercial matter, such as the subject of Navigation, are to compare views, ascertain what problems are now engaging the thoughts of experts, and to exchange information. There are a number of things in which the Europeans are in advance of us, and on which we should desire the benefit of their recent experience, such for instance as:

"1° Economy in operating ocean steamers of recent construction.

"2° The best plant and appliances for economical harbor work.

"3° The most economical methods of warehousing and distributing goods.

"In these the English are in advance of the Americans.

"4° The best methods of improving navigable, flowing rivers.

"5° Methods of cheapening transportation on canals.

"6° Substitution of hydraulic lifts for canal locks.

"In these, the French and Belgians are in the lead.

"We can, in exchange, give them valuable information as to the results attained in the United States, in cheapening water transportation, chiefly on the Great Lakes and their connecting waterways. A bare statement of those results will lead to the desire of knowing how it was done. To exhibit this, papers should be soon arranged for, on, say:—

"1° The improvements in navigating the Great Lakes.

"2° The new forms and sizes of lake vessels (whalebacks, etc.).

"3° The enlargement of Sault Ste. Marie Canal."

MR. JOHN C. DORE: Mr. President and gentlemen, I have the honor to represent the annexed Congresses of the Universal Columbian Exhibition of the United States, which is to be held at Chicago in 1893, at the Fifth International Congress of Inland Navigation.

While the Universal Exhibition will be a display of products, the annexed Congresses have for their objects to show the advances made in all the branches of civilization: agriculture, arts, commerce and finance, education, civil engineering, government, literature, religion and philosophy, labor, medicine, social reform, temperance, and the press.

I am requested to inform you that the co-operation of your distinguished members in the Congress of the Commerce of navigable ways, which will be held on the occasion of the Universal Exhibition of 1893, is earnestly desired.

To the desire of securing your collaboration must be attributed the fact of my being commissioned to be present at your sittings and to invite you all, personally and collectively, in the most cordial and pressing manner, to come over and take part in the deliberations of our Congress.

I trust that you will be willing to accept this invitation, either personally, or in the name of the body which you represent.

THE CHAIRMAN: On behalf of the Congress, I beg to tender my thanks to Mr. Dore for his gracious invitation and pray that he will tender in return our thanks to the companies he represents. All those among us whom circumstances will allow will not fail to respond to an invitation for which all here are grateful. (Cheers.)

Appendix. Sketch of a programme proposed for the Water Commerce Congress.

In addition to the subjects mentioned in the address, viz. 1–17, page 12, the following additional ones were inserted in a printed list distributed to each member of the Congress.

18. The influence of water commerce on exploration and discovery.

19. The great waterways of antiquity and their influence on national development.

20. Modern waterways at the date of the advent of railway transportation.

21. The reciprocal influence of water and railway transportation, with special reference to safety, speed, economy, and convenience.

22. The relations of the waterways of to-day to the interests of producers and consumers.

23. The relation of the waterways of to-day to national defenses.

24. The new waterways demanded by the needs of modern civilization.
25. The laws of nature by which water commerce is affected or controlled.
26. The laws of nations by which water commerce is governed.
27. Municipal regulations of water commerce.
28. Harbors and harbor entrances.
29. Ship Railways.

This list terminated with the following request: The delegates are requested to contribute communications on any of these subjects or on any others relating to water commerce.

On the 12th of October, the Committee on the Water Commerce Congress, in response to a notice, met at the office of the President of the Auxiliary, and unanimously adopted the programme, which included the reading and discussion of papers relating to:

I. The methods and cost of transporation on rivers, canals, lakes, and the ocean.
II. The importance of protecting canal banks in view of navigation at high speed.
III. The advantages resulting from replacing chains of canal locks by hydraulic lifts.
IV. The best form of canal and river barges in respect to capacity and cost of traction.
V. The new and the enlarged waterways required to meet the demands of commerce.
VI. The respective use of waterways and railways, and their competitive influence in reducing the cost of transportation.
VII. The benefits resulting from improvements in waterways.
VIII. Inter-oceanic canal projects. Ships canals. Ship railways.

The subjects of river and harbor improvements, technically treated, were not included in the programme, but the President of the Auxiliary and the Chairman of the Local Committee were both desirous that the most approved methods for attaining and preserving the proper depth of channel should be illustrated by practical examples.*

This programme was widely distributed, invitations to attend the Congress were sent throughout Europe and the

*In conformity with this urgent request, papers on the Improvements of the Seine, the Mississippi, the Harbors of Genoa, and La Palice, with notes on the Lower Weser, and the subaqueous foundations at Réval, were presented and briefly explained.

United States, and eminent specialists were asked to prepare papers for presentation at the Congress. This invitation was cordially accepted, and twenty-four papers were received besides five notes or short commuications on important topics. Distinguished gentlemen accepted positions as members of the Advisory Council and as Honorary Members.

The members of the Congress consisted:

1st. Of delegates from the various governments, and those holding official positions in the public service.

2d. Of delegates from the various boards of trade, from navigation and water transportation companies, from engineering and maritime societies, etc.

3d. Of those members of the Fifth International Congress on Inland Navigation, held at Paris in 1892, and others who accepted the invitation and were present at the Congress.

OPENING OF THE CONGRESS.

The Congress was opened on Tuesday, August 1st, in the Memorial Art Palace at Chicago, by Charles C. Bonney, President of the Auxiliary, who welcomed the delegates, and organized the Congress by appointing the Hon. John C. Dore, President, and Prof. William Watson, Secretary. The President then read the following address:

GENTLEMEN:—

All civilized nations have deemed it appropriate to celebrate the four hundredth anniversary of the discovery of this continent by Columbus; and happily, nearly all have joined in the celebration of that event by an exhibition of material things, peculiar to each, in every department of industry, thus showing the progress achieved.

It is encouraging to see that every step in advance has been for the general welfare, and especially that, through the agency of natural forces, great burdens have been lifted from the people; that the necessity for arduous manual labor has been greatly diminished, production immensely increased, the cost of distributing products of every description on both land and water throughout the world has been reduced many fold, and that this distribution is now accomplished with remarkable rapidity.

The Auxiliary to the World's Columbian Exposition has been deemed no less appropriate than the Exposition itself: the former is intended to show the great civilizing agencies by which remarkable achievements have been made possible, as they appear in Agriculture, Art, Education, Literature, Science and Philosophy, Engineering, Government, Religion, Moral and Social Reform, etc., as incentives to continued efforts in the same direction.

Undoubtedly, great rewards await genius in discovery and invention in the future, as they have in the past, to which the public is the prospective heir. The Auxiliary has many departments, and these again are subdivided. One of these, is designated Commerce and Finance, and one of its divisions, the Water Commerce, is assigned to the Congress here assembled. It is a very comprehensive subject, older than civilization, and co-extensive with navigable water. It has been the incentive to navigation, ship building, improvements in waterways, engineering and discovery.

It is reasonable to suppose that the scale of improvement of waterways in all ages has been commensurate with the requirements of trade. Under the old conditions progress was slow; the oceans were unexplored, the form of the earth unknown, production represented the labor of human hands, unaided by machinery driven by natural forces, and Commerce was limited then, as it now is, by Production, which in every age has augmented with the development of natural resources.

The discoveries of Columbus were a revelation. The form of the earth became generally known, and the maritime nations of Europe became rivals in discovery, conquest, and colonization. Nevertheless, none of them made rapid progress in production or means of distribution on land or water. The rapid progress in material prosperity, reserved for the 19th century, is indicated by inventions and improvements in every department of industry, namely, by more powerful steam engines and electric appliances, increased construction of railroads, larger vessels, deeper and broader harbors, river channels, and canals, and as the most economical size of vessels has not yet been determined, continued demands for still larger waterways may reasonably be expected.

The United States being a new country, developing in every direction, it is evident that they have greater need of artificial, and improved natural facilities for navigation than the old countries of Europe. Fortunately, the lower tides on the coasts of the United

States preclude the necessity of great expenditures in the construction of such docks and basins as have been found indispensable in the ports of the higher latitudes of Europe.

Some of the progressive steps taken in transportation on both land and water in the United States are as follows: In 1807, Fulton's steamboat carried one hundred and sixty tons on the Hudson, from New York to Albany at a speed of five miles an hour; a little later Stevens sent a steamboat from New York to Delaware. This was the beginning of ocean steam navigation. In 1831, cars were drawn by steam power from Albany to Schenectady. Fifty years ago there were less than 3,000 miles of railroad in the United States, and less than 5,000 miles in the world. There are now 175,000 miles in the United States alone. As all commerce is dependent upon production, and water commerce is mainly dependent upon commerce on land, it is not strange that commerce by rail should have developed more rapidly than commerce by water.

Twenty-five years ago ocean and lake freights were carried mainly on sailing vessels. The schooner Illinois, 100 tons burden, was the first vessel to arrive in Chicago. This was in 1834, and it is said that on that occasion all the male inhabitants of the village, amounting to nearly one hundred, assisted in dragging the craft across the bar. The first American sailing vessel, launched on Lake Superior in 1835 — the John Jacob Astor — belonged to the American Fur Co.; the first lake propeller, said to be the first screw steamer ever built for business purposes, was launched at Oswego on Lake Ontario in 1841; the propeller Independence, of 260 tons, was the first steamer launched on Lake Superior: this was in 1845; and her captain, A. J. Averill, is now a resident of this city. All vessels on the lakes above Ontario, prior to 1871, were of comparatively light draft on account of the Lime Kiln Crossing in Detroit River, and the shallow water on the St. Clair Flats. The improvements now in progress west of Buffalo, will provide a depth of water sufficient for vessels drawing twenty feet.

The total appropriations by Government for improvements on the Great Lakes up to 1892, were $37,247,993; the saving in the cost of transport on the Great Lakes during the year 1890, over the cost of the same freight by rail, at average rates, was estimated by the Inter-State Commerce Commission to be $135,000,000; hence it appears that $98,000,000 were thus saved in the year 1890, in excess of the entire expenditure of the Government for improvements on all the lakes and connecting rivers from the beginning, to 1892.

The registered tonnage of the United States vessels on the Great Lakes in 1849 was 161,832; in 1891 it was 1,154,870. That of the Canadian vessels was 138,914. The tonnage, domestic and foreign, owned by Americans in 1892, was 4,678,397. The tonnage of vessels entered at American seaports from foreign countries was 18,180,480, of which only 20.61 per cent was American. The total vessel tonnage, entrances and clearances, at all ports of the Atlantic, Pacific, and Gulf Coasts, in foreign trade, in 1890, was 30,794,653. The United States traffic, foreign and coastwise, on the Great Lakes, in 1892, was 33,000,000 tons. The traffic on the Mississippi and its tributaries in 1890, was 29,505,046 tons.

The water surface of the Great Lakes is 95,275 square miles, which added to that of their water shed make a basin area of 270,075 square miles. The Mississippi and its tributaries furnish facilities for transport for twenty-four states and territories, drain an area of 1,240,000 square miles, and are navigable to an extent of 15,000 miles.

In 1887, the cost of freight per ton per mile through St. Mary's Falls Canal was two and three-tenths mills; in 1890, the cost for the same service was one and three-tenths mills, or less than one seventh of the average cost by rail, as shown by the report of the Inter-State Commerce Commission for that year. One and three-tenths mills per ton per mile was a fair average for freight on all the lakes during that year. The report of the Inter-State Commerce Commission states that the railroads of the country carried during the year ending June 30, 1890, 76,207,047,298 mile tons of freight. If to this amount be added that carried on the Great Lakes, the Mississippi and its tributaries, the sum total will exceed 110,000,000,000. Vast as is this internal commerce, it is estimated that, at the present rate of increase, it will double in sixteen and one-half years. If this estimate of increase be even approximately correct, there must be a stupendous increase in railroads, waterways, harbors and terminal facilities, to meet coming requirements of transportation. The public benefits received directly from cheap transport by water, great as they are, are made much greater by the controlling influence which water carriage exerts upon freight charges by rail; and in view of the coming requirements for greatly increased facilities of transport, numerous schemes for ship canals and ship railways have been projected to connect the Great Lakes with tide water. The trend of commerce is west, northwest and southwest, and vice versa. That

water carriage may continue to exert a controlling influence on railroad charges for freight, it is evident that the future great waterway must not be far from the most direct lines of the general movement of commerce.

Public attention has been called to the real or imaginary necessity for a ship canal connecting the Great Lakes with the Atlantic via the St. Lawrence River, or via Lake Champlain and the Hudson River, of a capacity sufficient for the passage of vessels carrying 5,000 tons. It is admitted that the construction of such a canal would be a stupendous undertaking, and its chief advantage would be the saving of time and expense in the transfer of cargoes from ships to boats at lake ports, and from boats to ships at New York or Montreal, and the converse. These re-shipments would be required only for exports and imports, and as less than four per cent of the commerce of the United States is foreign, the expediency of constructing such a canal so far north for the special convenience of so small a part of the commerce of the United States may well be questioned.

The subjects of this Congress consist mainly of inter-oceanic canals, ship railways, improved coast and inland harbors, enlarged routes of interior navigation, better facilities for handling freight at terminals, etc., which have been assigned to distinguished gentlemen for their special consideration, and their reports will be the subjects of discussion by the members.

After the address, the President called for the reading of the first paper, viz.: "The Nicaragua Ship Canal," by A. G. Menocal, Chief Engineer.

DISCUSSION.

THE SECRETARY:

You will recollect, that at a session of the Fourth International Congress, it was stated by Col. Van Zuylen, that among other things it was especially the danger from volcanic eruptions, more frequently at Nicaragua than at Panama, which led to the selection of the Panama route. And again, by Mr. J. F. W. Conrad, that he preferred the route from Colon to Panama rather than the Nicaragua route, by reason of the fear for the stability of the artifical works, especially the locks, in a region of earthquakes such as the latter traverses.

MR. MENOCAL: In reply to the question of the Secretary, I would say that the subject has been recently investigated by Major C. E. Dutton of the U. S. A. With regard to the active volcanoes he states:

That of those in Costa Rica, the nearest, Irazu and Turalla, are about 58 miles from the junction of the St. Carlos, and 62 from the eastern locks. Of those in Nicaragua, the nearest is Ometepe in the Lake, 22 miles distant from the locks.

In respect to earthquakes:

While they are frequent in the vicinity of San José, the capital of Costa Rica, yet the portion of the Canal between Ochoa and the Caribbean is, in my opinion, too remote from the localities in which the Costa Rican earthquakes originate to be liable to any serious injury from them.

The volcano of Mombacho in Nicaragua, 35 miles north of the Canal line, is a center of decided earthquake activity. A very few years ago the city of Granada at its base was severely shaken, many houses being damaged and a number of them wrecked. A large church nearly ready for the roof was badly shattered. A few lives were also lost. This shock was felt forcibly at Managua, about thirty miles distant, and, though it caused much alarm and even panic there, it does not seem to have produced any serious damages.

Briefly, then, my opinion is that the risk of serious injury by earthquakes to the constructions proposed for the Canal is so small that it can be neglected.

This was followed by a short note written by S. C. Cobb, of Florida, on the relation of the State of Florida and the Gulf Ports to the Nicaragua Canal, expressing an interest in the canal and a desire for its achievement, in view of the benefits which would accrue to the commerce of those ports.

The next paper was on the new and the enlarged waterways required to meet the demands of commerce in Canada, by Thomas C. Keefer, C. E., Ottawa, Can.

Aug. 2. The first paper was on the project for a canal between the Upper Ohio and Lake Erie, by T. P. Roberts, C. E., of Pittsburgh, Pa.

DISCUSSION.

Mr. John F. Dravo of Pittsburgh, Pa., alluded to the difficulties in the construction of the locks and dams on the Ohio. These can be overcome, as they have been in the case of the Davis Island Dam, which only waits to be connected with similar dams to secure continuous navigation for the entire year with the exception of ice obstruction during the winter months.

Considering the canal and its connections with the Lakes and the Gulf of Mexico, the difficulties become unimportant when we take into account the objects to be accomplished.

The Ohio River waterway connections represent some twenty thousand miles of possible inland navigation.

The Secretary remarked with regard to the question of Lifts: That the actual time of lift was from three to five minutes. That the total time, including the entrance and departure of a barge in each direction, was fifteen minutes (La Louvière lift).

The next paper was on the commerce of the Mississippi River by George H. Morgan of St. Louis, which was followed by a paper on the benefits to be derived from the improvement of waterways:—Inter-oceanic canal projects ship canals and ship railways by Prof. Leveson Francis Vernon-Harcourt of London, England.

Aug. 3. The first subject of discussion was, "The Best Commercial Route from the Great Lakes to Tide Water." And the principal address was given by Samuel A. Thompson, Secretary of the Duluth Board of Trade, on "The Economic Value of a Ship Canal from the Great Lakes to the Sea." He said:

The influence which resulted in the destruction of the old canal system will in the end lead to the building up of a great system of canals in this country. Experience abundantly proves the economy of water routes as a means of the transportation of freight. Statistics show that from 1882 to 1890 the charges for freight carriage on railways have been decreased exactly 25 per cent. There has been a slight change in the other direction since 1890, for in 1891 the charge per ton per mile was 9.29 mills, against 9.27 mills in 1890, while in 1892 it was 9.67 mills. These figures standing alone might not indicate the ultimate triumph of the water carrier, but I believe

that the increase in the efficiency of steamships and waterways leads to like results in water traffic. The cost to the railroads of carrying freights, according to the Inter-state Commerce Commission's report was 6.3 mills in 1888, 6.04 mills in 1890 and 5.83 in 1891. The report of George H. Ely on the navigation of the great lakes shows that the cost of water transportation of freight on the lakes in these years was exactly one tenth of the cost of transportation by rail, or 0.46 of a mill. We do not know in this country what canals can actually do, but the cost of transportation on the Erie canal is about 2 mills per ton per mile. The brains of this century have been largely devoted to railway planning and management, and we do not know what the Erie canal could do if the same amount of intellect, energy and capital had been put into its management as are put into the management of our great trunk railroads.

The cost of transportation on the great lakes or deep water anywhere, however, is much lower than on existing canals. And I am pleading for a deep-water canal. I have financial reports from different steamers on the lakes, and they show the cost of transportation on some of them to have been for an entire year at the rate of only three fourths of a mill per ton per mile. The average cost of carrying from Buffalo to Duluth is 30 cents per ton. And we are yet going to do much in the great lakes to cheapen the cost of transportation.

Captain McDougal, the inventor of the whaleback steamer, has given me a few figures, by which I find that taking the average of the best model steamer the fuel consumed is almost exactly one ounce per ton per mile, while on the steamer A. D. Thompson and its consort the consumption in 1891 was less than one third of an ounce per ton per mile. Captain McDougal says we are to make on the great lakes a system of towing that will be analogous to the handling of a train of freight cars by a locomotive, and within five years we may expect to see tows coming down the lake which will handle 25,000 tons of freight in a single tow. Steam barges will be notified by wire that a loaded barge is waiting at one port and an empty one is wanted at another. Then we shall have to make such a revision of the actual net cost per ton per mile as will even astonish some of us who are accustomed to deal with the microscopical figures of to-day. And when we get 20 feet of water everywhere from lake to lake, through which boats may pass, carrying 5,000 or 6,000 tons of freight, this cost will have to be cut in half.

And so I say to the railroad man of to-day who argues that water ways cannot successfully compete with railroads that he is utterly mistaken. There is an idea in many quarters that water traffic is all right when you are not in a hurry, but that it does not do if fast traffic is expected. Whatever may be the case on the canal it is a fact that our fast steamers maintain a far greater average speed per hour than the fastest freight trains. Boats in the ocean make 16.44 miles an hour. With the freight train while it is supposed to make sixteen miles an hour, it, as a matter of fact, makes only eight miles an hour on account of stops and delays. Last year more than 11,000,000 tons of freight passed through the Sault Ste. Marie canal. If that same freight had been hauled an equal distance by rail the hauling would have cost over $77,000,000 more than was actually paid for its transportation by water.

The entire tonnage on the lakes, as near as we can get at it, is 30,000,000, and because the great lakes are where they are, supplemented by the fact that the Erie canal is where it is, the saving to this country in transportation charges, assuming all this freight to be carried by rail, is simply enormous. And I do not believe the development of the water ways would have anything but the very best effect on the railways. You cannot show a single instance where a railway has been injured by a parallel water way or where it has not been really benefited. When the river Main was canalized from Frankfort to Metz it was supposed by the railroads that their business was going to be very seriously injured. What, in fact, took place? The business of the river increased 64 per cent the first year, and the next year 36 per cent additional. Meantime the business of the railroads showed an increase of 42 per cent the first year and 58 per cent the next year. Where do you find railroads in this country that are more prosperous than the roads that make their way eastward from Chicago to the Atlantic? It is my honest conviction that absolutely the best thing that could be done for the railroad interests of this country would be the opening of a canal twenty-one feet deep right alongside of every railway, and I think there would be no better way to punish some of our railroad managers than to show to them in letters of fire, after we have built such canals, how much bigger dividends the railroads would have paid in the past if they had cultivated water ways instead of trying to drive them out of existence.

I believe there is a conspiracy to-day to drive the Erie canal out of existence. I cannot interpret in any other way the fact that a man

both governor of New York and a railway president vetoes a very moderate measure for the improvement of that canal, nor can I in any other way interpret the statement made in this building recently by a prominent railroad man that this year the trunk lines running east of Buffalo have entered into an iron-clad agreement that they will not make any through rates on freight with any lines of steamers and other vessels except the lines controlled by themselves. An independent line cannot go down to Buffalo and get any rates that will allow it to do business unless it is done through the Erie canal, which the railroads are putting to their own use.

The best commercial route for a ship canal is, in my opinion, first around Niagara Falls to connect Lakes Erie and Ontario. Then cross Lake Ontario to Oswego, and pass down Oswego river and across Oneida lake and the valley of the Mohawk to the Hudson river; thence down the Hudson to the sea. Going in this way we should make use of 110 miles of deep-water navigation, crossing from the outlet of the canal across Lake Ontario to Oswego, and in Lake Oneida we should get some twenty-three or twenty-four miles of deep-water navigation additional, where full speed can be made. We have in this route, with possibly one exception, the fewest miles of canal navigation, and hence the greatest amount of speed and economy. I favor that route also because it brings Lake Ontario into direct connection with the other lakes, and I favor it because I am an American citizen and this route lies entirely within the limits of the United States. And it seems to me that the cost of the canal will be so great that it must be constructed by the national government as a national work.

What is known as the Montreal or St. Lawrence route I consider not to be practicable. Of the total tonnage from the west to the seaboard less than 25 per cent is for export, and for our own seaboard states the St. Lawrence route is too far around. I cannot give the cost of the route I have described because no estimates have ever been made, but I have the opinion of an engineer that perhaps $150-000,000 would be a fair rough estimate of the cost. A tax of one tenth of a mill on the property in the commercial territory directly tributary to the great lakes would pay for the canal in ten years.

DISCUSSION.

Mr. E. P. North objected to the Montreal route on account of the fact that the St. Lawrence is closed with ice five months in the year.

In making a comparison of proposed routes, the question is, not whether one route would cost a million or two more than another, but of practicability and commercial advantages.

MR. CHAUNCEY N. DUTTON:

About 50 years ago, Mr. Jarvis, a leading engineer of that time, estimated the cost of freight transportation by water to be about one ninth of that by rail. This ratio still exists and will probably continue, for the same causes which effect railway rates apply equally to rates by water.

The proof of this is furnished by the published account of the transportation of the steamship Manola, and that of the principal trunk lines, as given by the Inter-state Commerce Commission.

The cost to the Manola, taking the average of all the freights handled for the season, was $\frac{4\,6}{1\,0\,0}$ mill per ton mile. The cost per ton mile on eleven of the principal railroads in New York, New Jersey, Pennsylvania, and Maryland, averaged $4\frac{7\,9}{1\,0\,0}$ mills; more than ten times as much as by the Manola. The cost per ton mile on thirteen of the principal roads in Ohio, Indiana, Illinois, Michigan, and Wisconsin averaged $3\frac{9\,6}{1\,0\,0}$ mills, *i. e.*, nearly nine times the freight cost by the Manola. These figures show that could a deep-water route be opened parallel to the New York Central road, the freight cost on the products between the lakes and the seaboard would be diminished $\frac{9}{1\,0}$.

Again they show that the relative cost of moving freight by a deep waterway 720 miles long from Lake Erie to New York *via* Lake Ontario, the St. Lawrence and the Hudson as compared to the New York Central, would be 72 to 440, or as one to six.

It is impossible that more than one route can be opened, and that should be the one which will furnish an avenue for the exchange of the products of all parts of the continent. Many routes have been proposed and advocated, but the St. Lawrence-Champlain route is the only satisfactory one.

Canada has five millions of people and the reciprocal advantages must be considered. If the commerce of the United States will warrant the expenditure for the navigation, that of Canada will pay the dividends.

The commerce from the great lakes is domestic and foreign. For the former, the St. Lawrence route is an adequate avenue; for the latter, the estuary of the St. Lawrence is the shortest and cheapest route.

To impose upon the people the use of the longer route is to tax them unnecessarily.

Briefly, if North America were under one government, only one route could be considered, and the reason that others receive attention is due to political difficulties in the way of opening the St. Lawrence-Champlain route. But these difficulties have been removed; for, on April first of this year, the Canadian Government, appreciating the importance of this project, chartered the North American Canal Company with ample power, giving them the free use of such portions of its navigation system as could be utilized in making a deep waterway, imposing only such restrictions as were necessary to guard the interests of the Canadian people and government. Further, giving them the right to draw water from the St. Lawrence River to feed the canal to Lake Champlain.

Under the charter given, it is proposed: To widen and deepen the summit level of the Welland Canal from Port Colborne, about 18 miles, to near Thorold; and there diverge with a new canal running eastward 8 miles to the bluff above Queenston. From this point it descends to the lower Niagara River. From Queenston *via* the Niagara River, Lake Ontario, and the St. Lawrence, there will be 280 miles of practically unobstructed navigation to Cornwall.

From the eastern end of Lake St. Francis a descent of 50 feet is made, and a canal 40 miles long will connect the St. Lawrence River with Lake Champlain. [From this canal an arm will extend the navigation to Montreal harbor.] And the final descent to the tide level will be made a short distance from Waterford.

To recapitulate: the length of the navigation from Lake Erie to New York City will be 720 miles; 630 miles of free navigation in lakes, rivers, and basins, and only 90 miles of restricted navigation in artificial channels. It is proposed to make these channels 10,000 square feet prism. There will be only five or six locks. These will be established having in view ultimate developments, on lines of 60 feet width, 500 feet length, and 22 feet draft.

The trip of a first-class steamer will occupy:

From Port Colborne to New York	60 hours
From Port Colborne to Montreal	32 hours
From Montreal to New York	32 hours

In reply to the question, Would not the St. Lawrence outlet to the sea be sufficient for the needs of commerce:— Most certainly not; the West has two terminals—Chicago and Duluth; the East two—

New York and Montreal. The route must reach from producers to consumers. New York is, and must always be, the terminal. A route eastward reaching only Montreal would be as partial as one westward reaching only Duluth.

In conclusion I would say that the seasons of navigation on the St. Lawrence River and on the Erie Canal are practically the same.

The next paper was read by Professor Vosnessensky, a delegate of the Russian Government to the Congress, on the new and the enlarged waterways required to meet the demands of commerce in Russia, by Emile Teodorovitch de Hoerschelmann, Chief Engineer, Adjunct Director of Land and Water Ways at Kief, Russia.

August 4th, The first paper was on the advantages resulting from replacing flights of canal locks by hydraulic lifts, as illustrated by the Fontinettes canal lift, by the Secretary, accompanied by photographs of the lifts as seen in operation. This was followed by a note on the importance of protecting canal banks in view of navigation at high speed, by Professor J. Schlichting, President of the Central Union of Navigation, Berlin, Germany, read by the Secretary as follows :—

INTRODUCTION.

At the request of the Organizing Committee of the Vth International Congress held at Paris in 1892, the author made a report on "The Protection of Canal Banks," which was the subject of detailed and repeated discussions during the sessions of the Congress.

On experimental, as well as on theoretical and practical grounds, the author, in his report, has arrived at this conclusion, for those canals in which the traffic is carried on by steamboats :—viz. that the banks should be nearly vertical for such heights, both above and below the water level, as are affected by the impact of the waves.

The author, having been requested to prepare a paper on "The importance of protecting canal banks in view of navigation at high speed," places at the disposal of the Congress for their discussion, the foregoing report, believing that in this way he can best comply with the request.

The Secretary read at some length extracts from Prof. Schlichting's report relating to the currents and shocks caused by the movements of boats traveling at great speed.

These movements, the author states, are considerably increased by those of the paddle or screw, which producing fresh waves strike the banks with full force, or ascending the slopes and returning, come into collision with the rising waves. From which it is evident that only well-consolidated banks can resist attacks produced by such irregular motions of the water, and he concludes by recommending the following means of consolidating the canal banks :—

(1) Make the ratio of the immersed cross section of the boat to the cross section of the waterway 1 : 4 for inland canals of about 2.5 metres deep, and 1 : 6 for ship canals.

(2) Construct solid vertical, or nearly vertical banks, extending above and below the water line, beyond the influence of the waves.

The second part of the report treats of the various constructions adopted for the consolidation of canal banks, illustrated by numerous examples taken from French, German, and Dutch practice.

The next two papers were read and explained by Mr. Telford Burnham. They were as follows: 1st, "The Chignecto Ship Railway," by H. G. C. Ketchum, Civil Engineer, Amherst, Nova Scotia. 2d, "The Working of the First Ship Railway," by William Smith, Harbor Engineer, Aberdeen, Scotland.

The next paper, read by Edward P. North, C. E., was on The Manchester Ship Canal, by Elijah Helm, Secretary of the Manchester Chamber of Commerce, with an introduction by Marshall Stevens, General Manager of the Manchester Ship Canal Company, Manchester, England.

This was followed by a paper on the best form of canal and river barges in respect to capacity and cost of traction, by De Mas, Chief Engineer of Roads and Bridges, Paris, France, read by the Secretary.

The next paper was on the proposed waterway from Lake Michigan to the Mississippi River, via the Illinois and Mississippi Canal, by Alonzo Bryson, of Davenport, Iowa.

The next paper was on the proposed enlargement of the waterway from Lake Michigan to the Mississippi River, via the Illinois River, by L. E. Cooley, Civil Engineer, Chicago, Ill., who also presented and explained the paper following, on the improvement of the Mississippi River, by Gen. C. B. Comstock, U. S. A., President of the Mississippi River Commission, New York.

August 5th, The two following papers read by Mr. Greer, of Chicago, were on the relations of the U. S. commerce to that of other countries, by William W. Bates, Chicago, Ill.; and on the status and interests of water transportation, by Thomas J. Vivian, in charge of Transportation Statistics, United States Census.

He also read a note on the present condition of the foreign commerce of the United States, by Ambrose Snow, President of the American Shipping League, New York city.

In reply to a communication from the Secretary relating to the subject of Water Commerce, he says:

"My interest in shipping has been almost wholly in the foreign over-sea trade. My efforts to arrest the decay of that interest have been confined to the question of some legislation changing the present laws now governing our merchant marine. The European nations have fostered their shipping interest with much care, while we have been content to wait for natural changes which would again bring us to the front. The only change thus far has been that we have been almost utterly driven from the over-sea trade. The seaports along the whole length of our coast are filled with foreign ships. The control of public opinion is in the hands of the foreigners. Our Boards of Trade, Chambers of Commerce etc., are filled with agents of foreign Lines, whose influence is exerted in favor of their foreign owners. Few or no American ship owners are found in them; indeed the few ship owners and people interested in American ships, are in eastern towns and exert no influence in the large cities. The above appears to be the situation of the American merchant marine in foreign trade. On the subject of improvement in the construction of ocean steamships, referred to in Article 1, I can only say that the part we play in the foreign freight-carrying business is so small that we now hardly count as a competitor on the ocean. All the trade

from our ports may be said to be in the hands of foreign steam and sailing vessels. The construction of freight carriers has changed very little on the seaboard. The lake commerce has grown into a large volume and we hear of the steamer called the whaleback; but that kind of ship has not been tried on the great ocean, and in the present condition of freighting will find no employment. The English subsidized ships have carried grain from here to Europe for one penny a bushel, and cotton for sixty cents a bale. There is no possible form of construction which can compete with the subsidized tonnage of Europe in foreign trade. Our coast and lake trade is protected from foreign competition. The length of time that that will continue depends upon future legislation.

A bill has been introduced into Congress having for its aim the opening of all our ports, rivers, and lakes, as well as the whole coast, to the free competition of the world. When that comes to pass, the foreigners will decide the rate of cost of the handling of our exports and imports. When once the foreigner has the monopoly of our carrying trade the length and breadth of the land, his generosity will be the main dependence of those who require his services. The following statement illustrates the situation, in the struggle for life, of our people who are competing with the foreigners: there is a line of American Steamers in front of our office, running to the West Indies, that, we are told, has not made a dividend in five years. A few blocks below, there is a Spanish Line, which, we are told, receive $4000, for each round voyage which they make running to the same port.

Construction, let it be what it may, cannot remedy an advantage enjoyed by the Spanish Line over the American. The foregoing is one example only of the condition which American shipping is facing. A favorite theory with some is that we shipping people ought to be permitted to purchase our ships in the cheapest market. There has been no cheaper market in the world in which to buy ships than New York. If the building business is to be transferred elsewhere, that would finish the ship-owning business of our country. The young and old of the present generation would turn from it in disgust.

The history of our merchant marine may be described as follows; that is to say, its creation in a seaport town:—The young men seek to embark in some enterprise by which they can make a profit. They finally decide to build a vessel as large as means will permit. They cast about for a captain who can take a small part.

That captain looks around among his friends and finds some who will be induced to venture to take a part of the vessel to help his friend. The captain's relatives will also strain a nerve for the sake of furnishing employment for him. The man who furnishes the sails and rigging, the blacksmith, the joiner, and all the different parties who are employed by this line of enterprise, are appealed to; the ship carpenter keeps as much as he can afford and the vessel is finally completed, owned by a small community who look for returns which will enable them to build another and another. If the industry grows, the town grows, and from these small beginnings the American merchant marine comes into existence; if transferred to another country, the town would decay; the young men would abandon all thought of the ocean trade, and whatever other country built the ships that country would monopolize the industry. Companies from the ship-building country would locate in our large seaports and probably be successful, but the iudustry would be a foreign one.

The remainder of the papers were presented and read by the Secretary, viz.:—

"Chain Towage with Magnetic Adherence," by L. Molinos, President, and A. de Bovet Director of the Lower Seine and Oise Towage Company.

"Electric Propulsion on Canals," by O. Büsser of Oderberg-in-the-Mark, Prussia.

A note on "Electric Towage" by M. Galliot Ingénieur des Ponts et Chaussées as follows:

DIJON, February the 20th, 1893.

WILLIAM WATSON, Ph.D.

DEAR SIR,—I beg to send you a short paper relating to the electric towage I am now constructing on the upper level of the "Canal de Bourgogne, France."

I hope it will be at work before the opening of your Congress, and that I shall be able to forward you another note explaining the results arrived at.

Your most devoted,

GALLIOT,
Ingénieur des Ponts et Chaussées,
Dijon, France.

ELECTRIC TOWAGE ON THE "CANAL DE BOURGOGNE, FRANCE."

The upper pool of the "Canal de Bourgogne, France," 6 kilometers long, is single gauged and does not allow boats to pass each other, and, moreover, it goes through a tunnel 3,330 meters long.

From 1867 until now, the boats have been towed in this section of the canal by two steam tugs, manned by a crew superintended by engineers "des Ponts et Chaussées."

These engineers have been examining, during the past three years, a scheme for replacing these steam tugs by electric ones. In August, 1892, the Board of Public Works approved the proposed scheme, and, in January, 1893, ordered the work to be immediately carried out.

The new system is expected to be in operation in June or July, 1893.

The necessary power will be supplied by the fall of water through the locks at the end of the level.

At Pouilly, the Seine-end of the level, the fall is 7 meters, and at Escommes, the Sâone end, it is 8 meters.

The quantities of water supplied per day at each lock for the feeding of the canal not being equal, they will take 230 litres per second at Pouilly, and 150 litres at Escommes; these proportions being calculated so as to afford the least inconvenience to the water supply.

Thus, the power of the falls will be 21.5 horse power at Pouilly, and 16 at Escommes. The power is obtained by turbines, with partial distribution.

The contractors guarantee an efficiency of 70 per cent for the turbines, hence their net powers will be 15 and 11 horse powers respectively.

These turbines will work continuous current Gramme dynamos at a velocity of 1,100 and 1,200 revolutions per minute. These dynamos will be connected in series.

They are to give a tension of 370 volts at Pouilly, and 280 volts à Escommes, and 25 Ampères, say 650 volts 25 Ampères together; so that their united power will be 16,000 volts, or, approximately 85 per cent of the power of the turbines.

The motor, a Gramme dynamo, will be placed on board the tug, and connected with the generators through a brass wire, 8 millimeters in

diameter. The contractor for this wire guarantees an electric conductibility equal to 98 per cent of that of an equal copper wire.

The wire is to be supported by insulators built in the arch of the tunnel, or hung from posts, fixed in the slopes of the cuttings.

The electric line consists of three wires, one from a pole of one of the dynamos to the opposite pole of the other dynamo, and two others from each other pole run alongside the first. These latter, ending on insulators, are to feed the motor by overhead rolling contact. They are expected to supply the motor with a current of 25 Ampères and 550 volts.

Straps and gears will connect the motor to the pulley working the chain immersed in the canal.

This chain is the same as that used for towage from 1867 up to the present.

A tension of 1,200 kilogrammes is to be secured, when the velocity is 0.75 metre per second. A special arrangement of gears allows this speed to be doubled.

The scheme is completed by a set of 250 accumulators, in order to give light, and to regulate the speed. On the other hand, they are to work the tug a short time when the dynamos are at rest.

The expense will amount to 115,000 francs.

The engineers think that these contrivances will lessen the annual expenses from 20,000 to 15,000 francs, and yet they intend to dismiss no man of the crew, though it will be too numerous.

GALLIOT.

DIJON, February 20th, 1893.

DIJON, le 22 Juillet, 1893.

DEAR SIR,—I have the pleasure of informing you that the maiden trip of my electric tug was made on the 18th inst. The works were completed only on the previous day, and the trial immediately made. It was not all right. We broke some trolley poles, and sometimes reversed the dynamos. But the poles being replaced by longer ones, and attention paid to the starting of the machines, we got a success.

You can inform the Congress that there is now, or will be before the first of August, a towage operated by electricity.

I intend to put it at work on Tuesday of next week, and continue from that day to work it without interruption.

Your most devoted

GALLIOT.

The next paper was a description of Lévy's system of cable towage between Paris and Joinville, as seen in operation by the Secretary. It was illustrated by a large collection of photographs, showing the system in operation in all its details.

The next paper was on the respective use of waterways and railways, and their competitive influence in reducing the cost of transportation, by Alexandre Halász, Professor at the Polytechnic School, Budapest, Hungary. It was followed by a note on the comparative cost of transportation by rail and by water in Austria, by A. Schromm, Navigation Inspector, Counsellor of the Government at Vienna, Austria.

The results reached in this last paper are as follows:

On all Austrian railways having a total length of 15,307 kilometres (9,567 miles), 79,959,604 tons were carried in the year 1890, corresponding to 7,252,273,014 ton-kilometres; *i. e.*, a traffic of 464,464 tons per kilometre.

On those waterways, for which documents have been prepared, on a total length of 1,656 kilometres (1,035 miles), there were carried in 1890, 5,238,005 tons, corresponding to 446,498,681 kilometric tons; *i. e.*, a traffic of 269,625 tons per kilometre.

The economic value of both methods of transport, which is shown by the given rates, is as follows: On the railways the rates for merchandise per mile ton is from $15\frac{3}{4}$ to 16 mills; on rivers from $4\frac{7}{8}$ to 7 mills. The lowest down stream freight was 1 mill per mile ton, against 10 by rail along the banks.

The next paper was on the improvement of the Lower and Outer Weser, by Ludwig Franzius, Director of Public Works, Bremen, Germany.

The length of the Lower Weser, between Bremen and Bremerhaven, is 41 English miles. The length of the Outer Weser, below Bremerhaven, is 6 English miles. The object of the improvement is to create a depth of water in the fairway enabling vessels drawing 19 feet 8.2 inches of water to reach the free port of Bremen.

The cost of this improvement is estimated at 7,900,000 dollars, to be paid for by the free town of Bremen. The time of construction is estimated at 6 years. The following results are anticipated :—

In 1886 the depth of water in the fairway only enabled vessels with a maximum draught of 9 feet to reach Bremen; at the expiration of 4 years, vessels drawing 15 feet 6 inches can safely navigate to and from Bremen at ordinary high water. The available depth at high water spring tides is proportional to the height of the tide; with favorable tides vessels drawing 16 feet 6 inches of water have already come up to Bremen.

The Method of Construction.—The improvement works are executed under the personal direction of Mr. Franzius, according to the plans proposed by him in 1879.

Dredging plant.—The dredging is done by day and night; the work during the night being carried on by electric light. The number of dredges at work in the channel is 8, which lift 746 cubic yards per hour.

The conveying of dredging spoil to those branches of the river which cannot be navigated by the punts and barges on account of the insufficient depth of water, is done by special auxiliary dredging machines, which force the material mixed with water by means of centrifugal pumps through pipes to a distance of 872 yards.

The dredging spoil is conveyed by 22 steam hopper barges, varying in capacity from 131 cubic yards to 262 cubic yards, also by 58 tug punts, with a capacity of 52 cubic yards; 48 of these have bottom valves; 10 of these are without bottom valves. The punts are towed by 5 tug steamers.

For the general surveying service there are: 1 director's steamer, 1 steamer for the surveys in the Outer Weser, and 8 steam launches of different sizes.

Statement of the work executed from 1888 till 1892.—From the beginning of the regulation works to the end of 1892, 22,300,000 cubic yards have been removed from the channel of the river; 17 miles of training walls and 7 dams, cutting off branches of the river, have been built; 2,747,000 cubic yards of fascine wood were employed for the construction of the training walls and dams.

The total expenditure up to December, 1892, was 5,700,000 dollars.

FRANZIUS,
Oberbaudirektor.

Bremen, in January, 1893.

The next paper was contributed by the Secretary on the navigation of the Seine from Paris to the Sea.

This paper concluded with an account of the remarkable experimental investigations of Prof. Vernon-Harcourt of London on the effects of training walls in the Seine Estuary. It was illustrated by Prof. Harcourt's original drawings loaned to the Secretary for the occasion. His drawings illustrating the effects of training walls in the Mersey, were also exhibited. The chief value of such investigations consists in their indicating the influence that any scheme of training walls would have upon an estuary; thus enabling the most effective of the schemes to be adopted, and those injurious to be avoided.

The next paper was on "The Port of Havre," by Baron Quinnette de Rochemont, General Inspector of Roads and Bridges, Paris, France.

The next paper was on the hydraulic works and pneumatic foundations made at Genoa, and at La Pallice, the Port of Rochelle—by the Secretary.

This paper was illustrated by photographs and drawings furnished by the contractors C. Zschokke and P. Terrier of Paris.

The Port of Rotterdam. G. J. de Jongh (Engineer-in-chief, Director of the Rotterdam Board of Works), placed at the disposal of the Congress one hundred fifty copies of his illustrated description of the Port of Rotterdam. After a summary of the contents had been given by the Secretary, copies were distributed to the members present.

The next was a note on The subaqueous framework-constructions in the Baltic Sea, by Th. Shmeleff, Réval, Russia.

Subaqueous framework constructions are convenient in the Baltic sea, because the borer (Teredo navalis) does not exist here. Those built in the beginning of the past century are well preserved. The timber of the old frames has been examined and found as solid as new. The low price of timber, the abundance of cobble-stones on the coasts of the gulf of Finland, and the simplicity of timber constructions have enabled us to select here the types of such construction.

Breakwaters may be built of:

1. Piled-up cobble-stones and masonry (Sketch 1). 2. Regularly set masonry (Sketch 2). 3. Piled-up cobble-stones enclosed by pale-walls (Sketch 3). 4. Frames filled with cobble-stones (Sketch 4).

The average cost of the works at some ports is as follows:

A cubic metre of piled-up cobble-stones, 10 francs. A cubic metre of timber-work, 60 francs. A cubic metre of masonry, 70 francs. A cubic metre of regularly set masonry, 75 francs. The driving of a pile of 15 metres in length with mean diameter of 0.33 metre together with the erection of the pale-walls, 400 francs.

Let us take for data the above mentioned estimates and the following profiles and calculate the cost of one metre in length of the breakwater.

The mean depth of the water supposed to be 10 metres.

The above mentioned comparisons show the frame-constructions to be the cheapest type of breakwater. But only when a cubic metre of timber costs 200 francs, which is very rare at present, a breakwater of the fourth type would cost as much as one of the first or second. In a sea where the teredo does not live, the cheapest breakwater would be of timber. But the only way to attain this economy in those seas inhabited by this animal, is to protect the timberwork against the worm, or discover some means of destroying it. For this purpose the caissons may be coppered at a cost of 20 per cent of the value of the breakwater. I propose for the fourth type of breakwater to copper the caissons: then the breakwater will cost $3753 \times 1.2 = 4500$ francs per running metre. And then for those seas inhabited by the teredo the fourth type of breakwater will be the cheapest.

20 January, 1893. Réval, Russia.

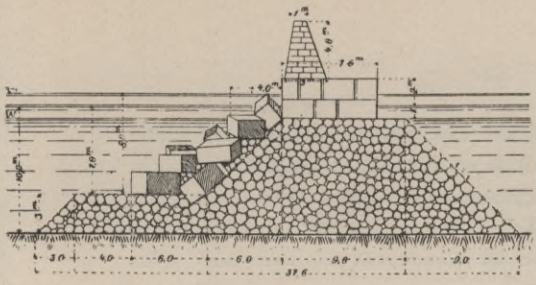
List of books, plans, and photographs presented to the Congress.

Forth and Clide Ship Canal in relation to the Development of Commerce, by J. Law Crawford, Law Agent and Secretary to the Provisional Committee of Promoters.

La Régularisation des Portes de Fer et des Autres Cataractes du bas Danube. Rapport par M. Béla de Gonda, Conseiller technique au Ministère royal hongrois du Commerce, Professeur agrégé à l'Ecole Polytechnique de Budapest.

Canal de la Marne a la Saone. 3^{e} Partie.—Bief de partage et descente en Saone jusqu'a Piépapeet, et

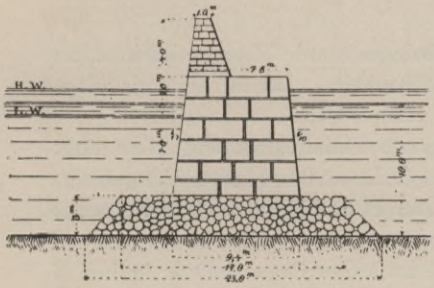
Sketch 1



On the first type, composed of piled-up cobble-stones and massives, one metre in length of the breakwater will cost:

$$\left[\left(\frac{37{,}60+31{,}60}{2}\right).3+\left(\frac{21{,}60+9{,}60}{2}\right).6\right]10\text{ fr.}+$$
$$+\left(\frac{6+4}{2}\right).8.\ 70\text{ fr.}+$$
$$+\left[7{,}60.3+\left(\frac{3+1}{2}\right).4\right]75\text{ fr.}=7084\text{ francs.}$$

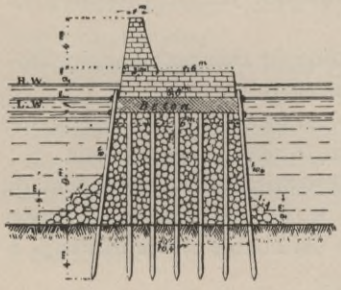
Sketch 2



On the second type, composed of regularly set massives upon a foundation of piled-up cobble-stones, one metre in length of the breakwater will cost:

$$\left(\frac{23+17}{2}\right)3.\ 10\text{ fr.}+$$
$$+\left[\left(\frac{9{,}40+7{,}60}{2}\right).9+\left(\frac{3+1}{2}\right)4\right]75\text{ fr.}=6937\tfrac{1}{2}\text{ fr.}$$

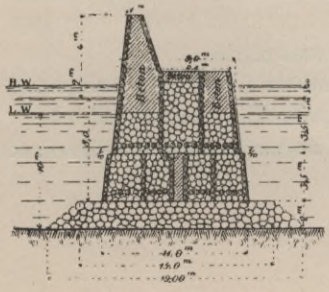
Sketch 3



On the third type, composed of cobble-stones enclosed by pale-walls, 11 piles calculated for a metre of the breakwater, one metre of its length will cost:

$$11.\ 400\text{ fr.}+$$
$$+\left[\left(\frac{10{,}40+8{,}60}{2}\right)9+\frac{4.4}{2}+\frac{2.2}{2}\right]10\text{ fr.}+$$
$$+\left(\frac{8{,}60+8{,}40}{2}\right)1.\ 70\text{ fr.}+$$
$$+\left[\left(\frac{8{,}60+7{,}60}{2}\right)2+\left(\frac{3+1}{2}\right)4\right]75\text{ fr.}=7720\text{ fr.}$$

Sketch 4.



On the fourth type, composed of 20% of timber and 80% of cobble-stones, one metre in length of the breakwater will cost.

$$\left(\frac{19+15}{2}\right)2.\ 10\text{ fr.}+$$
$$+\left[\left(\frac{11+10{,}30+9{,}90+9{,}20}{2}\right)3.5+3.2{,}5\right]\left(0{,}2.\ 60\text{ f.}+\right.$$
$$\left.+\ 0{,}8\ \ 10\text{ f.}\right)+$$
$$+\left[\left(\frac{9{,}20+8{,}60}{2}\right)3-3\ \ 2{,}5+\left(\frac{3+1}{2}\right)4\right]\left(0{,}2\ \ 60\text{ fr.}\right.$$
$$\left.+\ 0.8.\ 70\text{ f.}\right)=3753.6\text{ francs.}$$

Note sur l'accident à L'Ascenseur Hydraulique D'Anderton suivie de la traduction du rapport publié sur le même sujet par M. Edwin Clark, par Cadart, Ingénieur ordinaire.

Canal Projecté de Tancarville. Memoire présenté par la municipalité de Rouen a la commission de classement des voie navigables au sujet de ce canal.

Notice sur les Travaux d'Amélioration de l'embouchure du Danube et du bras de Soulina, Par Voisin Bey, Inspecteur Général des Ponts et Chaussées, en Retraite.

Die Beziehungen der Eisenbahnen und Binnenschifffahrt zu einander. Vortrag von Direktor Ströhler. Berlin, Sept. 9, 1890.

Ship Canals, by Prof. Lewis M. Haupt, C.E.

The Proposed Ship Canal between Philadelphia and New York (via Trenton). Addresses by Prof. Lewis M. Haupt, C.E., Univ. of Penna., Mr. Thomas Martindale, Philadelphia, and Mr. Erastus Wiman, New York.

Resolutions of Boards of Trade and other Organizations in behalf of a ship canal across New Jersey.

Publications of the American Economic Association, containing

I. The Canal and the Railway with a note on the Development of Railway Passenger Traffic, by Professor James, University of Pennsylvania.

II. Canals and their economic relation to transportation, by Professor L. M. Haupt, of the same university.

The Chignecto Ship Railway, the substitute for the Baie Verte Canal, 3 copies, by H. G. C. Ketchum, Amherst, Nova Scotia.

Sul Regime Della Spiagge e sulla Regolazione dei Porti; studi di Paola Cornaglia Ispettore nel Corpo R. del Genio Civile a riposo Allievo anziano della Scuola Nazionale dei Ponti e Strade di Parigi, 2 copies.

La Seine Rade de Guerre par M. de Coene, 2 copies.

Documents relating to Pneumatic Foundations presented by C. Zschokke and P. Terrier, engineers and contractors, Paris.

3 Photographs : Avant-port de la Pallice (La Rochelle). (1). Construction sous-marine des jetées et du batardeau. (2). Caissons mobiles. (3). Jetées du du sud.

Pamphlets. Execution des Travaux sous-marins.

One number of the "Annales des Ponts et Chaussees," containing "Notice sur les fondations à l'air comprimé des jetées."

Two numbers of the "Génie Civil," Travaux de Gênes — Travaux de Livourne.

Travaux Hydrauliques à Rome, Gênes, et Livourne.

Travaux Hydrauliques exécutés en France de 1880 à 1889.

The Commercial Aspects of the Manchester Ship Canal, by Marshall Stevens, General Manager.

Description of the Manchester Ship Canal and 100 copies of the General Plan and Proposed Berth and Quay arrangements at Manchester and Salford.

Contributions of the society of Portuguese Civil Engineers to the World's Columbian Exposition. Descriptive Catalogue.

Mémoire sur l'egout et l'assainissement de la ville de Coimbra par José C. da Costa, João da Costa Couraça, José Ferro de Madureira Bessa, Ingénieurs.

Notice sur les Travaux d'Amélioration du Port de Lisbonne.

Nouvelle Méthode pour le Calcul des Profils en travers des routes et des Chemins de fer par Francisco da Silva Ribeiro.

Portugal. Common Roads, Railways and River Communications by Frederico Augusto Pimentel, Civil Engineer.

Six semaines en Algérie par le Vicomte de Pulligny Chevalier de la Légion d'Honneur, Officier de l'Instruction Publique Commandeur de Charles III., etc.

L'Art Préhistorique dans l'Ouest et Notamment en Haute Normandie by the same.

Studi Sull' Irrigazione della Provincia di Teramo di Gaetano Crugnolia, ingegnere capo.

Serbatoi d'Acqua o Laghi Artificiali, by the same.

Sistema Orografico, Idrografia e Archeologia Preistorica della Provincia di Teramo. Memorie by the same.

Bericht des K. K. Schifffahrts-Gewerbeinspectors, Regierungsrathes A. Schromm.

ACKNOWLEDGMENT.—The Secretary takes this occasion to express his indebtedness to Henry D. Woods, City Engineer, Newton, Mass., for translating the papers of Messrs. de Bovet, de Hoerschelmann and Halász, also to the Canadian Society of Civil Engineers for the plates illustrating "The Chignecto Ship Railway."

CLOSING RESOLUTIONS.

Mr. Thomas C. Keefer, C.E., of Ottawa, Canada, after a complimentary allusion to the Secretary, who, he stated,

had served with himself on the Jury at the Paris Exhibition of 1878, proposed the following resolutions:

Resolved, That the thanks of the Congress be presented to the Hon. John C. Dore for presiding over its deliberations; to Professor William Watson for performing the laborious duties of Secretary.

The President, pending the passage of this first resolution, remarked that the success of the Congress was mainly due to the ability and untiring efforts of the Secretary, Professor Watson.

The following resolution was also proposed:

Resolved, That the Congress present to the Secretary the foregoing publications and photographs as a token of its appreciation of his disinterested services, which have largely contributed to the success of its sessions.

The resolutions were unanimously adopted. The President and the Secretary made appropriate replies and the Congress dissolved.

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